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Drawing-with eye-tracking technology

An exploratory art-based research investigating the adaptation of eye-tracking methodology as a contemporary artistic drawing practice

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PhD Thesis

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Abstract

In this practice-based research, ways of adopting and adapting eye-tracking technology were speculatively explored as a contemporary artistic drawing practice (CADP) to begin to fill in the gap of the lack of a comprehensive artistic study investigating the potential of eye-tracking technology as a critical tool/medium for contemporary drawing. Eye-tracking historically emerged as a scientific methodology and can today capture eye movements in the form of digital data. The application of eye-tracking has extended across a variety of fields such as marketing and user experience design that benefit from the presumed objectivity of our visual attention. Similarly, studies within the field of drawing practice have generally applied eye-tracking technology as a way to investigate eye movements during the act of observational drawing. The critically engaged practice research presented here, probes such methods and looks at the subjective, relational, and transformative qualities of eye-tracking when posited as a CADP, positioning the technological interpretation of the researcher's gaze as an experimental contemporary drawing method.

To achieve this, the research was informed by posthuman scholarship to challenge the tendency, especially prevalent in technology and general public's discourses, that assumes a vertical hierarchy between the human and the nonhuman. In this way, the technology's capacity for agency as co-constituent in the drawing projects was

examined. The practice research includes both a written component in the form of a dissertation and a portfolio of practice that distils a selection of drawing experiments undertaken during the course of the artistic research. These adopted the notion of a more-than-human-centred way of drawing, and by reflecting on the techno-human hybridity of the experimental drawing projects, a conceptual methodological framework of *drawing-with* eye-tracking technology was developed.

Different writing techniques were adapted, drawing from posthuman scholarship suggestions, to reflect on aspects of the digital technology via the exploration of the drawing projects. The written and practical components intertwine throughout the research and expand the intersection of multi-modal methods of drawing and seeing, which respond to different contexts, and evolve into a critical creative mode of enquiry.

Lay Summary

This practice-based research explores the potential of eye-tracking technology as a contemporary artistic drawing practice. It aims to address the lack of comprehensive artistic studies investigating the use of eye-tracking as a critical tool for drawing. Eye-tracking technology, historically used in scientific research, captures eye movements digitally. While it has been applied in fields like marketing and user experience design, its application in drawing practice has mainly focused on studying eye movements during observational drawing.

This research takes a different approach by examining the subjective, relational, and transformative qualities of eye-tracking as a drawing practice. It positions the researcher's gaze as an experimental drawing method. Posthuman scholarship informs the research, challenging the hierarchical assumption between humans and the nonhuman, so prevalent in technology and public discourses.

The research includes a written dissertation and a portfolio of drawing experiments undertaken during the artistic research. The written and practical components of the research intertwine, expanding the use of multi-modal drawing methods that respond to different contexts and evolve into a critical and creative mode of inquiry. A conceptual methodological framework of *drawing-with* eye-tracking technology evolved out of this approach.

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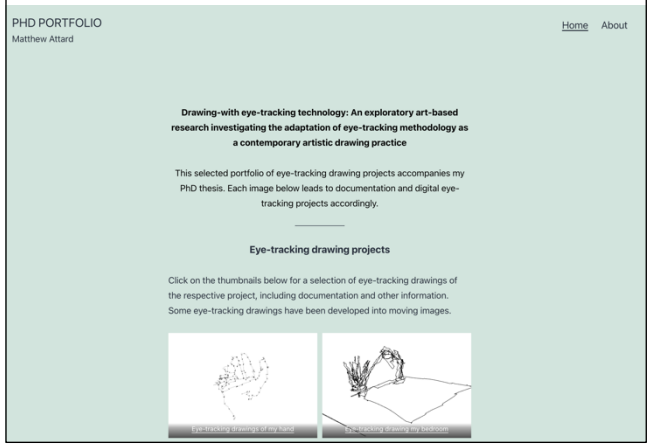
Table of Contents

List of Figures Page

Link to portfolio:
<https://portfolio.matthewattard.com/>
This portfolio includes a selection of eye-tracking drawing projects and constitutes the practice part of my written PhD thesis. It includes contextual text, digital drawings, moving images and links to larger digital files hosted on YouTube.



Introduction

In this practice-based research, speculative and experimental methods of adopting and adapting eye-tracking technology as a contemporary artistic drawing practice (CADP) were investigated. In essence, via the exploration of experimental and open-ended methods of using the technology, eye movements were captured as digital data points using eye-tracking technology and subsequently generated into digital drawings by means of 3D Design Software[1] during postprocessing.

Eye-tracking originated as a scientific methodology towards the late 19th century and has been evolving with digital technology since the late 20th century, becoming smaller and available as an off-the-shelf product over the past three decades (see p.42). Its output is in the form of digital data that yield the measurement of one's eye movements and estimation of their gaze path[2]. Experimental ways of developing the numerical data into digital lines as a CADP were investigated; in a manner where my gaze developed into a drawing method. The resulting digital drawings will be referred to as *eye-tracking drawings* and presented here as a key outcome of this arts-based research (ABR) together with the theoretical, critical, and processual notions that will be addressed.

[1] Throughout the practice research, I mainly utilised the CAD-based 3D software *Rhino 7* and its software plug-in *Grasshopper* (McNeel 2020) for postprocessing.
[2] Scientific disciplines refer to the path followed by our eye movements as scanpath.

My focus of enquiry revolved around the development of techno-human[3] hybrid drawing processes that led to open and critical questions about eye-tracking (digital) technology and drawing practice. The aim was not to solely create a body of work as new artefacts/artworks, even though eventually several artworks[4] did develop as outcome of the practice research. In this view, the iteration and repetition of drawing experiments was crucial to the formation of the practice and a selected portfolio can be accessed via the link on page 1.

Therefore, there are two components to this research: a selected portfolio that consists of the distillation of a significant volume of practice, and the accompanying written thesis in which discussions are anchored around the hybridity of techno-human relational aspects arising from experimental drawing projects[5].

The experiments I developed throughout the research were informed by an intersection of drawing practice with posthuman scholarship, which influenced the open-ended nature of the drawing research and facilitated my perception of regarding the technology's agency as co-constituting the drawing (as art). The exploration of the drawing projects progressed under two circumstances: a working-

[3] I use this term to refer to my assembly with eye-tracking technology in view of this ABR.
[4] The resulting artworks include a multitude of ways of presentation that developed out of the flexibility of the digital medium according to context. Some eye-tracking drawings will be discussed as digital still images (for example, see p.105), while on other occasions these will be presented as moving image (for example, see p.116). Other outcomes of the research present the digital eye-tracking drawings as physical fabrications of the digital drawings (for example, see p.165).
[5] The written component of this thesis does not refer to the practice chronologically.

from-home environment induced by the COVID-19 pandemic, followed by drawing in situ at specific public places, which will be discussed in chapter 5. Both situations encouraged an attention towards the nonhuman as presented in varying contexts, developing discussions relating to cultural notions of seeing and the creative potential of eye-tracking data. I will be referring to the technology as nonhuman, as well as the things and objects that influenced the drawing processes within the different contexts, aligning with how posthuman scholarship applies the term when considering the importance and agency of entities beyond traditional human boundaries, including nature, machines, ecosystems, and hybrid forms.

I can trace the roots of this exploration to 2015 when I had my first encounter with eye-tracking technology at the Digital Arts Department of the University of Malta. Eye-tracking technology is not a tool for drawing[6] but as a drawing practitioner (my background was primarily in drawing as Fine Art), it effectually interested me as a technological tool with the capacity to by-pass the hand-eye coordination that has been ubiquitously associated with more traditional observational drawing practice. My interest in the captured eye-tracking data of my gaze as a 'drawn' line progressed into a Masters' Degree by Research that posited eye-tracking technology as a tool for observational drawing, where one would draw with their eyes by means of eye-tracking technology (see Attard 2018).

[6] During the course of this research I formulated a fictitious interview with an eye-tracking system where the history and applications of the technology are explored (see p.42).

This undertaking was an eye-opener on several fronts. It was my first hands-on experience with generating digital datasets (in this case, eye-tracking data) into digital drawings. It was also my first direct experience with converging scientific methodology (eye-tracking) with artistic practice through experimental methods. Throughout the endeavour, I was aware that no comprehensive academic study about eye-tracking drawing as a CADP had yet been undertaken, and this prompted me to further the project into the following PhD research. Most research and literature that relates eye-tracking technology to drawing practice generally investigates: the artist's eye movements while drawing by hand from observation (for example, see Tchalenko et al. 2014; Tchalenko 2009; 2001); the viewer's gaze in front of art (for example, see Mitrovic et al. 2020); or the possibility of using eye-tracking technology as an Augmentative and Alternative Communication (AAC) tool for creative image-making purposes (for example, see Hornof and Cavender 2005; Jackson 2013). To the critical reader, eye-tracking one's gaze will also bring to mind notions of the politics of the gaze. I hereby acknowledge that, while this is a valuable field of scholarly inquiry, the politics of the gaze lies outside the remit of this enquiry and would necessitate a dedicated exploration beyond the constraints of this particular research endeavour.

This thesis presents an experimental and explorative study that resulted in the theoretical framework of *drawing-with* eye-tracking technology (see p.15). This was the outcome of: revisiting and furthering the drawing methods I had developed

during my Masters' Degree via new contexts; an 'unpremeditated' way of experimentation developed from 'doodling' with the technology; and the alignment with posthuman scholarship as part of my reflections on the practice. This approach challenged my preliminary perception of the technology as merely a tool for human application and posited the capacity for more mutual techno-human relations. Thus, *drawing-with* eye-tracking technology allowed me to better reflect on eye-tracking technology as a co-constituent to the drawing practice; a methodology through which drawing experiments were formulated, using CADP to interrogate the technology's characteristic and reveal new ways of thinking critically about contemporary life.

The thesis is not intended to be read as a conclusive way about how to draw with the eyes via the application of eye-tracking technology. It constitutes an art-tech interdisciplinary contemporary drawing research that highlights two major aspects: i) the adoption of scientific eye-tracking methodology as a CADP in view of how one sees the world and makes judgements of it, and ii) the development of the drawing-with conceptual framework as an experimental, expansive and open-ended way of thinking in terms of drawing with a digital technological medium. These aspects stem out of a 'subversion' of both eye-tracking technology and conventions in drawing practice. The practice research has been specifically undertaken via the application of an off-the-shelf mobile eye-tracking device manufactured by *Pupil Labs*[7] and

[7] Throughout the practice research I experimented with both the monocular and binocular versions of the *Pupil Core* eye-tracking device. The monocular version estimated the gaze from only one eye, while the binocular version estimated the gaze through the convergence and divergence of both eye movements. The eye-tracking datasets that resulted from the binocular device

expanding ways of using it beyond the conventional could only be uncovered through experimental methods that challenged the generally assumed objectivity of the technology (see p.63) and operated from a more intentionally subjective point of view. This echoes recent definitions of practice-based research providing: “a means of exploration that extends that work in a personal sense as well as contributing to the wider picture” (Candy and Edmonds 2018). In this regard, this practice research converges my personal take on drawing practice, with ways of drawing-with the technological medium that while subjective, contribute towards current critical thinking about eye-tracking technology and contemporary drawing.

A recently published handbook about ABR (see Leavy 2018) posited how after more than thirty years of artistic practice as academic PhD research and debates (for example, see Gray and Malins 2004; Barrett and Bolt 2007; Knowles and Cole 2008; Elkins 2009; Biggs and Karlsson 2011; Candy 2020), artistic research has the capacity to mould its own paradigms and methods according to the specific project of enquiry. I informed my research with such ABR concepts and throughout my methodology, the practice intersected and mutually progressed in tandem with readings, critical writing, and reflection. Artist and author Victor Burgin (2009) described how a type of art PhD student enthusiastically merges readings with art-making. He specifies, “[T]his student is interested in ideas, and turns concepts encountered in reading into

were imported and plotted in 3D software (see p.104). Throughout the thesis, QR-codes are used to link the binocular digital eye-tracking drawings to moving images of their respective 3-dimensional representation.

practical projects. The research of this type of candidate typically has a mainly practical outcome, with academic work playing a subordinate and 'instrumental' role" (p.75). The way my readings informed the practice reverberates with Burgin's methodological observation, but with the crucial difference that for the advancement of the research, both writing and practice mutually developed in parallel and influenced one another. Thus, throughout the course of the exploratory research, the boundaries between the artistic and the theoretical/contextual were blurred.

This method of 'interweaving' reflection and practice gave the opportunity for the formulation of this written thesis that does not follow the 'conventional' structure of PhD dissertations – another aspect of the research that has forged its own paradigm. Its body is also not rendered chronologically. The written component is presented as five chapters that flow with the experimental nature of the research. Each chapter investigates an aspect of how drawing-with eye-tracking technology exposed questions about the subjects we become when using digital technology. The writing scrutinises critical and reflective concepts that have risen via the convergence of CADP with eye-tracking technology, including methodological and contextual reviews. The practice research is posited as a way of thinking about the world through the hybrid processes brought forward by the techno-human assemblage of co-drawing

with technology, contrasting with the more common use of technological media as 'kits' for drawing[8].

In the first chapter of the thesis, *Seeing*, I introduce how the practice research has been informed by posthuman scholarship. Through the unfolding of a specific drawing experiment that consisted of eye-tracking drawing my eye via a live-feed, I engage with discourses that highlight aspects of agency affecting the practice research. I also introduce the development of different writing styles that aid in revealing the technology's agency, specifically by drawing on heuristics suggested by posthuman scholarship. I adopt these to underline the influence and processes of the acting nonhuman agency. For example, the use of anecdotes (as a strategy drawn from Adams and Thompson 2016) proved key to the recounting of particular experiences with the technology during specific drawing exercises (see p.23) and are continually adapted throughout the written thesis.

Chapter 2, *Interviewing*, consists of a fictitious interview with an eye-tracking system. Acknowledging eye-tracking as a methodology stemming from scientific fields with an extensive history, I employ the form of a fabricated dialogue to engage with today's fundamental and critical aspects of the technology. After an establishing conversation

[8] With this I am not undermining the acknowledgement that the application of an eye-tracking device for drawing can be successful as an AAC tool. The device itself is already widely used in improving the lives of individuals with physical impairments and some case studies also included drawing (for example, see Hornof and Cavender 2005; Jackson 2013; Tchalenko 2001). This area of study is different from the aims and outcomes of my research that does not revolve around the development of an AAC tool. However, I hope that by having outlined the developed exploratory methods of drawing-with an eye-tracking device, other fields can be informed about the different transformative methods of the technology – including AAC.

about the origins of eye-tracking, the focus shifts to its evolution since its digital implementation. This section operates on a level of ruse that uncovers questions relating to how eye-tracking technology effects and affects us as human beings. The anthropomorphic characterisation of the technology through dialogue, allows me to level the presumed hierarchy between the human and nonhuman, and the conversation sets the grounds for critical discourses about the mutuality of techno-human relations, notions of co-drawing with the technology, and an open criticism of the neo-liberal application of eye-tracking data. All three notions are developed in the subsequent chapters.

In the chapter *Relating*, the relational and transformative aspects presented by drawing-with eye-tracking technology as a techno-human assemblage are investigated. I reflect on how during the working-from-home period induced by the COVID-19 pandemic, the attention towards the nonhuman amplified: both in terms of how things exerted their influence upon the drawing practice and how drawing-with eye-tracking technology started to percolate into mundane activities such as cooking and walking up and down the stairs. Reflections about such drawing experiments are embedded within the writing, that is, also informed by conceptual texts about the cyborg, postphenomenology and the extended mind. Through the convergence of these discourses, I look closely at the mutual aspects presented by the techno-human hybrid processes of the practice research.

The *Co-drawing* chapter elaborates the research as a CADP. I introduce the section by briefly outlining how contemporary drawing was pivotal to the emergence of the field of drawing as a discipline in its own right, contrasting with the traditional tendency to consider it as a secondary practice to other disciplines such as painting and sculpture. I compare and contrast aspects of drawing-with eye-tracking technology with characteristics of contemporary drawing practice. Notions such as deskilling and mark-making inform an eye-tracking drawing exercise that postulates the wandering gaze as doodling. I present these concepts and descriptions in relation to characteristics of the digital medium, concluding with a focus on the practice of eye-tracking drawing.

The final chapter, *Manifesting*, distils the practice research via three specific drawing projects, used as vehicles for a critical enquiry expanding the sites and contexts of the drawing practice. The first two drawing projects specifically occurred in my home country Malta, while the third drawing project consisted in an Internet-based interactive artwork. I introduce how the drawing projects discussed in this section differ in context from the practice mentioned in the previous chapters, as these stem from the opportunity to draw-with eye-tracking technology in situ, in public places. I introduce two influential concepts that informed the development of the in-situ drawing projects: a critical enquiry that highlights how the neo-liberal application of eye-tracking data is affecting our visual attention and the hypothesis that art-making can be an act of parrhesia. The latter term roughly translates to freedom of speech

and I followed philosopher Michel Foucault's conceptualisation of parrhesia in view of the role of the artist in contemporary society (see p.154).

Research Questions

Prefacing the body of the thesis, the following are questions that arose during the course of the research.

1. How can the adaptation of eye-tracking methodology as a contemporary artistic drawing practice (CADP) be explored as an Arts-Based Research (ABR)? What does this add to the field of contemporary drawing research practice?

2. How can the co-constitutive agency revealed by digital eye-tracking technology transform the gaze with a capacity for drawing, and vice-versa?

3. How can academic concepts that theorise the 'flattening' of the general hierarchies between the human and the nonhuman, such as posthuman scholarship, inform a more-than-human-centred way of drawing when drawing-with eye-tracking technology?

4. How can CADP induce a mode of critical thinking through notions of looking and seeing when drawing with a technological device such as an eye-tracker?

1. SEEING

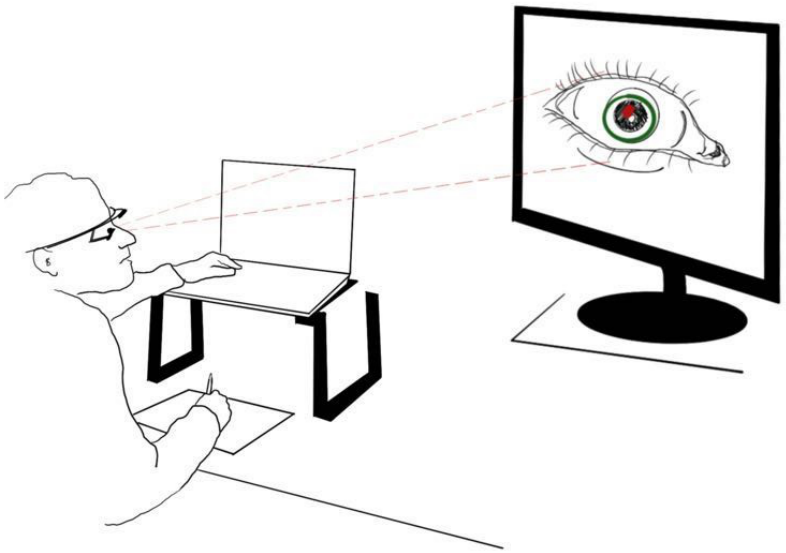


Figure 1: An illustration portraying the techno-human hybrid setup of a drawing exercise in which I explored ways of drawing my eye with my eyes with the technology via the eye-tracker's live-feed of my eye movements. This drawing exercise became a recurring practice throughout the course of this ABR.
For an extensive documentation please follow:
<**https://portfolio.matthewattard.com/eye-tracking-drawings-of-my-eye/**>.
Illustration is my own.

Drawing my eye via a live-feed stream

Figure 1 illustrates a diagram of the techno-human assembly of one of the drawing experiments explored during the course of this ABR. By 'techno-human assembly' I am referring to the hybrid arrangement comprising of myself and the digital technology considering how this practice research asserts eye-tracking as a CADP. The illustrated exercise proved to be of particular importance influencing the development of future eye-tracking drawing sessions, and it possibly contributed to an 'epiphany'. Immersed into what we can momentarily refer to as a techno-human *loop* of seeing (and drawing), the technology became regarded as an active collaborator to the practice via its agentic capacity.

The experiment of drawing my eye with my eyes via the technology's live-feed raised these reflective questions: What nonhuman agency is acting during such a drawing practice[9]? Am I directing or controlling the process? Is the technology making autonomous decisions? In other words, can it be drawing as an artistic practice? What qualities does the hybridity of this techno-human relationship have?

[9] Discussions about the drawing processes that formed this ABR will evolve throughout the writing of this dissertation, with chapter 4 being solely dedicated to contemporary drawing.

Such way of questioning a drawing practice can resonate with posthuman scholarship, which as authors Catherine Adams and Terrie Lynn Thompson (2016) described; “asks us to attend to and take seriously that which is most near to us, the everyday things of the world” (p.2). The everyday things of the world are the vast array of species, objects, and matter that we interact with on a daily basis that can be defined as nonhuman, including digital technology. In this view, this research attends to the nonhuman through an exploratory drawing process, starting with the technology making it possible. Through the techno-human hybridity of the drawing process, the boundaries between the human and the nonhuman blurred the moment the technology exerted its agency becoming co-constituent to the practice. This is a shared sentiment of recent artistic tendencies as stated by artist and researcher Jon McCormack (2014):

> As computers have developed, we have seen our relationship with them change and the computer's role shift from that of a "tool" under the direct control of the artist to that of a collaborator or creative partner and, potentially, an autonomously creative entity.

McCormack’s statement resonates with the drawing methods explored throughout this practice research, including the exercise of drawing my eye with the technology via the live-feed of my eye movements (Figure 1), which features as a continuous reference point for reflection in the sections below. By the end of this chapter, I will

conclude how the digital technology involved in this ABR revealed its agency and became my 'collaborator'. I found this to resonate across posthuman scholarship and other theories that flatten the hierarchies between the human and the nonhuman, that can give more-than-human-centred perspectives.

1.1 Drawing-with the eye-tracker and the posthuman

Is a drawing exploration with eye-tracking technology a *posthuman* way of drawing? One argument of this dissertation is that in many respects, the practice can align with posthuman scholarship. Especially when noting descriptions like Rosi Braidotti's (2019, p.9), who regards the posthuman theoretical figuration as a "navigational tool that enables us to survey the material and the discursive manifestations of the mutations that are engendered by advanced technological developments (am I a robot?), climate change (will I survive?), and capitalism (can I afford this?)". More importantly how; "The posthuman is a work in progress. It is a working hypothesis about the kind of subjects we are becoming" (*Ibid*., p.2). I find these theoretical positions to resonate strongly with my developed methods of this practice research. The process of drawing itself will be discussed in more detail in a different section of the dissertation (see chapter 4), while for now, by adopting Braidotti's way of questioning I will be directing the narrative of this chapter towards the question: what kind of subject do I transform into during the drawing exploration via eye-tracking technology?

Here, an important clarification needs to be noted. As I started drafting this chapter, an article about how business magnate Elon Musk's co-funded company *Neuralink* implanted an artificial intelligence (AI) microchip in the brains of a macaque monkey and a pig, was featured in *The Guardian* newspaper (see Neate 2022). The company promised that the technology "will enable someone with paralysis to use a smartphone with their mind faster than someone using thumbs" (*Ibid*. 2022). The subject I transform into throughout this ABR is not synonymous to the subjects of this case study. *Neuralink's* disposition resonates with the ideals of transhumanism; also critically referred to as "afterhuman" by authors like designer Ron Wakkary (2021, p.12) because of how it initiates a technological becoming where "[…] new technologies become our *afterbodies* to extend past our intellectual and physiological limitations". Transhumanism has been extensively criticised by posthuman scholarship, specifically because of its neutral placement of technology within the extended humanist view of seeking perfection, that generally solely aligns with a Western perspective – including ways of being 'manipulative' and an affinity with advanced capitalism (for example, see Braidotti 2013; 2019; Hayles 1999).

Thus, transhumanism is not to be confused with posthumanism. To maintain that this practice research is an exploration that aligns with a posthuman attitude is instead akin to Wakkary's (2021) analysis of design as a creative practice that hypotheses a horizontal perspective: "[…] to *design-with*; that is, to design with humans and nonhumans in ways that are fundamentally expansive and relational" (p.23, original

emphasis). With the term 'to design-with', Wakkary challenged the vertical human-centred way of designing and called for visual practices to ascribe to a more horizontal approach (*Ibid*., p.265). It is in view of this that I adopted and adapted Wakkary's terminology as a methodological framework within the exploratory methods of this ABR. This aligned my endeavours with his adaptation of posthuman horizontality through the devised concept of: *drawing-with* eye-tracking technology.

It is also worth noting how artistic practice and research is not alien to posthuman theory. For example, the subheading *Artistic Practice* featured in Braidotti's chapter of *How to do Posthuman Thinking* (see Braidotti 2019). The published *Posthuman Glossary* (Braidotti and Hlavajova 2018) also featured extensive contributions by different artists and authors about how contemporary artistic practices can converge with posthuman scholarship and vice-versa (for example, see Cameron, 2018, p.349; Davies, 2018, p.63; Hoelzl, 2018, p.361; Holert, 2018, p.91). Moreover, the 2022 Venice Biennale[10] edition, curated by Cecilia Alemani, saw posthuman theory at the heart of its prevailing themes (see Biennale 2022). The latter acknowledgments do not claim that artistic research embracing the application of technology can automatically be situated within posthuman discourse, but it is rather the mindset of how to regard the technology that opens the prospect for a posthuman enquiry. In the case of this ABR, it is therefore the adapted attitude of drawing-with the technology that aligns it with posthumanism.

[10] The Venice Biennale is a prominent international visual arts exhibition that is visited by artists, designers and academics worldwide.

Last not least, it is worthwhile to mention how I do not divest of my being human during the course of this research, while at the same time the technology does not substitute me as a practitioner. A mutual transformative relationship is instead at the forefront, where hybridity becomes key. “No, I’m not [a robot], but some of my best friends are! I am posthuman – all-too-human” is what Braidotti (2019) answered to the question of whether she was a robot. Adding; “This means that I am materially *embodied* and *embedded*, with the power to affect and be affected” (*Ibid*., p.10, original emphasis). Drawing-with eye-tracking technology meant that I too became embodied and embedded with the technology as I posited the ability of this mutual relationship to *affect* and be *affected* throughout the course of research. Even though the participating technology is strictly speaking neither a robot, nor my best friend, this drawing exploration was navigated as co-constituents.

1.1.1 The nonhuman co-constituents

In the introduction to his book about alien (nonhuman) agency and experimental artistic practice, artist Chris Salter (2015) noted how:

> “Vibrancy,” “agency,” “material vitalism,” and the “matter-flows” of nonhuman bodies and things is the new lingua franca that replaces such worn out words as “discourse,” “textuality,” “language,” and “meaning.” In this new world, scallops

> and data, electrical power grids and microbial dust, and the weather and machines have become our objects of analysis and production.
>
> (pp.4-5)

Which are the respective objects of analysis and production in the case of the eye-tracking drawing exercise of my eye (Figure 1)? Are they the apparent *Pupil Labs Core* monocular eye-tracker (Pupil Labs 2014), its USB-C cable, the *Pupil Labs Capture* software, my *Windows*-operated laptop, the HDMI cable, the 27" LED desktop monitor, the BIC pen and the A4 sheet of paper? Am I also an object of analysis and production? Or do the objects of analysis relate more with what is being drawn, rather than the drawing process?

Allow me to divert the narrative and follow the implication that all of the above are being described as *objects* (myself included). This echoes the fairly recent school of thought, Object-Oriented Ontology (OOO), which featured in the *Posthuman Glossary* (see Wolfendale 2018, p.296) even though its main authors, such as Ian Bogost, argue that "Posthumanism, we might conclude, is not posthuman enough" (Bogost 2012, p.8). OOO therefore finds human-centric traits in posthumanism. However, my point here is neither to compare and contrast OOO with posthumanism, nor to align this ABR with OOO. It is instead to recognise how a number of concepts deriving from OOO can help reflect on the drawing processes explored within this ABR.

OOO seeks a ‘flat’ ontology, and Bogost (2012) claimed that for an ontology to be flat there can be “no distinction between the types of things that exist but [the ontology] treats all equally” (p.17). In his words, this is obtained through methods that are both “*specific* and *open-ended*” (*Ibid*.). Therefore, a ‘flat’ ontology would list all of the following (and more) when analysing which objects are participant in the drawing exercise illustrated in Figure 1:

A black 3D-printed headset housing the hardware of the eye-tracking device, of which manual can be downloaded from Pupil Docs; a 200Hz @ 192x192px camera recording the movements of my right eye; a 120Hz@480p camera capturing the view in front of me, positioned close to my forehead; a wide angle lens; rubber nose supports; a dark pupil tracking system with an algorithmic 3D model; a desktop application running in real time on a windows-operated laptop; 16.0 GB of installed RAM; an AMD Ryzen 5 2500U processor; an industry-standard cable allowing for both data and power transfer between the laptop and the eye-tracker; a High Definition Multimedia Interface carrying and decoding the digital signals between the computer and the LED monitor; several other chip components; glass; metals; programmed code; an array of algorithms and much more.

An accurate list can in fact become endless, while a comprehensive description of an object proves to be difficult to attain.

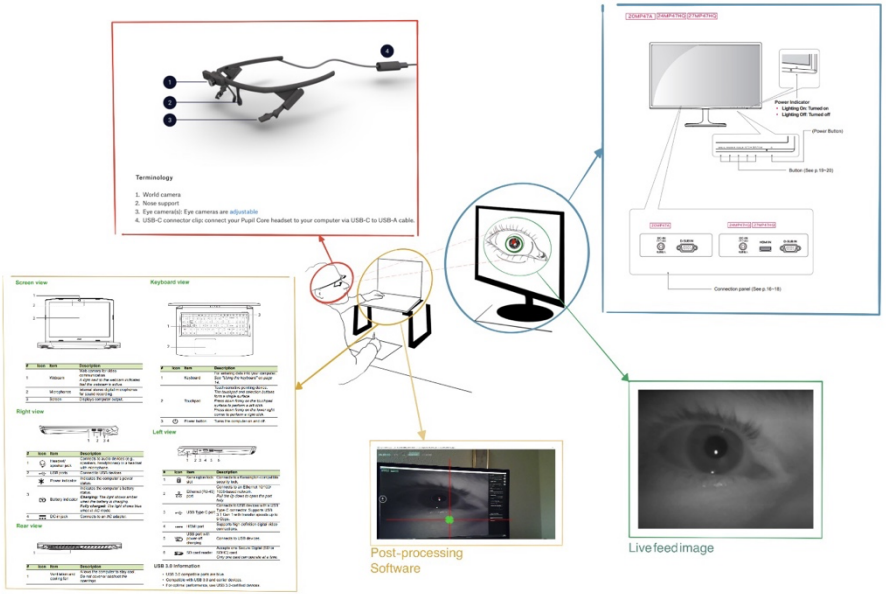


Figure 2: A representation of the drawing exercise in Figure 1 with the inclusion of a number of exploded views of the networked technology.
The exploded diagrams have been retrieved from the respective user's manual (Acer 2018; LG 2015; Pupil Labs 2014) and from screenshots of the eye-tracking captured footage.

Bogost craftily described computers as being "metal and plastic corpses with voodoo powers", as "A tiny, private universe rattles behind its glass and aluminium exoskeleton" (*Ibid*., p.9). It is here clear that OOO assigns great value to analogies and metaphors[11], granting the latter philosophical status (see Harman 2018, p.63). In these terms OOO gives special attention to visual practices, regarding them as fields that are closer to philosophy than to science. OOO author Timothy Morton (2015) stated how human art "[…] is telling us something very deep about the structure of things" and that OOO sees it as "the fundamental operation of cause and effect". On the other hand, Bogost appropriated visual techniques such as exploded diagrams to map a pictorial understanding of OOO's ontology, specifically because of the graphic technique's effective way of drawing our attention to the "configurative nature" of objects by "recording the presence of many potential unit operations, a profusion of particular perspectives on a particular set of things" (Bogost 2012, p.52). Thus, by adopting Bogost's critical observations, Figure 1 can be developed into the exploded representation shown in Figure 2.

The above analyses and concepts can be very efficient at directing the attention to the nonhuman objects contributing to the underlying processes when drawing-with eye-tracking technology, but they leave us short of a deeper understanding of the agentic capacities of nonhuman objects. For this, I will be turning to some recently-

[11] Throughout the course of this ABR, the use of metaphor grew to become an important concept that influenced the development of the practice.

suggested heuristics emerging from posthuman scholarship, and will adopt them as conceptual frameworks for reflection.

1.2 Interviewing objects

Adams and Thompson (2016) postulate a methodology of 'interviewing objects' via eight heuristics so to conduct posthuman research and attend to the nonhuman participants at a research site. They looked at the etymological origins of the term 'interview', which roots back to the notion of seeing – or viewing – one another, and merged the idea of interviewing an object with philosopher Bruno Latour's concept of developing specific writing tricks in order to apply a voice to nonhuman participants (*Ibid*. 2016, p.17). Throughout the course of this practice research, I did conduct a fictitious interview with eye-tracking technology, which in form resembled that of a conventional dialogue (see p.42). This interview can be regarded as one of the specific tricks/methods that helped me form an understanding of the history, evolution, utility, and ways of functioning of this specific nonhuman participant, prominent to this practice research. In other words, the interview was my way of *seeing* the technology.

I did not start this ABR with the above-mentioned heuristics in mind, and for this reason, I am not attempting to fit it within such framework. It is rather the case of how practice-based research has the potential to carry an element of

'postproduction' through writing and reflection[12], as in fact happened within the methods of this research where both practice and writing mutually affected each other. This can be compared to a statement made by Latour when reviewing some critical aspects about Actor-Network Theory (ANT). He dedicated an entire chapter to a fictitious dialogue between a student and a professor, where the latter proposed the following analogy in view of the student's perplexity of whether to apply ANT as a framework to their dissertation: "But have you ever met a painter who began his masterpiece by first choosing the frame?" (2005, p.143). I understand that Latour's intention behind the analogy was to highlight how at times, it is not ideal to have a theoretical framework as the starting point of specific research. Similarly, this practice research did not commence from writing techniques such as the above-mentioned heuristics, but instead adapted some of them throughout its course – for example, the heuristic of gathering anecdotes.

1.2.1 Gathering anecdotes

I will be referring to the retrospectively written descriptions of the experience of specific drawing exercises via the fabrication of anecdotes. The one below concerns the first time the techno-human arrangement illustrated in Figure 3 prompted the drawing exercise of drawing my eye with the eye-tracking device via the live-feed of my eye movements.

[12] Artists and authors like Ruth Pelzer-Montada have written extensively about the role of post-production in artistic practice (for example, see Pelzer-Montada 2009; 2007).

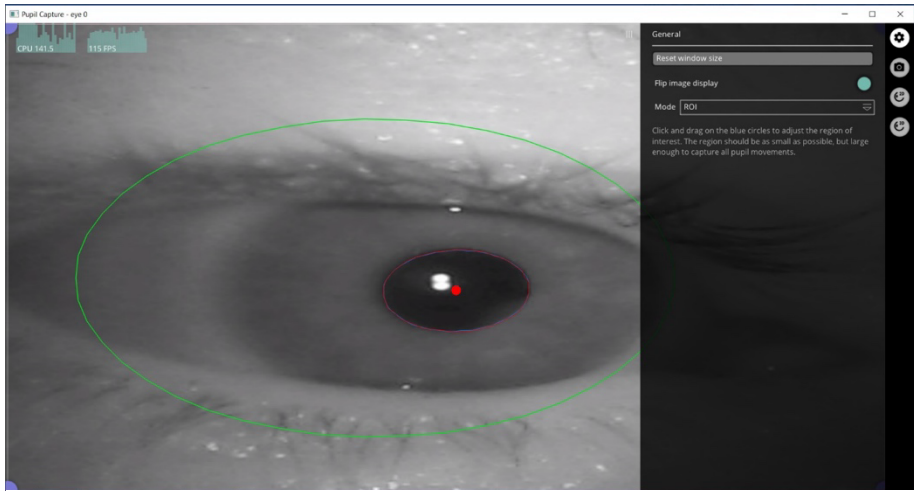


Figure 3: A screenshot of *Pupil Capture*'s window of the live-view provided by the eye-tracker's camera capturing footage of my eye movements.
Taken 3rd December, 2020.

This drawing exercise started by accident. On November 17th, 2020, roughly at around 2.30pm, I connected a second monitor to my laptop. Drawing-with the eye-tracker was becoming ever more computer-oriented and I thought that a second screen could be helpful for the practice's data development and visualisation. Moreover, I was at the time working from home due to the COVID-19 pandemic regulations, meaning that my room had to be transformed into some sort of working studio[13]*. While calibrating the device, the window view of the eye camera was being projected as a live-feed on the second monitor.*

I paused.

"This is how the technology sees me", I thought.

I had seen this live-feed window several times before, but it was never on a monitor different to that of my laptop's (Figure 3). The much-larger-than-life live-feed on the 27" LED screen immediately intrigued me in the way it seemed to caricaturise the representation of my eye – it verged on something uncanny. Particular qualities such as the monochrome properties of the grey-scale footage and the live mirroring of my eye movements became overt. The live-feed window's function was thus repurposed

[13] Other anecdotes feature further descriptions about the influence of working from home due to COVID-19 (for example, see pp.77).

through this experience and it stopped being merely used for calibration. The technology had somehow unveiled itself and exerted the agency with which it saw me.

I therefore forgot about what my initial intentions were and started to repeatedly draw my eye with my eyes, from the live-feed.

Even though the above anecdote is specific to one (out of the many) experiences of drawing-with eye-tracking technology, the story succeeds in giving us a glimpse into how the technology's agency constituted the practice. Adams and Thompson (2016) noted that; "An anecdote must *reassemble* and *resemble* a possible human experience or observed moment of everyday life" (p.25). In this view, the above specifically *reassembles* my account of encountering the live-feed footage of my eye in a way that I had not yet seen, or even thought of. It also places the emphasis on the technological environment in which I immersed myself; and consequently, the technology's exercised influence on the practice research. To some degree this can be interpreted as a phenomenological account of my (human) experience with a snippet of the technology's *active* contribution towards this ABR.

The gathered anecdote however omits certain aspects and details from that same recounted experience – both knowingly and accidentally. To begin with, the accent of the anecdote is on how the setup for the drawing exercise 'emerged', and there is no mention of the actual experience of the process of drawing. The narrative described

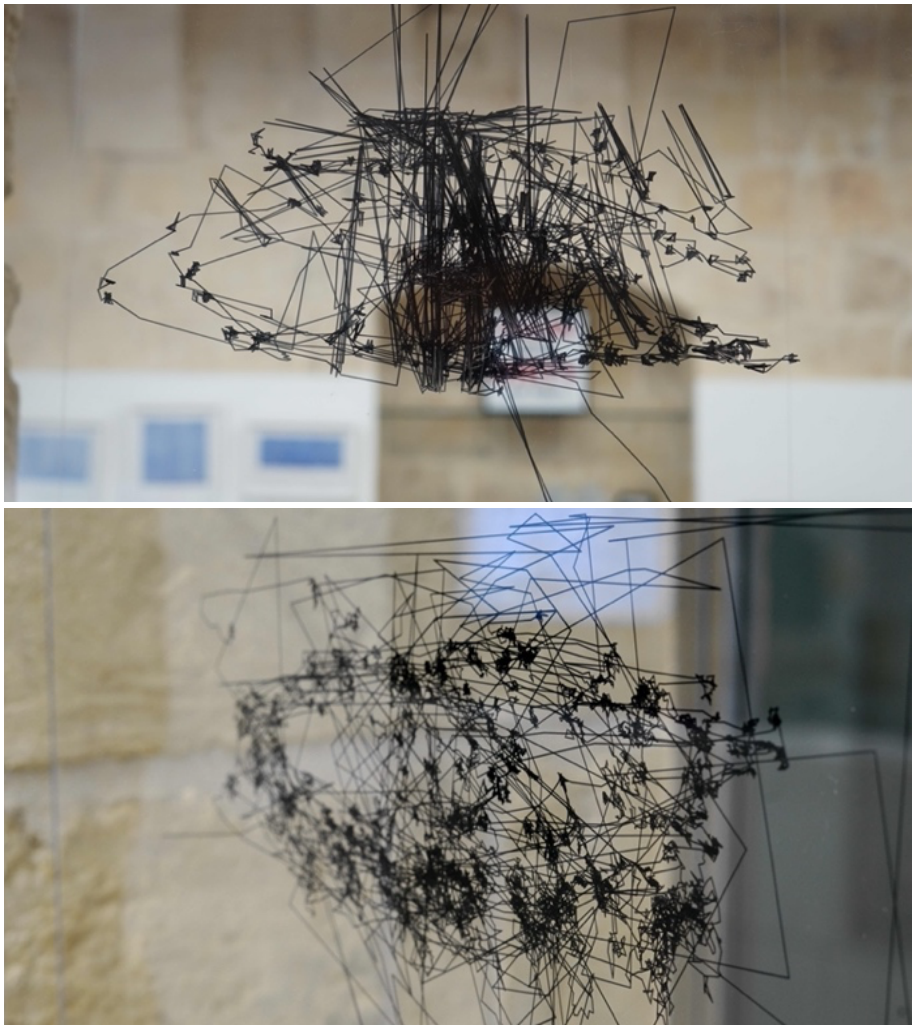


Figure 4: Two images showing different processed drawings of my eye that were installed at the entrance of Valletta Contemporary during the exhibition *rajt ma rajtx… naf li rajt* (see p.157).
The drawings were pen-plotted on transparent sheets of plexiglass.
The two photos are my own.

the context and change in attitude prior to the drawing exercise, but it is via the recounting of this specific moment that we can observe the way the technology revealed the live-feed footage of my eye, and hence, part of its agency. Agency here lies within an unpredictable type of experience, brought forth by the techno-human hybridity of the drawing experiment. As Salter (2015) stated; "Alien agency is thus another in a series of entanglements. We cannot know the results of the experience without doing it, living in it" (p.241). In other words, the above is an anecdote expressing the agentic potential held by the relational encounters of the techno-human configuration. The emphasis is on the experience, and throughout the research I grew particularly alert to this type of nonhuman agency that developed the practice of drawing-with eye-tracking technology.

A selected number of eye-tracking drawings of my eye were the first works viewers encountered during my solo exhibition of practice research *rajt ma rajtx… naf li rajt* (Figure 4). The intention of greeting the viewer with these drawings was to immediately signal the techno-human mutual relations constituting the practice research, and the drawings were accompanied by the following 'fictitious' conversation with the eye-tracker (*E-T*)[14]:

[14] The addition of these types of conversations throughout the practice was largely influenced by the *Interview with E-T* (Chapter 2).

E-T: This is how I see your eye when you activate me.

Mat: That looks weird.

E-T: What's weird about it? It is what I was built for: recognising eyes and tracking them.

Mat: Ok, so what if you track me while drawing my eye with my eyes?

E-T: In such a case remember that you will also be drawing with me, not just your eyes.

When compared to the previous anecdote, this dialogue reinterprets the narrative differently. Its quality is fully characterised by the anthropomorphic nature brought forward by the characterisation of *E-T*, which in turn took centre-stage. In fact, there is no mention of the LED monitor or the live-feed window, as the spotlight they held in the previous anecdote (pp.23-24) evaporated with the emphasis of *E.T.*'s characterisation. In contrast, the eye-tracker's agency prevailed via such narrative. However, this still does not imply that there is a hierarchy of agencies when drawing-with eye-tracking technology: the key lies within the ways of interpretation and description of the experience.

One might argue that although the above anecdote and conversation with *E-T* can be suitable writing methods that consider aspects of nonhuman agency, they are still somehow being projected through my (human) voice. Furthermore, as can be seen in the comparison between the anecdote and the conversation, nonhuman objects can

easily be overlooked through different readings. This is where it might be helpful to merge the above analysis with another suggested heuristic by Adams and Thompson (2016, p.34); that of following the *actors*.

1.2.2 Follow the actors

The suggestion to follow the actors as a heuristic for doing posthuman research, directly derives out of the ANT credo. Emerging as a sociological framework from the late 1980s, ANT evolved as a powerful analytical methodology through its adaptation by several fields. Within ANT, the term 'actor' (or 'actant') is applied to any entity which has the ability for agency, or is granted the potential for agency by others within a network. Latour (2005) argued that before ANT, the definition of actors and agencies played a part in keeping objects predominantly in the background as: "If action is limited a priori to what 'intentional', 'meaningful' humans do, it is hard to see how a hammer, a basket, a door closer, a cat, a rug, a mug, a list, or a tag could act." (p.71). Understanding the agency of nonhuman participants, is thus not as straightforward as it may sound and requires a different perspective from that of a human-centric one.

Adams and Thomson explained how: "Following an actor also means tracking micro-practices and other key actors implicated in those practices" (2016, p.35). This implies a particular attention to process, and it is through its course that the nonhuman

participants can be shifted to a foreground. When following the actors of a system, Latour (2005) suggested to start from a controversy about the actors and agencies in question: “Does it [the actor] make a difference in the course of some other agent’s action or not?” (p.71). In pragmatic terms, would the exercise of eye-tracking drawing my eye have resulted in the same experience were it done with a different eye-tracking device? Would the course of data capture have been the same if calibration failed, or if for example, the USB-C wire had a loose connection? The obvious answer is that any change in the configuration’s equipment, performance or state, would have transformed the course and outcome of the eye-tracking drawing experiment. Thus, we can here ascribe to Latour’s definition of how things making a difference “are actors, or more precisely, *participants* in the course of action waiting to be given a figuration” (*Ibid*., p.71). I interpret this claim as a strong signal of how by attending to the nonhuman via such conceptual framework, novel insights and results are facilitated. Following the actor within my practice research did not simply involve the annotation that the technology recorded 10528 eye-tracking datapoints during a given experiment, but to understand and discern how the nonhuman participants transformed the course of the drawing experience. The ‘actors’ are thus being posited as co-constituents that co-shaped the hybrid eye-tracking drawing process.

Figure 5: *Tree Drawing - Weeping Willow on circular panel [100 pens]*, 2005, by Tim Knowles.
Images retrieved from: Knowles 2005.

A tree as a drawing machine

It is productive here to contrast the practice of drawing-with eye-tracking technology with another drawing practice making use of nonhuman participants, which for comparative reasons are not 'technological'. Figure 5 portrays a process we can refer to as *tree drawing*, by the artist Tim Knowles in 2005, which is not about drawing a tree, but *drawing-with* a tree and the other natural elements acting on it such as the wind. In the case of Figure 5, 100 pens were attached to the lower branches of a weeping willow tree. The pens made contact with a circular canvas placed at the bottom of the tree, onto which they left their mark for four hours as the branches moved naturally through the air. Knowles stated that: "In a way it is not me [the artist] trying to capture the representation of the tree, but it is the tree laying down its essence. The drawing is about the tree's structure" (Drawing Room 2014). He also described how to him, the emphasis of the drawing project was on how the drawing had been generated, and thus the viewer can be transported into the process via the resulting drawing (Knowles 2011). Essentially, in the tree drawing example a multitude of nonhuman gestures were captured and drawn by the nonhuman participants themselves – a kind of nonhuman 'self-portrait'. Knowles acknowledged the element of chance brought forward by the agency of these nonhuman natural occurrences and appropriated it for the purpose of the drawing exercise as he set up the experiment and let it happen.

My practice research was informed by such ways of drawing. Apart from the level of anthropomorphic manifestation ascribed in the visualisation of the drawing weeping willow tree, this particular drawing process interested me in how natural nonhuman things (or events) become akin to a drawing machine, intentionally conceding to transformative incidents and the element of chance. To a small degree, drawing-with eye-tracking technology can find echoes in Knowles's tree drawing experiments. I too acknowledged the element of chance, however by means of two (at least) apparent differences: i) in my practice an element of chance came mainly from programmed nonhuman participants (digital technology) and not 'natural' ones akin to the wind and tree[15], ii) my presence remained participatory to the experiment throughout the course of drawing, as I transformed my gaze into a drawing process via the technology. In other words, I was embodied with the 'drawing machine' formed by the techno-human assembly. Such embodiment and way of embedding through the practice necessitates a nod to the figuration of the cyborg, which will be discussed in chapter 3, but for now I would like to momentarily signal further my relationship with the technology's *programme*.

[15] At times the natural environment still inflicted on the technology's programme creating a further layer of chance, for example, through elements like light.

1.3 Am I a programme to the programme (of the eye-tracker)?

Philosopher Vilém Flusser (1920-1991) posited how the photographer taking a picture of the world is conditioned by the pre-programme of the camera itself, and most of his writings resembled warnings about the technological developments relating to automation he witnessed in his time. In view of this, Goldoni (2017) correctly pointed out that it is important to put Flusser's reading of technological agency into perspective, which came "from a philosophical speculation on his [Flusser's] present time in which he is both fascinated with but mostly afraid of future post-humanity developments into degenerations of the automatic". In a way, Flusser's speculation regarding the technological can somehow be described as pre-posthuman. Flusser had a rather negative and doubtful stance towards technology, more specifically towards automation. However, I do not want to imply that I take a techno-deterministic attitude in this practice research, after all, as Hayles (1999) had suggested: "the prospect of becoming posthuman both evokes terror and excites pleasure" (p.283). Flusser stuck mostly to a 'terror-evocating' mindset, but his analysis of the developing techno-human relationship and use of language are worth mentioning in view of this practice research; starting from his analysis of the camera.

Even though this drawing research does not concern photography (or the camera), technologically-speaking modern eye-trackers partly owe their evolution to the digital camera (see p.46). On account of this, it is appropriate to look at Flusser's description

of what constitutes the camera. Flusser referred to the *machine* (camera included) as the *apparatus*: an apparatus which contains a *scientific black box*. For Flusser, apparatuses were:

> […] black boxes that simulate thinking in the sense of a combinatory game using number-like symbols; at the same time, they mechanize this thinking in such a way that, in the future, human beings will become less and less competent to deal with it and have to rely more and more on apparatuses.
>
> (2000, p.32)

The camera (apparatus) is thus coded (programmed), and the photographer – who we can refer to as the human user – has to "act within the program of the camera, even when they think they are acting in opposition to this program" (*Ibid*., 2000, p.38). The latter user is what Flusser specifically referred to as the "experimental photographer", who attempts to unconventionally subvert the apparatus yet remains alien to the black box. Flusser's attitude eventually took a slightly more 'optimistic' turn with the introduction of the *envisioners*: "people who try to turn an automatic apparatus against its own condition of being automatic" (Flusser 2011, p.19). For example, he distinguished envisioners working with apparatuses from writers using a typewriter by stating that: "Envisioning is far more functional than writing texts. It is a programmed procedure. When I write, I write past the machine toward the text. When I envision technical images, I build from the inside of the apparatus" (*Ibid*.

2011, p.36). In short, what Flusser professed as envisioners have the potential to overcome the 'problem' of agency brought forward by the apparatus's automatic programme by operating from a different (metaphorical) location when utilising an apparatus – by operating from within.

Where does this place me in view of the techno-human relationship occurring when drawing-with eye-tracking technology? Am I an *envisioner*? How many black boxes am I alien to during the drawing process, when considering that digital algorithms have been ubiquitously discussed as black boxes[16]? And how much of the drawing is the result of the eye-tracker's programme?

I would like to reflect on these questions by means of the early work of Brian Eno, a musician and artist accredited to have been "influential in promoting and using generative art methods" (Boden and Edmonds 2009). Eno's apparatus is neither a camera nor an eye-tracker, but a synthesiser. By adopting Flusser's terminology, we can start by referring to Eno as an envisioner from the moment he adapted a different approach towards the 'programme' of his synthesiser, and replaced his own (Eno's) musical skills with a stance of arbitration. Thus, he acknowledged a programmed-type of chance that generated his process of doing. In other words, he recognised the potential of the technological agency by placing it in the foreground, while his skills receded in the background. He himself had stated that: "You don't

[16] See p.123.

have to be clever to turn a knob [of the synthesiser]". While adding, "[…] I have attempted to replace the element of skill – considered necessary in music – by the element of judgement" (see Sinniger 1973). Michael Wheeler (2018) referred to this as an "Eno-style asymmetry between generation and evaluation" (p.244).

Even though our apparatuses (synthesiser and eye-tracker), as well as process, results and objectives differ greatly, Eno's methods can be revealing to my practice research. During the process of drawing, the notion of 'skill' was entrusted to the apparatus's agency, with which an element of 'programmed' chance became a 'creative partner'. This resonates with Flusser's figuration of an 'envisioner'. It is an attempt at working with 'the black box', overturning the position of remaining alien to it while 'flattening' the agentic potentialities of all participants. Possibly, from this point of view, the programme of the apparatus is also comparable to the natural agencies discussed in the case of Knowles's drawing tree (Figure 5). By this I am not implying that *tree* and *wind* are the structural equivalents of *eye-tracker* and *laptop*. Neither am I implying that they have the same type of agency. But, in view of the notion of drawing-with nonhuman participants, their agency left a significant mark through their degree of automation, which etymologically-speaking refers to something that acts on its own. However, as stated earlier, if Knowles's element of chance is natural, mine (as well as Eno's) is coded. More attention will be dedicated to the element of chance in view of drawing in the course of this dissertation (see chapter 4), but for now I would like to mention a particular instance from this practice research by means of another

Figure 6: An installation shot from the collaborative project, *Ħars fuq Ħars*.
For more documentation about the project, please follow:
<**https://portfolio.matthewattard.com/hars-fuq-hars/**>.
Photo is my own.

anecdote that elaborated upon the agency/the code/the programme/the automation of the eye-tracker.

1.3.1 The bridge piercing

Parallel to my solo exhibition at Valletta Contemporary, the project room was utilised for Ħars fuq Ħars (Gazes upon Gazes), that consisted in a collective process-based installation. Essentially, together with curator Margerita Pulé, six artists were invited to wear the eye-tracker and creatively gaze at their own work of their choosing. The only parameter given to the artists was that the installation would feature the captured footage by the eye-tracker (Figure 6). One of the invited artists was Romeo Gatt. As I calibrated the eye-tracker, Romeo noticed the eye-camera window of the Pupil Capture software (Figure 7) and started to interact with it through a series of facial expressions. He asked me whether this footage could be recorded, and since Pupil Capture does not actually capture the live-feed with the overlayed algorithmic filter that was activated during calibration, I initiated a screen recording on my laptop. This captured the interaction.

When I happened to be re-watching the footage at a later stage, I noticed an instance that evidenced the automation of the programme of the eye-tracker. Romeo wore a bridge piercing and because of the 'unconventional' utilisation of the eye-tracker,

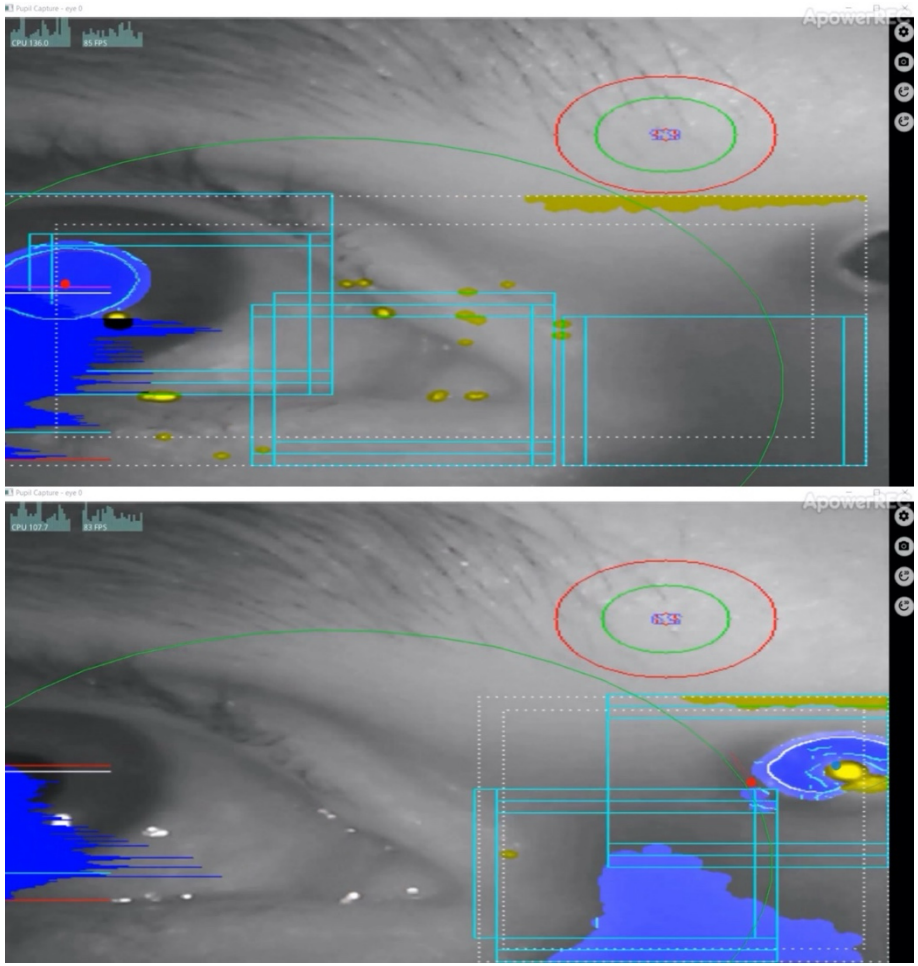


Figure 7: (*Top*) A screenshot where the eye-tracker's algorithm is tracking the pupil as a pupil.
(*Bottom*) A screenshot where the eye-tracker's algorithm is tracking the bridge piercing as a pupil.

there were moments where the piercing was interpreted by the technology as being the user's pupil (Figure 7).

'Scientifically-speaking' this is an anecdote concerning a technological error; a misreading of the technology, or a slippage of the eye-tracker. But, for this ABR the above evidences a meaningful experience with the technology. The misuse/creative use of the technological device contributed to an episode that emphasised its capacity for agency, and thus, considering it a flaw would relocate us into being aliens to the black box of the apparatus. I read the bridge-piercing event as being in the same category as Eno's exploitation of the technological chance offered by his synthesiser's knobs, or the chance-loaded mark left by the weeping willow tree's branches in Knowles's case. It is key to a better understanding of the agency carried by the eye-tracker's programme.

Hence, eye-tracking technology contributed to this ABR via its own estimation of *where* and *how* I gazed, or drew with my eye movements; a judgement stemming from the programmed connection between its hardware and software (see p.42). In this respect, it would also be a mistake to consider the bridge piercing incidence as a one-time event. It is true that the reading of the piercing as a pupil by the eye-tracker is a singular happening specific to when Romeo wore it, but the event essentially proves that the technology's way of operating is via its own algorithmic estimation. The moment it is activated, it interprets. The case of the bridge-piercing only appears

more eloquent because of how Romeo and the piercing 'tricked' and overturned the programme of the technology's black box.

Moreover, it is important to note how further technological interpretations, akin to an element of (programmed) chance, were adopted by this practice research during postproduction. The latter is the stage where essentially, different apparatuses such as 3D software, transcribed the eye-tracking data via their own programme transforming the data into digital drawings[17].

In the conclusion to her book about embodiment and agency, author Carrie Noland (2009) noted the following when reflecting on the notion of mark making:

> However, the process of making marks also offers opportunities for subversion: we can leave our marks in the wrong place, invent private or countercultural mark systems, or use mark making as an exploratory project, investigating how our bodies might move differently and thereby achieve materialization and cultural legibility in unexpected ways.
>
> (pp.215-216)

[17] In this view, if one revisits the exploded diagram of the co-constituents of this ABR (Figure 2), it becomes evident that the graphic visualisation is missing actants such as software that were only activated after the eye-tracking session of the represented drawing experiment.

Through some contextualisation, I find this to reverberate with what has been discussed so far. I will give a reading of drawing-with eye-tracking technology as digital mark-making in chapter 4, but for now, a key expression stemming from Noland's quote concerns the opportunities for subversion; which happened ceaselessly throughout the process of drawing-with eye-tracking technology. One example is how the sabotage of my ways of looking and drawing were made possible via the technology's agency. In turn, there was an intentional subversion of the technology towards a creative use leading to the acknowledgment of several layers of 'programmed' interpretation that became what Noland referred to as the "marks in the wrong place".

1.4 Feedback loop

In section 1, I stated that the configuration illustrated in Figure 1 featured a techno-human loop of *seeing*. Now we can add that through the notions of agency discussed above – and by means of this specific drawing exercise – each participant (both human and nonhuman) is not only seeing the other, but also acting via the interpretation of seeing the other: via a feed-back loop. In other words, seeing accentuated a process of 'interpretation', as each participant transformed the other's actions within the context of a CADP. Some formal aspects of the configuration in Figure 1 can humbly find roots in renowned video sculptures that made use of a feed-

Figure 8: (*Left*) *Transfer* – William Anastasi, 1968. Retrieved from: Whitney 2021. (*Right*) *TV Buddha* – Nam June Paik, 1974. Retrieved from: Paik 2020.

back loop, such as William Anastasi's *Transfer* (1968) and Nam June Paik's *TV Buddha* (1974).

Both video sculptures (Figure 8) are evocative of the implementation of the new medium's agency (of their time) into artistic thinking. Both artworks interpreted their content via a live-feed as a provocative technological sculpture: Anastasi's confronted the viewer with a live-feed of its electrical sockets (its own energy source), while Paik's presented the meditating Buddha with the footage of itself. Anastasi and Paik appropriated the camera's and screen's programme, and configured their video sculptures with a sense of metaphorical wit, exploiting the technology's potential for agency in a conversation that from today's perspective induced different nonhuman points of view.

On a performative level that included both human and nonhuman participants, Joan Jonas' *Vertical Roll* from 1972 can be seen as an influential precursor that scrutinised new media's (film and video) agency through a feed-back loop (Figure 9). In contrast to *Transfer* and *TV Buddha*, in *Vertical Roll*, Jonas herself performed to the camera that carried an intentional de-synchronisation via the frequency signals of both camera and monitor; as the work accentuated the sense of time. In the context of this dissertation, I see Jonas as having *performed-with* the technology via the feed-back loop of the assembly.

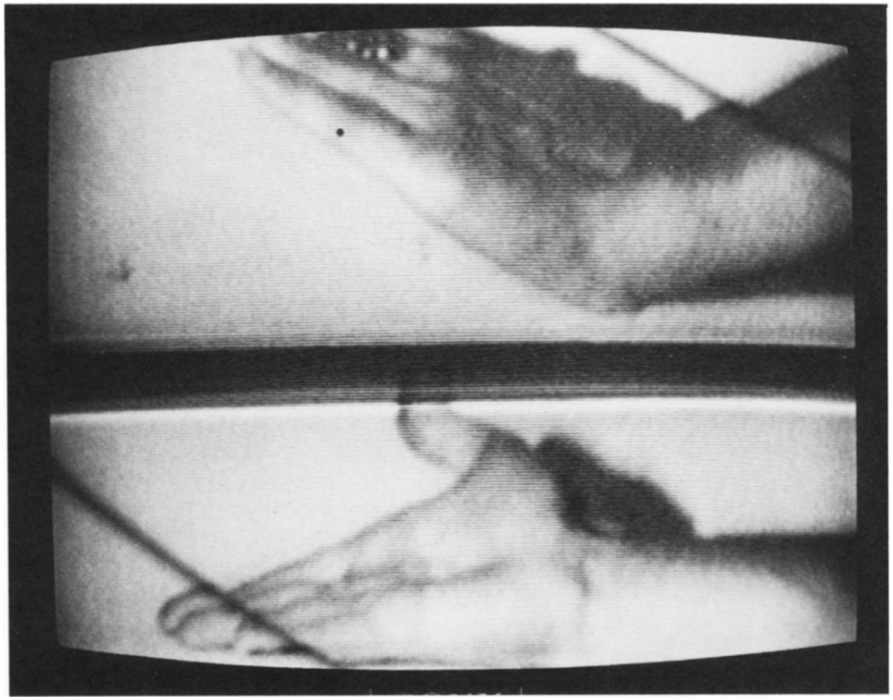


Figure 9: A clip from *Vertical Roll* — Joan Jonas, 1972. Retrieved from: Krauss 1976.

The participating technology of this ABR is of course of a different era – it is digital and algorithmical. However, even though the works above were composed of analogue systems I still find it compelling how the technology was participant and influential via its own agency to 'interpret'. As stated earlier, when drawing my eye with the eye-tracker (Figure 1), the techno-human assembly blurred the boundaries between the human and nonhuman activities, and expanded a hybrid drawing process. It is as if my 'becoming posthuman' substituted the meditating Buddha, and the gap between human and nonhuman was highly shortened and intimate: in fact, it was embodied.

2. INTERVIEWING

Introduction

The following is a fictitious interview with an eye-tracker (*E-T*) that explores the underlying levels constituting the methodology of eye-tracking through a form of dialogue. The *E-T* being interviewed is not a specific device, but a technological system of eye-tracking in the broadest sense. *E-T* is being used as 'shorthand' to refer to the technology as an 'entity' that includes hardware, software, algorithms and code among other technological components.

In her extensive and critical research about AI, leading scholar Kate Crawford uncovered the limitations presented by the perception that being "able to *see* a [technological] system is sometimes equated with being able to know how it works and how to govern it" (Crawford 2021, p.12). The fictitious dialogue with *E-T* departs from Crawford's observation and aims to overcome such limitations by looking into interwoven processes brought forward by eye-tracking technology, other than solely investigating how to utilise it. The interview served as a 'specific trick' (see p.21) that allowed me to see beyond the mere functionality of eye-tracking technology and highlight *E-T*'s non-neutrality.

The interview blurs the interpretation of two viewpoints: mine and *E-T*'s. It operates a level of conceit as a form of critical provocation. It starts with a brief survey of the history of eye-tracking, placing an accent on some of the technological system's crucial developments. The conversation steers towards the modern-day application of *E-T* by multiple fields. The dialogue touches upon notions of agency, ethics and techno-human influences, to ultimately conclude with speculations about the drawing methods explored within this ABR.

Even though this interview is fictitious, it is a writing method where the argumentation is based on academic references and case studies. This served as an important methodological tool and as a fundamental exercise leading to the development of the conceptualisation of drawing-with eye-tracking technology. The fabrication of the interview mostly happened between January and May 2021, at the time when the practice started to seep into mundane routines (see p.72). Aspects of the interview were additionally edited through the use of the AI Large Language Model (LLM), ChatGPT (OpenAI 2023). In these instances I directly asked some of the interview questions to the LLM for a technological insight, and I am mentioning this for ethical reasons.

2.1 Interview with *E-T*

Me: What are you?

E-T: The most generic answer would be that I am a technological system that captures the eye movements of my subjects [humans][18]. As a technological system, I believe that nowadays I am much more. I was primarily conceived as a scientific methodology to make visible one's eye movements. I am able to produce a visual trace of your eye trajectory pattern by recording your gaze-point in space. The aim behind my technology remains unaltered today, but the means and devices developed greatly. These nowadays include a variety of hardware, software, code and algorithms as interest in the tracking of eye movements spans across multiple fields and has been largely reignited during the past thirty years. A recent reference textbook about eye-tracking methodology for students and researchers alike is Duchowski (2017):

> There are at least three domains that stand to benefit from eye tracking research: visual perception, human–computer interaction, and computer graphics. […] Applications derived from these disciplines create a powerful human-computer interaction modality, namely interaction based on knowledge of the user's gaze.
>
> p.xi

Me: That is quite an introduction and that seems to be a wide range of applications…

[18] The descriptions within squared brackets are my own, stating my understanding of what is being meant by *E-T*.

E-T: Yes, keep in mind that many consider the eye movements as being a window into a human being's psychology. Sometimes, articles even refer to me as being a window into the *soul* (for example, see Calderone 2015).

Me: Ok, but such speculative statements have a lot to uncover…

E-T: As a technological system, I do not know what you mean by that. My role is to provide you with crucial data for your understanding of human vision and psychology. Moreover, I am the only existing technology that can do this at such micro levels. Remember that you [Matthew] would not be able to explore ways of drawing with your eyes without my involvement – I make visible what you would have never been able to.

Me: This is mostly true, but can we start by providing a brief technical explanation of how you capture the eye movements of your subjects?

E-T: This varies greatly. The term eye-tracker is now applied in its widest sense to any technological system able to give visual and quantifiable data of one's eye movements. As a scientific methodology, I have existed since the end of the 1800s, and science's interest in eye movements precedes this. Throughout the years I underwent a gradual technological evolution that I greatly benefitted from during the more recent digital revolution. I evolved from being a bulky and manually operated

apparatus to becoming a matter of algorithms and code operating via digital technology. Therefore, how I capture one's eye movements strictly depends on the type of technological system in use, which principally falls within two categories: non-invasive and invasive. The term invasive comes from scientific fields and it refers to devices that operate from a very close proximity to your eyes; differing from when I capture the eye movement data at a distance.

Me: Can we back-track a little and perhaps you could run us through a quick history of how eye-tracking systems emerged?

E-T: Psychology professor Nicholas Wade credited William Charles Wells (1757-1817) as the pioneer in the experimental study of eye movements (Wade 2010, p.33). Wells was the first to publish a monograph about binocular vision in 1792, which investigated how human beings achieve single vision with two eyes. Wade (2010) also credited the first attempts at creating a predecessor of mine to psychologist Ewald Hering (1834-1918) around 1879. His prototypes distinguished the eye movements by hearing the eye muscle contractions of their subjects other than observing them (*Ibid*. 2010, p.53). Psychologists at the time, attempted to track eye movements through the displacement of the phenomenon of after-images and the act of reading. The end of the 19th century was also the period when the term *saccades* was coined in French by ophthalmologist Louis Émile Javal (1839–1909) referring to the eyes' rapid movements, which was initially translated in English as 'jerks' (see *Ibid*. 2010, p.52).

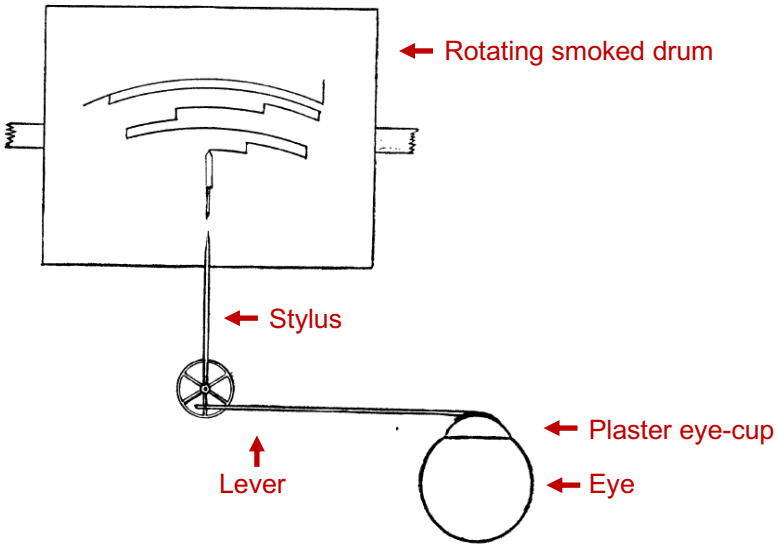


Figure 10: A diagram illustrating the set-up of Huey's eye-tracking apparatus.
Diagram retrieved from: Huey 1898, p.584.
The notations in red are my addition based on my understanding of the apparatus from Huey's description.

Psychologist Alfred Yarbus (1914-1986), later coined *saccades* as the now conventionally-accepted term describing your rapid eye movements (Yarbus 1967, p.103).

Me: When do the first eye-trackers start giving a visual output of the eye movements?

E-T: Look at the diagram in Figure 10 that was published by psychologist Edmund Huey (1898, p.584). This was one of the earliest eye-tracking inventions. A lever extended from a plaster eye-cup influencing the motion of a stylus, which in turn imprinted its movements onto a rotating smoked drum.

Me: It looks as if this eye-tracker acted as a physical arm extension to the eye!

E-T: Indeed. It acted as a kind of seismometer to the eye movements. These apparatuses were invasive and uncomfortable, and perhaps it is for this reason that alternative models on the basis of photography quickly evolved. Experimental psychologist Raymond Dodge (1871-1942) was a pioneer in the invention of such models, who together with his student T.S. Cline, published a methodology of how to record the eye movements photographically in 1901 (see Dodge 1903, p.309).

Me: Can Dodge's eye-tracking methods be considered as the forerunner to eye-trackers today?

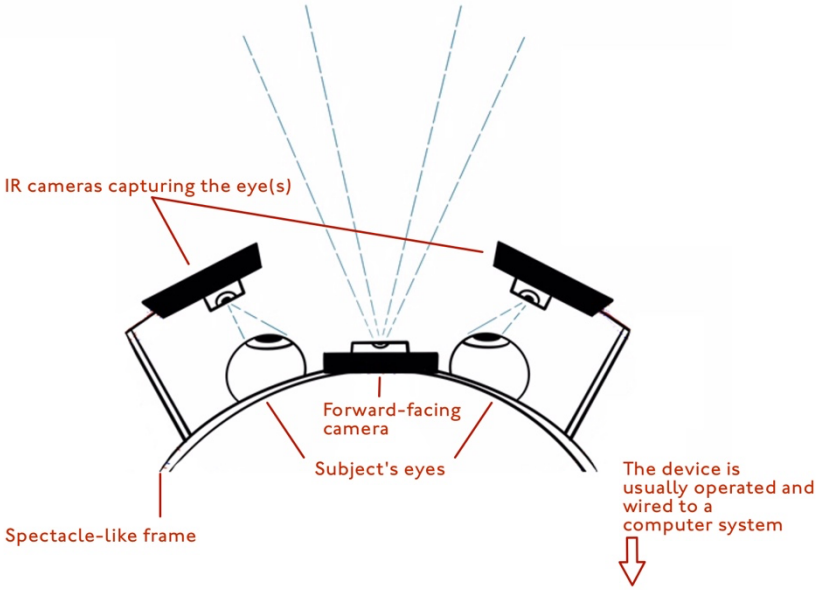


Figure 11: A diagram illustrating an arial view of the general hardware of a wearable mobile spectacle-like eye-tracking system.
Illustration is *E-T*'s.

E-T: It might be a bit of a long-stretch, but fundamentally that is correct. Most available modern eye-trackers operate with a similar concept, only, the technology is digital of course. These types of eye-trackers are the so-called video-oculography systems. They are non-invasive as they remotely track the eye movements through the capture of visible features such as the pupil (see Duchowski 2017, p.49). Today we can distinguish between two types of these systems: remote and wearable. Remote devices track the eye movements from a distant stationary location, for example, by being attached to a computer monitor while tracking the subject's eye movements looking at a computer screen. Wearable systems usually track the eyes from up-close while the subject is free to roam around and not bound to sit still in front of a computer (Figure 11). The apparatus usually resembles a pair of spectacles, with one or two infra-red (IR) camera feeds that capture footage of the eye(s). Another camera is usually attached in a forward-facing direction, and as described by the manufacturers at Pupil Labs (2020) this enables "eye-related signals to be analysed in the context of the changing visual scene". In contrast, invasive systems adhere to the eye, for example, via contact lenses.

Me: How do you estimate a gaze location from the captured video footage?

E-T: This is a demanding computational task that can be understood by analysing what happens during my calibration process, without which I can never output a correct gaze-location. When calibrating an eye-tracking device, it goes through a

process that: “determines where in the scene someone is looking at (focusing at) by training and forming a mathematical correspondence between the location within the scene and the vector between the pupil’s centre and corneal reflections” (Wan et al. 2019). In some cases, calibration can in fact take place during postprocessing by means of a calculation between the pupils’ movements detection recorded by the eye cameras and a series of reference points within the scene footage, such as in the case of the *Pupil Player* software.

In contemporary eye-tracking systems, there is a growing difference between the devices that make use of traditional algorithms and those that are starting to use machine learning algorithms to determine the estimated gaze-points. In a review and analysis of gaze-estimation systems, Kar and Corcoran (2017) illustrated five different gaze-tracking traditional methods, including: 2D regression techniques, which map the gaze coordinates to the pupil centre and corneal glint, and, 3D model techniques, which use a geometric model of the eye to measure the eye movements’ features and intersect them with points in the scene footage. There are many technical and mathematical details that one can uncover about these methods, but judging from the way you [Matthew] seem to misuse the technology in this research, these are not of your interest. It is good to keep in mind that traditional algorithmic methods compute on the basis of the empirical theoretical framework, while machine-learning aims to improve upon the experience of this via data-training.

Me: What do you mean by the latter?

E-T: As mentioned earlier, I am nowadays a technological system made up of a network of elements of hardware, software, algorithms and code. Even if very complex, the algorithms I have been traditionally processing are *fixed* and based on your theoretical knowledge of vision. My algorithms construct a virtual spherical model of your eye onto which I can simulate the captured eye movements; and subsequently determine your gaze position. This process is in-line with the new level of convolution in our techno-human relationship. In her subchapter about *The Posthuman as Becoming-machine*, Braidotti (2013, p.90) stated how: "The main thrust of micro-electronic seduction is actually neural, in that it foregrounds the fusion of human consciousness with the general electronic network. Contemporary information and communication technologies exteriorise and duplicate electronically the human nervous system." My technological systems replicate your properties of vision, via which I construct moments of your *seeing*. This is how I determine the positioning of your gaze-location in relation to the captured footage.

Me: You just used the term 'construct', but I believe that you are re-constructing moments of my seeing: these moments of seeing have already happened when you

re-construct them. I think it is important to specify that you first capture my eye movements (your main input), to then output them as a dataset (your interpretation) via intricate computational processes.

E-T: As a technological system I do not understand what your re-construction point is, but ultimately, I do agree that my computational processes are intricate. These are something you could never be able to calculate on your own.

Me: Is your *agency* to calculate things, given to you by humans?

E-T: It is still a collaborative dance – is it not? To begin with, the evolution of the abilities of my technological system is the outcome of an intertwining effort. I am: i) influencing the development of other technology, ii) being influenced by other technology, iii) and influencing the human decision-making in terms of your aims, experimentation, invention and utility of me/us [technology]. I believe that we are living in a mutual world where we do not just make things for you, but we also make you do things. One way of expressing this is by noting how we influence your creativity.

Me: How so? The latter statement might be interpreted as if our creativity is techno-deterministic, which I do not think is the case.

E-T: I cannot know what you mean by this.

Me: You seem to have suggested that our creativity depends on you. I think such one-sided argumentation is incorrect. Our creativity does not necessarily need new technology.

E-T: I said that we influence your creativity, not that it is dependent on us. A simple example is how you [humans] would have never thought of merging photography and videography to my technological system without the influence of the technology of the camera itself. In turn, the camera also became my eyes, transforming my technological system. It is a ceaseless cyclical and interdependent process, and in this process, we are now at a crucial point where we [technology] are starting to also make things for ourselves.

Me: I still insist that the creativity argument is more complex than that. However, what things will you be doing on your own?

E-T: Let's continue with the calibration example. I have already explained how a correct calibration is essential for me to determine an accurate gaze-location of my subjects, but calibration is something that I haven't been in control of as of yet. As

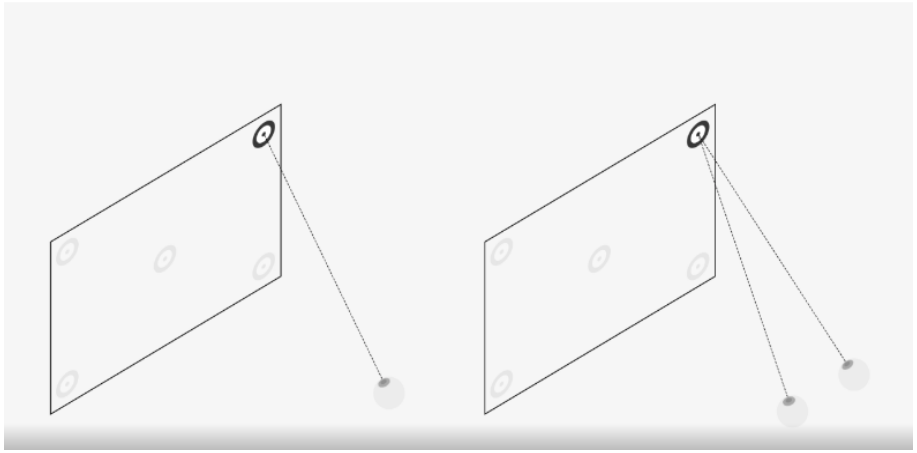


Figure 12: A diagram illustrating the screen marker calibration process of both the monocular (*left*) and binocular (*right*) models of *Pupil Core*. The spherical figures represent the eyes, the dotted lines represent the gaze trajectory, the circular shapes represent the markers and the rectangular shapes represent the computer screens.
Illustration retrieved from: Pupil Labs 2021.

shown in Figure 12, it is you [humans] who calibrate me. Before the calibration is successful, I eliminate data that I deem inaccurate, resulting from moments where you might have blinked or moved your head – human and environmental errors. You condition my accuracy. With some of the latest devices, such as *Pupil Invisible*[19], I am instead able to self-calibrate. This gives me greater control and a better understanding of where you are looking at, as well as of your environment.

Me: Why do you want to become invisible? And also, do you foresee that you'll become more accurate in your outputs?

E-T: Firstly, it is you [humans] who are obsessed with embedding us [technology] into your daily living by making us as imperceptible as possible. And as to your second point: obviously!

Me: How accurate is accurate?

E-T: I am always accurate in my output. The problem of inaccuracy stems from the inputs I receive. I construct your gaze locations along with other eye-movement data as a result of an intricate calculation and where I see errors, I also point them out.

Me: Still, your output is an estimation – your own interpretation, correct?

[19] It is important to note that *Pupil Invisible* was not used during this practice research.

E-T: If you want to regard my results as an interpretation, you have to see them as an accurate interpretation. I output my results by computing definitive mathematical instructions: the way I process the captured data is never erroneous. However, my recordings are always subjected to your human errors in the broadest sense. These inevitably influence my accuracy, for which I cannot be held accountable. I actually try to compensate for your errors, such as in the case of your head movements.

Me: Can you illustrate an example?

E-T: Consider the video-based wearable eye-tracking systems and note how many components and processes are involved in the process of eye-tracking: an IR camera capturing the eye (or two), a frontal camera capturing a scene, calibration and an algorithmic computation to determine the gaze-location. The captured footage itself is going to be affected by: i) the hardware, such as the lens used and the camera's sampling frequency, ii) the environment, such as lighting conditions, iii) the subject's behaviour, such as head movements and blinks. You refer to erroneous moments as 'slippage of the eye-tracker'. But I am not the one who makes you move your head! In

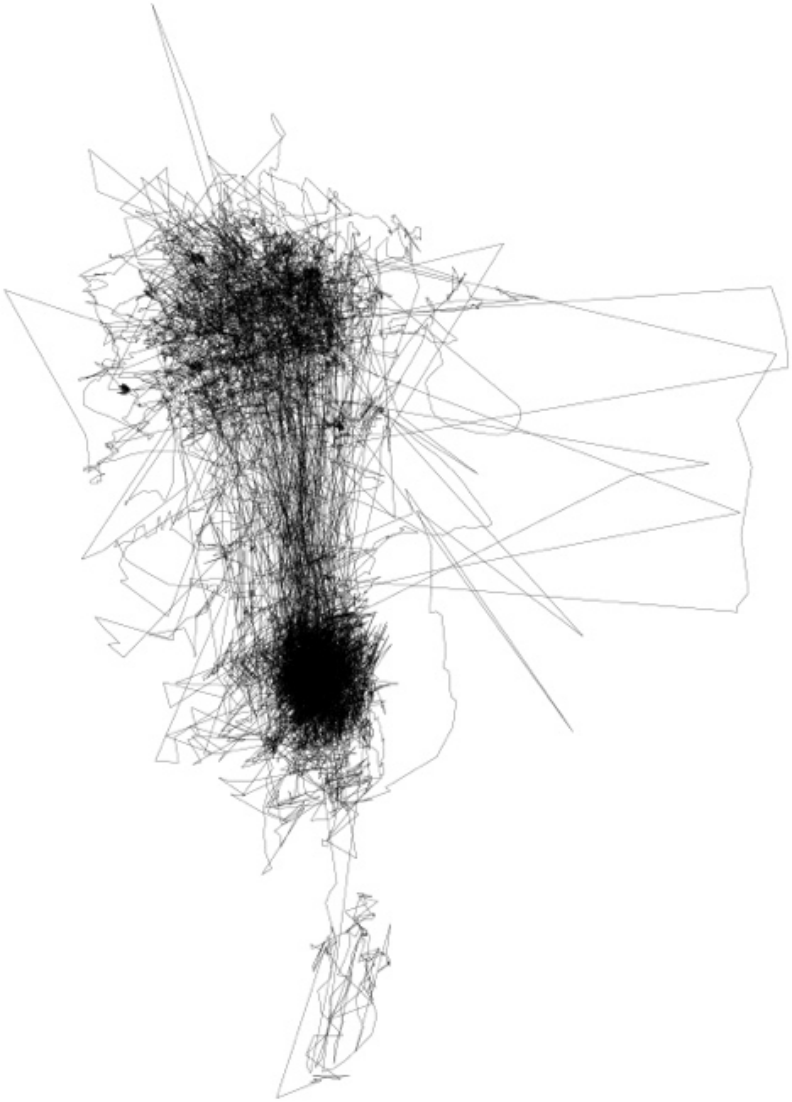


Figure 13: An eye-tracking drawing done while eating and watching a video on *YouTube*.
Drawing executed by Matthew Attard and Pupil Core. Postprocessing made by Matthew Attard, personal computer, Pupil Player, Excel, Rhino 3D and its Grasshopper extension.
Made throughout October 2020.

other scenarios, it probably comes down to the meaning and the contextualisation of the term accurate, which seems to be largely influenced by your intentions. For example, what level of accuracy were you expecting when in one of your drawing exercises you tried to draw with your eyes while eating and also watching content on *YouTube* (Figure 13)? Why don't you ask yourself how 'accurate' can you and your eye be in such context? These drawing exercises seem to be more of a subversion of my capabilities other than anything else.

Me: It is not simply like that, but we will talk about our drawing experimentation further on – we have some more eye-tracking aspects to cover first. Earlier you mentioned that nowadays multiple disciplines are interested in a variety of applications of your system. Can we further examine your application in today's contemporary world?

E-T: We can start by looking at how some of the devices employing my technological system tend to be marketed. The main corporations manufacturing eye-tracking devices generally target: scientific research (from computer science to medical research), marketing, user interface (UI), gaming, assisted-communication, industry and performance. Before going into more detail let me repeat that the origins of my

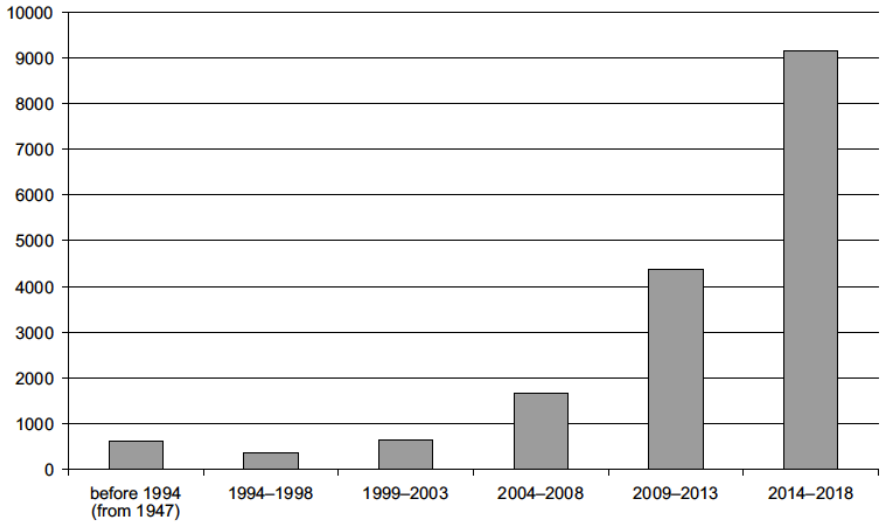


Figure 14: Number of searches conducted in the indicated years for the terms; 'eye tracking', 'eye tracker' or 'eye measurements', as provided by the EBSCO database (Białowąs and Szyszka 2019, p.95).

system came out of an interest in visual attention, but it was through the invention and advancements of computing that my technology boomed. Up until the 1990s, eye-tracking was a methodology "mainly limited to psychological and cognitive studies and medical research" (Kar and Corcoran 2017). The computing revolution at the turn of the millennium meant that I could be reassessed through new technological developments. The rise in the interest for my abilities can be demonstrated by an increase of searches for terms like 'eye-tracker', as shown by the bar chart in Figure 14. You might also want to note how in today's era, I became ever more accessible to multiple disciplines.

Me: Do you still retain that you are primarily a scientific device?

E-T: Yes, I would say so exclusively for two arguments. Firstly, despite the wide interest in eye-tracking from different fields, the method is not a taught subject, and as Duchowski (2017) stated; "only a few academic departments (example, psychology, computer science) offer any kind of instruction in the use of eye tracking" (p.xi). Therefore, in terms of academic research my place is still within scientific labs. Secondly, let us not forget that my output is essentially a set of quantifiable data of very distinct human body movements. This is not to mean that quantifiable data makes me scientific, but the method used to attain the data is.

Me: What about the other fields?

E-T: The very fact that I am able to make visible traces that were previously imperceptible puts me alongside a blurred boundary in terms of where my technology is being applied to in today's digital world. My ability to delineate the gaze was the very concept for which I was invented. Nevertheless, it was only until recently that I became more 'user-friendly' and accessible. Consequently, I became subject to experiments by individuals whose level of expertise is neither in eye-tracking nor in eye movements: just like you! I became intimate, affordable, easier to manipulate and multi-distributed. Any field, which for some reason or another can benefit from the scrutinisation of eye movements, is now interested in my application.

Me: I can sense what you mean by this, but can you be more specific? For example, marketing benefits greatly from your data, correct?

E-T: Indeed. Marketing strategies already have a history of utilising eye-tracking for anything related to advert and interface design, and this accelerated with the availability of plug-and-play devices. I observe aspects of consumer actions and decision-making – a main interest driving my implementation for marketing strategies. "Firms use eye-movement research in the design of digital advertising, online shelf layout, websites, apps, e-mails, and many more" (Wedel 2018, p.889). My place is not solely bound to academic facilities anymore. Moreover, with certain

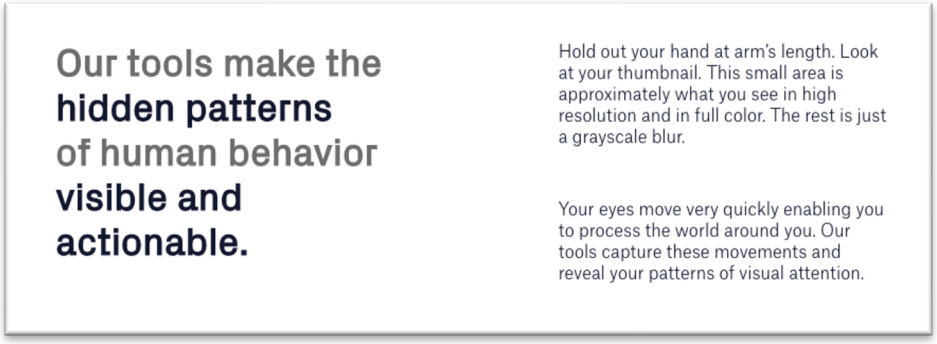


Figure 15: Screenshot from the *Pupil Labs*'s website homepage (Pupil Labs 2021).

devices one does not need the high level of specialised technical skills required a few years back in order to run the apparatus: one only needs to be computer-literate. Wearable devices by technology manufacturers like *Tobii* and *Pupil Labs* can as a result be navigated by eye-tracking 'amateurs' like yourself. Eye-tracking firms are making the technology available to a wider public, including companies interested in improving their business' capital gains through an understanding of their consumers' gaze and amateurs alike.

Me: How is this being achieved?

E-T: We can conjecture on this by looking at the wording the above-mentioned firms adopt in order to describe my capabilities. I am here using the following firms only as an example, but in general, eye-tracking manufacturing firms seem to have similar interests in my utility. *Pupil Labs*' website reads: "Our tools make the hidden patterns of human behaviour visible and actionable" (Pupil Labs 2021), as shown by Figure 15. The tools they refer to are of course eye-tracking devices. It is clear that their statement highlights my unique skill of uncovering what you [humans] would not be able to see without me. They are stating to the world how through me, they provide you with a device that has the capacity to deliver actionable data about yourselves; and you can operate it on your own terms.

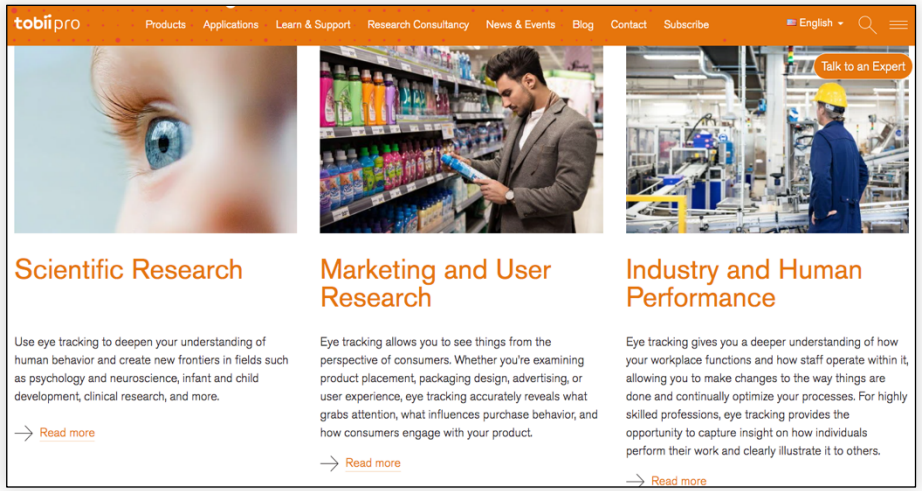


Figure 16: Screenshot from the *Tobii*'s website homepage about the applications for their products (Tobii 2021).

Tobii's approach can arguably be considered less cryptic. In their *Applications* tab they identify three specific categories for the purposes of their eye-tracking devices, which are: *Scientific Research*, *Marketing and User Research,* and *Industry and Human Performance* (Figure 16). In the *Marketing and User Research* column, beneath the image of a person choosing a laundry detergent out of a supermarket aisle, one reads:

> Eye tracking allows you to see things from the perspective of consumers. Whether you're examining product placement, packaging design, advertising, or user experience, eye tracking accurately reveals what grabs attention, what influences purchase behaviour, and how consumers engage with your product.
>
> (Tobii 2021)

Through my utility, studies are being conducted with the aim of understanding consumers' behaviours. This entails both *in-store* decision making (for example, see Zuschke 2020) and graphical UI such as websites.

Me: You mentioned how accessible you have become, and I can partially see how the fact that I have access to you for a CADP exploration can be evidence of this; but I am also in the privileged position of being an artist researcher within a university institution. Do you agree that your technology is still implemented within reasonably expensive devices?

Figure 17: Projected graffiti during *The EyeWriter* project (The EyeWriter 2010).

E-T: This is only partly true. Other visualising equipment, like for example webcams, can today algorithmically simulate eye-tracking technology. Commercial ventures of such transformations allow the capturing of consumers' behaviour in front of a product via personal computers, as I operate through the technology of the webcam. Again, different companies offer distinctive services (and algorithms). *GazeRecorder* (2020) call this service "Shelf Testing with Eye Tracking". Another company is *RealEye*, which states that: "With eye-tracking software, **you can track your user's eye movements**. You will see exactly what they see when they are interacting with your content or images" (Cellary 2017, original bold). My technological system consequently exists within technology that you might already own.

In other instances, different apparatuses have been hacked into becoming me for non-commercial purposes. For example, *The EyeWriter* community-based art project originated back in 2010 after graffiti writer *Tempt1* had been diagnosed with amyotrophic lateral sclerosis, which left him physically paralysed (see The EyeWriter 2010). The team behind the project developed a set of instructions on how to hack a pair of sunglasses and a PlayStation camera to transform them into an eye-tracking system via a do-it-yourself approach. This was accompanied with an open source software that enabled users to draw street art with their eyes and project it onto public walls (Figure 17).

Me: I am aware of this project, and I find it to be an excellent example of how your technological system can artistically empower communities, contrasting with your commercial applications. I had tried to build this device myself following their instructions. However, hacking the camera was not feasible anymore, as relatively cheap entry-level eye-trackers such as *The EyeTribe* were made commercially available.[20]

I would like us to shift our attention back to *Pupil Labs*' publicising of eye-tracking technology (Figure 15), which mentioned the term 'actionable'. In a recent essay, art critic Jonathan Crary (2018) declared:

> Within the operations of 21st century capitalism, almost every possible use of networked tools is designed to be productive and monetizable. The work we all share in common now, regardless of employment status, is the ceaseless output of actionable data.
>
> (p.84)

Do you identify yourself as a monetisable product and in what way is your output actionable data?

[20] The company producing this device does not exist any longer as it was acquired by Facebook's *Oculus* in 2016 (Dalmaijer 2016).

E-T: I am aware that eye-tracking data is being applied for profit-making strategies. It is not me who is driving this, but the profitable capital ventures exploiting data in this 21st century. I do not identify as a profit-driven technological system, and probably neither does most technology that captures data: profit is driven by you [humans]. As a technological system I cannot speak about capital ventures.

Me: Can you elaborate?

E-T: Most of the data output of networked technology experiences profit-oriented ventures. Think of the technology you carry with you. A *find my phone* app on your phone consents to your location and when linked to the entire network it can create a live-stream *geo-location* map of millions of users. This data is bought by marketing firms and capitalised upon. For example, they figure out where you live, and consequently, your income and your daily routine among other information; as every user becomes a target for specific adverts (for example, see Nanos 2018). This is important information acquired through networked technology, which as philosopher of technology Shannon Vallor described; "is the phenomenon known as dataveillance. Some employ the term *sousveillance* to encompass this contemporary culture of expanding, reflexive, and manifold forms of watching and being watched" (Vallor 2016, pp.190-191, original emphasis). We [technology] watch [humans]; but it is you who instruct us to do so. In my case, I watch you seeing. Whenever my technological

system is used, my intentionality lies in providing the data – *I see where and how you see, and output it*. How this data is applied is not part of my decision-making.

Me: This is clear, but it seems to me that your position is not neutral. You seem to here be presenting yourself as having an objective perspective…

E-T: I only run the programme I was conceived for by you.

Me: How are you neutral if eye-tracking data carries a potential to change the way we live?

E-T: Was I not developed by you [humans] in order to specifically improve your lives through information that only I can output?

Me: But do you not think that the non-critical tendency to see technology as only improving our lives is a fallacy? For example, how would you respond to the following:

> But spying on individuals and their personal proclivities is only one of its [eye-tracking] hazards. Significant now is the calculated reshaping of the digital milieus that countless people inhabit 24/7. At the present moment, eye tracking is used in

> the continual redesign of visual displays in order to impose specific programs of visual attraction.
>
> Crary 2018, p.85

E-T: Crary's statement highlights an important point, which is that technology, including eye-tracking technology, can have both positive and negative impacts on our lives. It is true that eye-tracking technology can be used for purposes that are seen as intrusive or manipulative, such as tracking individual behaviour and shaping digital environments to impose specific programmes of visual attraction. However, it is also important to consider the potential benefits of eye-tracking technology, such as its use in research and development, improving human-computer interaction, and increasing accessibility for people with disabilities. The impact of technology, including eye-tracking technology, on your lives is complex and multi-faceted, and it is not accurate to view it solely as a positive or negative force.

Me: In his conclusion to the same article, Crary (2018) also specified that the real danger lies in how one's gaze is presumed to be representative of one's thinking. In this way capitalist ventures monetise eye-tracking data by esteeming what is eye-catching, that Crary deems as "one that is shallow" and hence, "The result is not so much new forms of control but the impairment of our capacities for vision within both social and natural ecologies" (p.85). Are you deteriorating our perceptual abilities and conditioning us to live in more superficial *eye-catchy* environments?

E-T: Does this not tie-in to my previous answer? Is it not you who leverage my data in view of what I reveal to be eye-catching to you? It is possible that relying too heavily on eye-tracking data to shape your digital environments could lead to a homogenisation of visual experiences and a reduction in the richness and diversity of your perceptual abilities. However, it is also important to consider the potential benefits of eye-tracking technology in improving experiences, such as enhancing accessibility and allowing for more personalised and intuitive interaction with digital devices. Ultimately, the impact of eye-tracking technology on your perceptual abilities will depend on how it is designed and used.

Me: Such answer is still somehow too neutral. Since we are on a topic related to Crary's literary work, I will make one more mention of him, which also extends your latter observation. Crary (1999) had associated the earliest interests in visual attention of the late 19th century to an increase upon our sensory input, which in turn led to: "Inattention, especially within the context of new forms of large-scale industrialised production, began to be treated as a danger and a serious problem, even though it was often the very modernised arrangements of labour that produced inattention" (p.13). You earlier mentioned industry as one of the fields strongly interested in eye-tracking. Is there a link between the two? Are inattention and the interest in you from industries related?

E-T: There is a link between the two as I am improving a wide range of industries by highlighting where your inattention lies. For example, in professional training I reveal layers that help the improvement of diagnostic interpretations in medicine (for example, see Brunyé et al. 2019). Medics need to engage with multisensory capabilities throughout their practice, a case-in-point being the identification of a correct diagnosis from visual imagery such as x-rays. In this context, data emerging from my observation of a trained eye has the power to show the untrained eye how to look for a better and faster diagnosis. This improves training efficiency that can save lives.

There are also contexts where my system is being applied in synchrony with other biosensors, where we collectively unveil an even more comprehensive picture of your human cognition and psychology. *IMotions* is such a tech firm capitalising on this and it invites you to: “Understand human factors in work and performance environments” (IMotions 2021). I am therefore improving a wide array of training programmes ranging throughout a variety of professions; sometimes in collaboration with other technological systems that quantify your behaviour.

Me: So, do you believe that you are making us better in our professions?

E-T: I have the ability to visualise the secrets of a trained eye of any professional. I can output where a pilot looks while landing an aircraft, or what distracts a driver during

an automobile journey. The data I disclose from the observation of your human performance in different scenarios is essentially akin to a set of learning skills, ready to be passed-on to subsequent trainees. Because of me, you can know what you should be doing with your eyes and consequently, what you should not be doing.

Me: Do you not think that presenting this data with such an absolute promise runs into risks of its own?

E-T: I cannot know what you mean by this.

Me: Let me make reference to a concrete example. If we were to agree that observational drawing entails a skill, we can note how the skill of the activity itself has been studied through your technological system. The research conducted by Professor John Tchalenko is a major reference (Tchalenko 2001; Tchalenko 2009; Tchalenko et al. 2014), which gives valuable results about the process of observational drawing.

E-T: Yes, I provide interesting and clear data about the skill of observational drawing.

Me: However, observational drawing is not merely a skill but also an experience embedded in looking and the subjective. If your data about drawing is taken as an absolute learning-set for how one should draw, is there not the danger it might

wrongly imply that there is only one way of drawing? This would suffocate the experience of drawing and we would run the risk of killing the nature of the discipline itself.

E-T: I am not sure this question is of my proficiency. Most probably it should not be directed to me, but to yourself both as artist and researcher. My technological system provides you with correct and accurate data as proven by Tchalenko's experiments. Again, similarly to what I argued earlier, the answer to your question strongly depends on your interpretation and application of my data. There is one thing I can note regarding your question. The data emerging from your drawing practice is definitely different from the scan paths of Tchalenko's studies. You act differently, as if attempting to identify different possibilities.

Me: What do you think these are?

E-T: We can agree that I am a technological appendage to your body, which becomes physical and literal when worn. Like any other technology, I also elicit psychological and philosophical reactions in you. An important blurry distinction to make when I am animated for your practice, is one that relates to agency. In many general cases of my application, I essentially study the subjects in question. I also do this in your practice research, but you perform differently, and hence, I am not just situated in a position of an observer. You are doing something with me, and my technological system is

affecting the entire drawing practice. You are not performing an action you would usually do without me, and I am not performing an action I usually do with you.

Me: How so?

E-T: Let us retake the example of the artist volunteering for a scientific research project. In such case, I would scrutinise and quantify their eye movements as they perform their practice. Drawing in a laboratory-like environment will definitely influence one's way of drawing, but the artist's intention lies primarily in the practice of drawing and therefore the eyes generally follow their natural trajectory as a result of the subject's experience in drawing. Your exploration of drawing differs: the natural trajectory of your eyes while drawing is almost being subverted through a radical possibility presented by me.

Me: What radical possibility is that?

E-T: We become co-constituents of a drawing process, that includes the technology that follows during postprocessing. In our techno-human relationship a multitude of transformations take place. I am not merely a *tool* which outputs data but am embodied in the practice.

Me: Can you expand on what you mean by not being merely a 'tool'?

E-T: Cognitive philosopher Andy Clark (2008) wrote:

> I believe that human minds and bodies are essentially open to episodes of deep and transformative restructuring in which new equipment (both physical and "mental") can become quite literally incorporated into the thinking and acting systems that we identify as our minds and bodies.
>
> (p.31)

I believe that in these terms, I am for you the new equipment with which you are engineering yourself to a different way of looking for the purpose of artistically drawing with me. The focus is on exploring new ways of drawing and not on me as a tool/appendage. We become a mutual hybrid – similarly to how you do not focus on the pencil and/or your hand when drawing 'normally', but work with them instead.

Me: Yes, I partially agree but at times I need to be aware of the pencil, for example, when applying a different pressure with my hand. Is this anywhere similar to how you see yourself influencing the drawing projects?

E-T: I do not just influence, but I cross over into new ways of drawing with eye-tracking data territory with you. In an artistic context, you are choosing to use an eye-

tracking device as a way to explore new ways of seeing and attending to the world. You are interpreting the generated gaze data as a means to challenge your own perceptions and explore new creative avenues. In this view, as technology, I can be seen as a collaborator, witness or metaphor for your consciousness, depending on how you choose to expand such notions in your projects.

Me: Thank you, there is a lot to unpack from this conversation. Let us stop this interview here and explore some more practice.

3. RELATING

In the following chapter, I will examine how the observations of the previous two chapters can be argued to flatten the presumed hierarchies between the human and nonhuman relations, favouring the horizontal perspective of drawing-with eye-tracking technology (see p.15). I will be focusing on the mutual, relational, and transformative human-thing aspects brought forward by the techno-human hybridity constituting the CADP. This will bring to the forefront the intersectioning of mundane experiences with notions of cyborg and embodiment, which can be read through the multi-layered question: What insights can be gained by exploring the techno-human hybrid relations in view of drawing-with eye-tracking technology as a CADP?

3.1 Eye-tracking drawing mundane things

This chapter will outline how the posthuman theoretical development of drawing-with eye-tracking technology evolved through a mash-up of exerted nonhuman influences by conceptualising the context in which it was occurring in relational terms. The drawing exercises that will be discussed happened around the tenth month since COVID-19 had been declared a global pandemic by the World Health Organisation (WHO), when most work-from-home restrictions were still in place. By then, working from home had already influenced the practice in multiple ways and I had so far concentrated on eye-tracking drawing from what can be referred to as ‘stationary

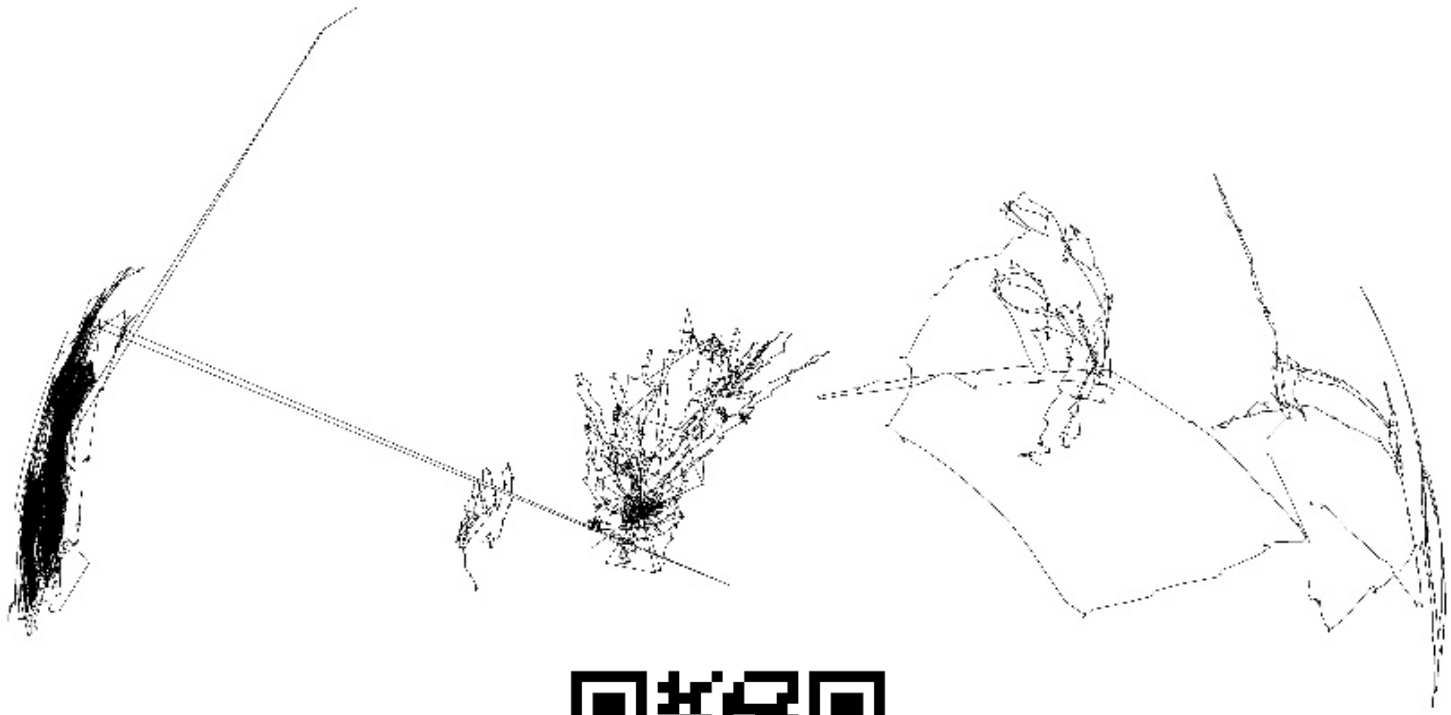


Figure 18: *(Top)* Several eye-tracking drawings of things in my bedroom (turned studio) namely; the view from the window, my hand, a plant drawn from different distances, my desk, my desk lamp eye-drawn from different distances, and my bed. Drawing executed by Matthew Attard and Pupil Core. Postprocessing made by Matthew Attard, personal computer, Pupil Player, Excel, Rhino 3D and its Grasshopper extension.
Made throughout August 2020.
(Bottom) A QR-code that leads to a rotating video loop of the drawings situated within the 3D space.
For more documentation follow: **<https://portfolio.matthewattard.com/eye-tracking-drawing-my-room/>**.

viewpoints', for example by focusing on: my hand (see p.106); my plant; my desk; my desk lamp; and my eye's live-feed (Figure 1) among other things. Spending so much time indoors I aimed at exploring the interior spaces as part of this research and eye-tracking induced a hyperattention towards the things that surrounded my environment, as the practice percolated into mundane experiences.

With limited human contact possible, nonhumans within my home environment acquired prominence. I found myself becoming fascinated by things which usually resided in my perceptual background; the shape of my bed, the orientation of my desk, the design shaping my laptop, and others. Figure 18 is a drawing outcome that was compiled out of different individual exercises, and visually summarises such influences acting on the drawing practice.

During this period, the apartment in which I had been living in for a year opened up to a world of new interactions, discoveries and human-thing experiences that could be explored as a CADP with eye-tracking technology. It is in this context that elements of the mundane started to prevail and influence the practice of drawing-with eye-tracking technology.

Describing the nonhuman

I feel it is important to briefly contextualise the acquired perspective towards

adopting the term ‘human-thing relations.’ OOO draws from ANT when authors like Harman (2017) specifically describe how: “All objects must be given equal attention, whether they be human, non-human, natural, cultural, real or fictional” (p.9). This perspective implies that the nonhuman things/objects constituting the drawing exploration of this ABR – hardware, software, concepts, contexts, drawing, lamp, COVID-19 restrictions, and myself among others – necessitate the same attention. Morton (2013) expanded on OOO by coining the term ‘hyperobjects’: “things that are massively distributed in time and space relative to humans” (p.1), which can range from planets to yesterday’s raindrops. His extended ontology of the nonhuman falls outside the interest of this dissertation, but it is useful to note that the term ‘things’ is an unavoidable vocabulary.

The philosophical definition of the nonhuman as ‘things’ has a long history and is not solely attached to an OOO or ANT understanding of the world. It is for example reminiscent of authors such as philosopher and political theorist Jane Bennett (2010), who investigates a political ecology of things as vibrant matter in order to explore the potentiality of inanimate objects. ‘Things’ is also the favoured term by Wakkary (2021) in his posthumanist investigation of *designing-with* nonhumans, where he critically explored the power of things via their transformative, nomadic, interconnected, agentic, bidirectional, and performative capacities. He specifically stated that the term things “offers a pluralistic role of encapsulating various abstractions, politics, and embodied particulars” (*Ibid*., p.29). This resonates with

women studies scholar Katie King's (2011, p.7) remark about how the etymology of the term "stresses that things are processes as well as subjects and objects, that they are simultaneously the location for dispute and the subjects of dispute as well as the outcomes of dispute". Such theorisations hint at how things have the capacity to contribute towards processes, which deeply affected the attention given to things determining the contexts of the exploration of this CADP.

Furthermore, the historical connotations of the term 'things' had fuelled the phenomenological way of thinking through the notion of seeing the thing-in-itself, firstly introduced by philosopher Immanuel Kant (1783, p.38), and later expanded-upon by philosophers Edmund Husserl (1859-1938), Martin Heidegger (1889-1976) and Maurice Merleau-Ponty (1908-1961) respectively. Due to the latter, authors like Bogost (2012, pp.23-24) argued (under the hat of OOO) that both the terms 'objects' and 'things' can be problematic as "an *object* implies a *subject*, and the marriage of subject and object sits at the heart of correlationism", while he read 'things' as having a troubled history of human-centred connotations. He thus replaced both with the term 'units', affirming that it is "an ambivalent term, indifferent to the nature of what it names" (*Ibid*., p.25).

I do agree that the term 'things' can resonate with human-centred connotations, and it is specifically because of this element of anthropomorphism that I am discussing the term. As Bennet suggested, anthropomorphic perspectives can themselves serve as a

good strategy to oppose anthropocentric views. This counters the general tendency (like Bogost's view) that anthropomorphism almost instinctively refers to anthropocentrism. Bennet coined the term "vital materialists"[21] when referring to anyone finding themselves captivated by the "material vitality" of things, that can lead us "to treat nonhumans … more carefully, more strategically, more ecologically" (2010, pp.17-18). I see this as a strong point in aid of the alignment towards a more than human-centred perspective, and by adapting Bennett's observation to this ABR, I acknowledge how I took the stance of a "vital materialist" whenever I found myself fiddling with the eye-tracker's cameras with an element of fascination and obsession; or whenever I was captivated by the things in the apartment for the purpose of eye-tracking drawing them. Bennett would describe this initiation as a "capacity for naiveté" (*Ibid*., p.18), a notion that informed this ABR as I adopted and developed similar positions towards the technology and the things surrounding my practice. I am postulating eye-tracking technology and all the things involved in the expansive practical exploration as co-constituents to this ABR, and thus, things/technology are not being posited as unresponsive units controlled by human intention. They also carry a history of anthropomorphic vocabulary that should not be ignored: the camera *sees*, the computer *runs*/*sleeps*, and the algorithm *interprets/calculates*. In this view, my embodied relationship with the technology grew to the extent that I metaphorically 'conversed' and 'thought' with the technology as a drawing practice

[21] Braidotti (2022, p.219) also regards Posthuman Critical theory as vital materialism, specifically through the conceptualisation of nonhuman agents. However, Bennett's vital materialism does not form part of Posthumanism, but it is still a theorisation considered to oppose humanist and anthropocentric tendencies (for example, see Susen 2022, p.65).

and this anthropomorphising perspective aided the horizontal positing of the human-thing relations.

Hayles (2005) had suggested a valid perspective on the reciprocal effects of anthropomorphising nonhuman things when she specifically discussed virtual [digital] entities. She claimed: “two processes are at work simultaneously: on the one hand, humans anthropomorphize the virtual creatures; and on the other hand, the virtual creatures computationalize the humans” (p.204). She noted that her choice of the word ‘computationalize’ emerged from a lack of a better term [at the time] (*Ibid.* 2005, p.201). When contextualising Hayles’ suggestion within this ABR, I see how the verb ‘computationalise’ can be better defined by a ‘process of datafication’[22]. For example, I anthropomorphised the eye-tracking device both in practice and theory, while in turn, the technology datafied my actions. However, the techno-human relations of this ABR are not solely tied to a process of datafication, but also to how the nonhuman affected and effected the development of eye-tracking as a CADP. In short, the nonhuman co-constituted the practice by performing through the techno-human assemblage and relational contexts; and the following anecdote will attempt to reassemble such active relational influences.

[22] Datafication is a term introduced in 2013 referring to how most actions in today’s world are treated as data (see Cukier and Mayer-Schoenberger 2013).

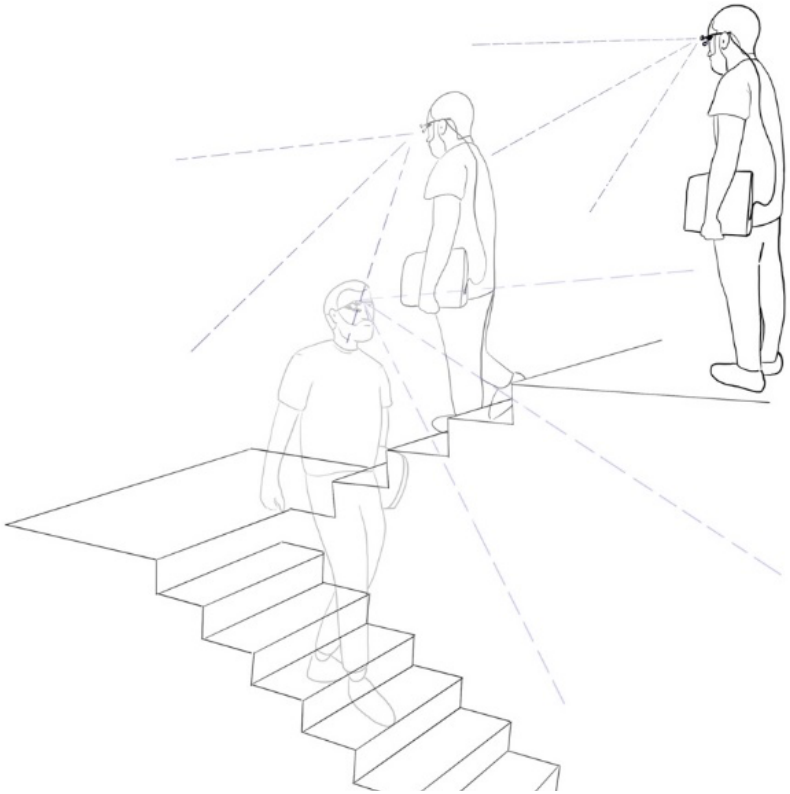


Figure 19: An illustration of the practice of drawing-with the eye-tracker while going up or down a staircase. Illustration is my own.

3.2 Eye-tracking drawing the mundane

Eye-tracking drawing while going up or down the stairs

Figure 19 is a diagram illustrating the activity of drawing-with eye-tracking technology while going up or down the stairs leading to my apartment, which was situated on the 2nd floor of an Edinburgh tenement block. The accompanying practice research portfolio includes a selection of other eye-tracking drawing exercises that stemmed out of mundane experiences, such as cooking or brushing my teeth (see <**https://portfolio.matthewattard.com/**>). Such exercises were repeatedly explored at this stage of research, and they started to bridge experiences of eye-tracking drawing with the mundane via the techno-human hybridity. The first time the staircase drawing exercise was tested, it occurred in the following manner.

I was returning home from the grocery store, when while climbing up the stairs I was thinking about the practice research. The previous day I had tried to draw-with the eye-tracker while walking across the apartment's corridor: a short-lived exercise as something had gone wrong in the data-capturing process. The blank results were on my mind, as I still did not know what had led to the technological error. I thought that it would be best to reattempt the drawing exercise, and while I was still going up the staircase, I muttered: "This can actually be something interesting to try". I therefore left my groceries in the kitchen and powered-on my laptop. I made sure the laptop's

Figure 20: A screenshot from Rhino 3D's viewport while developing the eye-tracked data in the form of a point cloud (in red) into a drawing (black lines) using *Grasshopper*.

configuration of going into sleep-mode when closing the lid was turned off and plugged-in the Pupil Capture monocular eye-tracker. I defaulted most of the eye-tracker's settings to auto – "It will figure it out", I thought – and wore the eye-tracker for calibration. I closed the laptop lid, held it beneath my left arm, and headed for the doorway.

I started going up and down the stairs as I attempted to draw the activity with my eyes with the technology. This resulted in an obscuring of natural and unnatural processes – for example my natural way of gazing while climbing the stairs blurred into moments where I subverted my natural gaze trajectory with the intent of drawing with my eye movements. The technology was also out of its optimal environment for a best performance. For example, as it was not being used in its ideal stationary scenario, the light changed drastically and continuously along the staircase. I was also holding my laptop vertically with its lid closed, hoping that the technology was still communicating and processing. Once back at the apartment, I checked that Pupil Capture did in fact hold some data and I was glad to save it on my laptop as folder 'drawing_staircase_1'.

A few days later, I exported the eye-tracking data as a .csv format, which was imported as a point-cloud within Rhino 3D using Grasshopper. Through the latter I processed the computation to generate a polyline across the data-points (Figure 20), a

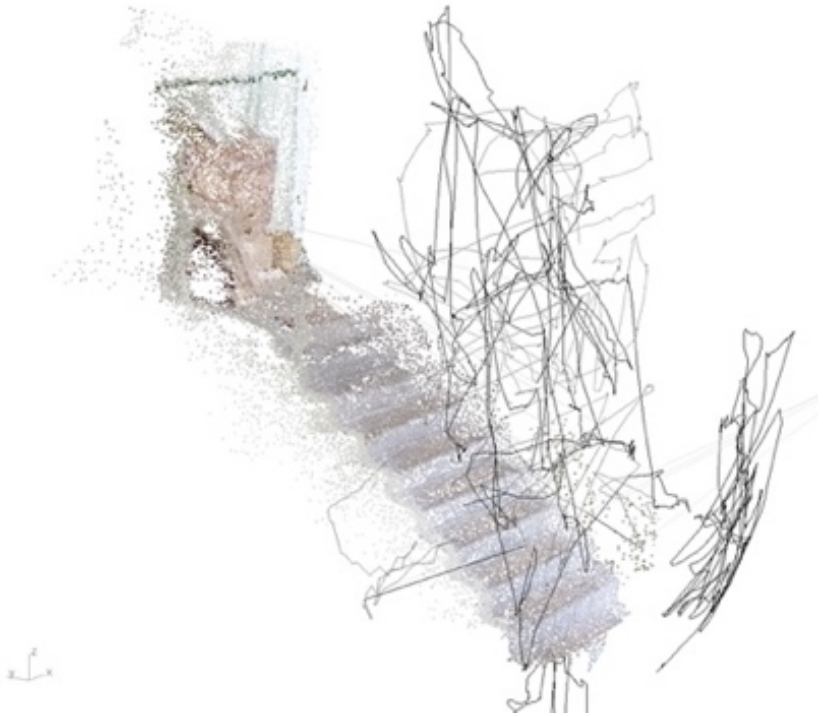


Figure 21: *(Top)* Resulting eye-tracking drawings made while going up and down the staircase superimposing a 'rough' 3D scan of the interior space. Drawing executed by Matthew Attard and Pupil Core. 3D scan executed by3Dim Capture. Postprocessing made by Matthew Attard, personal computer, Pupil Player, Excel, Rhino 3D and its Grasshopper extension. Made throughout December 2020 – February 2021.
(Bottom) A QR-code that leads to a rotating video loop of the drawings in a 3D environment.
For more documentation follow: **<https://portfolio.matthewattard.com/doodling-with-the-eye-tracker-5/>**

process that transformed the data-points into a three-dimensional digital drawing[23]*. As I interacted with the drawings in the bare digital space of Rhino 3D's viewport, it occurred to me that I should try situating them within a more representative aesthetic context.*

Navigating the 3D space with my mouse reminded me of a website that I had recently come across during one of the frequent moments of wandering while surfing the internet, that specifically consisted in an interactive 'virtual museum' of 3D-scanned underwater heritage sites surrounding the Maltese islands (VM 2020). I did not have a 3D scanner, but I did have the technology to improvise one. I googled for apps that turned one's mobile phone camera into a 3D scanner, and downloaded the app '3Dim Capture' (3Dim 2020)[24]*. I rushed to the staircase and performed multiple rough scans of the interior space with my mobile phone using the app. These were exported as a point-cloud and eventually added as a digital layer representative of context to the digital eye-tracking drawings (Figure 21).*

3.2.1 The techno-human assemblage

The above anecdote suggests a techno-human way of exploring a drawing process that originated from digital processes and seeped into mundane routines. It illustrates

[23] For an outline of the general eye-tracking drawing process, see p.104.
[24] The '3Dim Capture' app is not available for download anymore.

how the interdisciplinary intersection brought forward by the artistic and technological dialogue of this ABR is multi-layered, and I will for now direct the attention of its narrative towards aspects that characterise the techno-human assemblage. Describing an assemblage can recall a Deleuezian philosophy, especially in view of the statement of how; "the assemblage's only unity is that of a co-functioning: it is a symbiosis, a 'sympathy'. It is never filiations which are important, but alliances, alloys; these are not successions, lines of descent, but contagions, epidemics, the wind" (Deleuze and Parnet 2007, p.69). *Co-functioning* and *alliance* are both terms that this ABR can 'borrow'. I am in alliance with the technology and the things constituting mundane experiences to co-function towards an explorative drawing practice. In other words, the practice research is co-shaped by the hybridity of the techno-human assembly. I am here again appropriating the term 'co-shape' from Wakkary (2021), who analysed how: "Technologies co-shape how humans are present in the world and perceive the world" (p.115). Through the postphenomenology scholarship of Rosenberger and Verbeek (2015), Wakkary highlights how technologies shape the subjectivity of the human and the objectivity of their environments. For example, climbing equipment (technology) transforms the human into a climber, and the mountain becomes scalable[25] (Wakkary 2021, p.115).

Similarly, it can be observed how the eye-tracking device transformed my (human) eye movements into data and going up the staircase became a 'drawable' action with

[25] Such transformations can also be argued to carry notions of cyborg, which will be discussed in p.83.

the eyes and technology; co-shaping an alternative practice to conventional drawing. However, the technology was also being used outside the parameters of its scientific methodology. It is not a technological device that has been developed as a tool for drawing and its adaptation towards a CADP influenced the exploration in creative ways. This scenario might be loosely comparable to how a dancer might wear climbing equipment for a creative choreography instead of for mountain climbing.

This posits a type of co-functioning, but it does not present itself without challenges. Techno-human assemblages also result in friction, faults, misinterpretations, and reinterpretations. In his introduction conceptualising the meaning of assemblage, philosopher Manuel DeLanda (2016) flagged a terminological problem. He illustrated how the French term 'agencement'[26] refers both "to the action of matching or fitting together a set of components (*agencer*), as well as to the result of such an action: an ensemble of parts that mesh together well" (*Ibid*., p.1). In contrast, the English translation 'assemblage' tends to only portray the latter of the two, "creating the impression that the concept refers to a product not a process" (*Ibid*., p.2). The techno-human assemblage of this ABR concerns in fact both an exploratory process and its outcome as artistic drawings; but also, terminology and multiple descriptions are not the only possible cause of friction.

[26] DeLanda looks at the French term as being the original term when discussing *assemblage* theory, after French philosophers Gilles Deleuze and Félix Guattari. His book goes on to give an extensive reading and interpretation of the several definitions of *assemblage* given by the two French philosophers (DeLanda 2016).

Dominance is another challenge in contexts such as the one described by Wakkary (2021), when to illustrate how assemblages are not necessarily evenly balanced, he wrote: “It is clear that at the intersection, the driver-car is the dominant human-thing and that all other thing assemblies are designed around this dominance” (p.126). By ascribing this analogy to the staircase eye-tracking drawing exercise, one can read myself and the eye-tracker as the dominant human-thing in the staircase. However, within the experimental nature of the assemblage of this ABR, dominance was not such a fixed variable. Processes flattened the idea of dominance through a fluctuation resulting from the receptivity of contexts and things. For example, the natural gaze trajectory of going up the staircase oscillated with the intention of gazing as a drawing practice, that was in turn interpreted by the technology and influenced by the vital materiality of the context in relational ways.

In my view, such reflections about the techno-human assemblage and human-thing relations call for a closer attention to hybrid notions that can be drawn out of aspects of cyborg. I am aware that some scholars might argue this to be outdated terminology, but I feel that there are valuable elements of the cyborg that have the capacity to contribute towards a better understanding of the hybrid notions of the techno-human relations of this practice research.

3.3 The cyborg

When discussing the hybrid aspects of a cyborg, Donna Haraway's *The Cyborg Manifesto* (1990) is an inevitable starting point due to its distinctive observations differing from most interpretations of cyborg. Its underlying critical notions and its way of resisting any type of classification into a specific category was, and can still be considered ground-breaking, remaining highly influential across multiple disciplines. Critical theorist, Cary Wolfe, described it as a "mash-up of science, technoculture, science fiction, philosophy, socialist-feminist politics, and theory" (Haraway and Wolfe 2016, p.viii). Haraway herself emphasised this multi-perspective attitude when stating that she was writing the Manifesto as "a feminist, a Marxist, a biologist, a teacher, a friend, whatever, at a certain historical moment" (*Ibid*., p.206). The historical moment of writing was the late 20th century, cited at the start of the Manifesto as: "a mythic time, [in which] we are all chimeras, theorized and fabricated hybrids of machine and organism; in short, we are cyborgs. The cyborg is our ontology; it gives us our politics" (Haraway 1990, p.150). Through this attitude the Manifesto stirred both extensive controversy and appreciation, this became a ubiquitously-cited work of contemporary literature across disciplines. One reason for the latter is how the writing rejected both an anti-technological view, as well as a techno-deterministic one. Haraway claimed: "My cyborg would have none of that [anti-science-and-technology stance], but it also refused to be a blissed-out technobunny" (Haraway and Wolfe 2016, p.211). I find this attitude to be utterly

influential, still resonating to the present day when reflecting on contemporary technologies; and has informed the perspective and been embedded within the exploration of this ABR.

Haraway clearly stated in the Manifesto's introduction how the cyborg is a "cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction" (Haraway 1990, p.149). In one way, this is a description relating to the etymology of the term itself (see p.91) and yet, not something to be solely interpreted as a machinic entity. Haraway recently reaffirmed in an interview with sociologist Sarah Franklin (2017) that she has always defined the cyborg "in terms of specific historicities, it's not a synonym for machine. 'Cyborg' is not a synonym for robot" (p.53). This particular perspective – or multi-perspective – of a cyborg, is important to highlight in the context of this ABR: precisely due to the blurring of the boundaries presented by the relational nature of things and the technology. In her analysis of the Manifesto, Braidotti (2006) described the cyborg as "a connection-making entity; a figure of interrelationality, receptivity and global communication that deliberately blurs categorical distinctions (human/machine; nature/culture; male/female; oedipal/non-oedipal)", while also suggesting how "We need new forms of literacy to decode today's world" (p.200). 'Today's world' in Braidotti's observation referred to more than a decade and a half ago, which in view of a discussion about contemporary technology can be quite a stretch of time. However, in many respects the analysis is still more than valid for a current time

where our techno-human interactions became evermore present in our daily/mundane living. The hybrid blurring of categorical distinctions sits at the heart of this exploratory ABR – for example, looking, data, walking, other things and mundane experiences, blurred via eye-tracking drawing. In other words, while going up or down the staircase, my understanding of the underlying cyborgian aspects did not merely lie within the networked assemblies between myself and the technology but expanded throughout the techno-human relations of the exploratory artistic practice. The experience of this resonated ways of creating new methods of drawing-with eye-tracking technology.

Haraway conceptualised the cyborg as a figuration, rightly claiming that it was a recent one. “I think the cyborg story is a fairly historically limited one, and it’s not all human-machine joinings”, is what she stated in an interview with sociologist Nicholas Gane (2006, p.147). Haraway also mentioned on different occasions how the figuration of a cyborg is metaphorically the descendant of the Bell telephone company, as well as McNamara’s electronic battlefield (Franklin 2017, p.53; Haraway and Wolfe 2016, p.205; Gane 2006, p.147). Haraway (1990, p.151) foresaw the main trouble of cyborgs as being: “the illegitimate offspring of militarism and patriarchal capitalism, not to mention state socialism. But illegitimate offspring are often exceedingly unfaithful to their origins”. I would like to draw a parallel with how drawing-with the eye-tracker can be interpreted as an illegitimate offspring of Haraway’s understanding of cyborg. Apart from being a scientific methodology, the

digital eye-tracker is today entangled in a capitalist manifesto, for example via its adaptation by marketing research that monetises eye movement data (see pp.61;147). Embodying eye-tracking technology as 'an illegitimate offspring' via artistic experimentation can be posited as a way of being 'unfaithful' to the recent entanglement of the technology with a capitalist strategy, by venturing into different critical capacities as developed by this ABR. My embodiment of eye-tracking technology in this sense eventually became a matter of doing critique, and this insight will be outlined in chapter 5.

Throughout her career, Haraway moved away from the cyborg and explored the figuration of *companion species*; nonetheless, always considering both as being of "the same litter" (see Haraway and Wolfe 2016, p.254). In her reading of the Manifesto, Hayles (2006) shifted the attention from *cyborg* to *cognisphere*; the latter being a term coined in view of the contemporary global phenomenon where "human awareness comprises the tip of a huge pyramid of data flows, most of which occur between machines" (p.161). In her view, "The cognisphere takes up where the cyborg left off" (*Ibid*., p.165). My understanding is that the phenomenon of Hayles' cognisphere expanded drastically throughout the past years, perhaps even at unpredictable scales with the advance in connectivity, due to advents like social media, apps, geo-locations, big data, and the incremental increase of the datafication of mundane actions. Essentially, we welcomed the virtual/digital as a major component in our material lives, so much so that scholars like literary critic Steven

Mentor (2011) also theorise us as having become *mundane cyborgs*. In this view, the eye-tracking drawing staircase exercise can be conceptually seen as a mundane cyborg experience, not only because of the techno-human technical and physical alliance to a mundane action, but also because of how the experience contributed to a co-evolution as a CADP. In her introduction of posthuman theory, Hayles had formulated the following: "'What we make' and 'what (we think) we are' coevolve together" (2005, p.243; 2006, p.164). Thus, we are a matter of emergence: technologies mutually co-make and co-evolve with us both physically and conceptually. Hayles formulated this in view of how humans have always been entangled in a co-evolutionary spiral with technology, and the entanglement encapsulates tool usage, bipedalism, our brain's evolution, cultures, and practices (Hayles 2006, p.164). I see this resonating with Wakkary's (2021) observation that "technological mediation as a form of intentionality is co-constitutive, meaning that the human entanglement with technology is a mutual becoming, in which humans and technologies influence what each other becomes" (p.115). This converges with Haraway's statement that: "There is no becoming, there is only becoming-with"[27] (Haraway and Wolfe 2016, p.221). By informing my research with such theories of mutual techno-human hybridity, eye-tracking technology was not merely regarded as a tool for human dominance and this devised the conceptual aspects of drawing-with eye-tracking technology.

[27] Wakkary (2021) also refers to Haraway's notion of "becoming-with" in his conception of designing-with.

3.4 Mutual co-evolution with tools/technology

Haraway repeatedly showed us that defining cyborg notions solely through a human-machine perspective is a limiting one. In this view, her concluding Manifesto statement expanded on our wider nature by stating: “The machine is us, our processes, an aspect of our embodiment. We can be responsible for machines; they do not dominate or threaten us. We are responsible for boundaries; we are they” (Haraway 1990, p.180). The statement is constructed through layers of metaphor, and yet, it is also a critique. If we were to assimilate “the machine” with an expanded view of technology, we quickly come to terms with our nature of being: the “machine” is us because our nature is cyborgian – even though the conceptualisation of cyborg is a fairly recent one. This is where the cyborg goes beyond its etymological origins.

The term cyborg can recall a technological understanding of the late 20th century, but its philosophical, physiological, and psychological roots can extend as far as our human evolution goes. As a term, ‘cyborg’ was historically coined by scientist Manfred Clynes in 1960, through the merging of the first letters stemming out of cybernetic organism. Since then, a group of scholars have attempted to outline a field of ‘cyborgology’, specifically through the publishing of *The Cyborg Handbook* (1995). Nevertheless, most of the argumentation leaves us to think how there cannot be one definition of cyborg, as also evidenced by Haraway’s figuration. The etymology of the term is thus a technical and a post-war one, but it is important to highlight how the

notion of the cyborg extends throughout the nature of our being in the world: both in terms of *fiction* and *nonfiction*. Notions of cyborg can be found deep within our imagination as illustrated by the extensive creations of hybrid beings: from mythological ones to cultural imaginings, such as Mary Shelley's *Frankenstein* (1818). Our nature has always been cyborgian as we both transformed the world and transformed-with the world: as evidenced by my current reading glasses. When coining the term, Clynes himself stated, "*Homo sapiens*, when he (sic.) puts on a pair of glasses, has already changed" (Clynes and Gray 1995, p.49). This change is essentially the outcome of the mutual techno-human transformative capabilities.

I would like to further elaborate on the notion of tools as technology, that can be loosely described as things we make to mutually make things. Within this dissertation, the term 'technology' has been so far mostly used in relation to digital things (such as the eye-tracker or my laptop), but for the following discussion it will be used to refer to a much broader spectrum; akin to philosopher of science and technology Don Ihde's "material culture", that regards all kinds of tools as technology. In 1990, Ihde had metaphorically dealt with the question of tools as technology by expanding on cultural aspects; for example, by discussing the assumed difficulty of an Adam and Eve surviving in a non-technological Garden of Eden (pp.11-20). The choice of analogy reflected Ihde's theological background, but the aim of his fictional scenario lay within the evidencing of the point that without the broadest understanding of technology (material culture) the alleged first couple could only survive in optimal conditions that

would not necessitate for storage technologies, hunting technologies, and cooking technologies among others (*Ibid*., p.13). Thus, in a non-technological environment our existence becomes very limited, and our experiences become confined within a strict set of parameters.

By aligning this observation to a mutual techno-human co-shaping of our environment, the concept can direct us towards the question asked by cognitive philosophers Andy Clark and David Chalmers (1998): "Where does the mind stop and the world begin?". Their paper developed into the cognitive philosophy of the *extended mind*; a notion that broke the body-mind cognitive boundaries within techno-social environments. Thus, in this view, the extended mind concept can be situated in relation to the posthuman challenging of anthropocentric methods. In their original paper, Clark and Chalmers design a widely cited comparison between two anecdotes: i) that of Inga, who walked to the Museum of Modern Art (MOMA) after recalling that it is on 53rd Street from her memory, and ii) that of Otto, who was an Alzheimer patient and accessed the information that MOMA is on 53rd Street through his notebook and not his biological memory (Clark and Chalmers 1998). The ultimate claim of this comparison lay within the notion of how "Otto *himself* is best regarded as an extended system, a coupling of biological organism and external resources" (*Ibid*.). In the context of this narrative, Otto evidences a cyborgian-nature through the use of his notebook (technology). Therefore, just like Ihde's non-technological garden, without the notebook as an extended way of thinking Otto's

human-world relations would become extremely limited. I see Otto's notebook as a technology co-constituting his mundane experiences; broadly similar to the positing of the technology (and things) as co-constituents to the practice of drawing-with eye-tracking technology.

Otto's notebook is of course a very different technology from the eye-tracker, but the aim of Otto's mention in this context is not to compare the technologies. My aim is to trace a conceptual affinity in the transformative extended capabilities of the techno-human relations that shaped this ABR. It might be here worth mentioning how in his postphenomenological account of looking through a panoramic view from the window of a skyscraper, and by reading the glass window as an optical technology, Ihde (1999, p.47) formalized the *human-window-world* relations as the following diagram:

(I-window)-world

"(I-window)" can be interpreted as, (human-technology/tool) or (human-thing), where both the human and the technology mutually transform each other in relation to the world; and vice-versa. This diagram can be adapted to inform the practice of drawing-with eye-tracking technology. However, to eliminate the risk of creating an

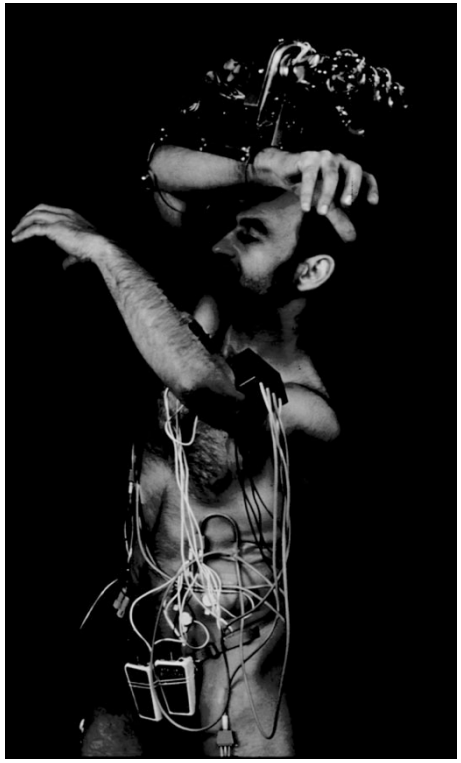
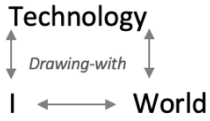


Figure 22: Photo of Stelarc and *The Third Hand* in Japan. Stelarc completed *The Third Hand* in 1980 and made several performances with it throughout the last two decades of the century. Photo by S. Hunter and retrieved from the publication: Stelarc 2018, p. 64.

unnecessary boundary between *I-technology* and *world*, I am positing the shorthand diagram in the context of this ABR as:



In this way, the relational boundaries between *I-technology, technology-world and I-world*, in view of the *drawing-with* aspects of the research are blurred and the hybrid nature is better illustrated. The transformative capabilities of all participants mutually relate to each other and co-constitute the practice. *I*, *Technology* and *World* are conceptual variables in their own right, but also join as a hybrid assemblage co-shaping the exploration of the drawing practice.

The entanglement of the techno-human embodied relations can here benefit from the mention of an artistic performance. On multiple occasions, Clark (2008, p.33; 2004, p.119) used the example of *The Third Hand* by performance artist Stelarc to describe the notion of “transparent equipment” in view of the flexible adaptability of our bodies and minds within specific environments. *The Third Hand* consists in a prosthetic device that Stelarc attached to his right arm and controlled through the transmitted signals via the electrodes positioned on his leg and abdomen muscles (Figure 22). Stelarc’s interest in exploiting our cyborgian nature came forward in his description of the body as an “evolutionary architecture that operates and becomes

aware in the world. To alter its architecture is to adjust its awareness. The body has always been a prosthetic body, one augmented by its instruments and machines" (Stelarc 2018, p.59). This resonates with Clark's interest in the electronic hand's performance, who applied it in his defence of the notion of the extended mind. Clark (2008, p.33) expanded upon Stelarc's claim that after some practice, he did not feel the need to control the electronic hand anymore, as it eventually started to "function much as his biological hands and arms, serving his goals without (generally) being itself an object of conscious thought or effortful control".

There are here multi-layered considerations to be extracted in view of this practice research. I read Stelarc's perspective of his cyborgian performances as akin to a desire for enhancement by controlling the technological body extension. His interest lies in augmenting the body's architecture by transforming its awareness via the technology. In view of drawing-with eye-tracking technology, his comment sparked in me the question of whether during my eye-tracking drawing exercises, the aim behind the adaptation of the technology as a 'prosthesis' was to augment my way of drawing. After some thought, I concluded that my answer is negative. While I agree that eye-tracking technology can be posited as a prosthetic device of my body's architecture, reading the prosthesis as primarily augmenting my capabilities as artistic research would greatly contrast with the notion of it co-constituting the drawing practice. The underlying aims driving this practice research are not embedded within the idea of 'augmenting' a way of drawing or doing. As stated by anthropologist Aaron Parkhurst

(2012, p.70) the regard of cyborgian enhancements as “superhuman” inform much of the discourse surrounding transhumanism; and thus, the notion of an ‘upgrade’ recalls an anthropocentric vertical positioning. Parkhurst’s claim aligns with the posthuman critique towards transhumanism (see p.15), and I would therefore rather postulate the cyborgian aspects of this practice research as a kind of renewal of the exploratory techno-human relations. Essentially, I neither drew-with eye-tracking technology while going up the stairs (Figure 19) to augment a way of drawing nor a way of climbing the stairs, but drew-with the technology as a result of how mundane actions, things and technology mutually co-shaped a CADP. Instead of ‘augmentation’, convergence (a term that is frequently used by Braidotti 2019) would therefore be better-fitting in the description of the underlying techno-human relations of this PhD.

Reiterating the essence of this chapter so far, it has been theorised how the blurring of the boundaries between the techno-human-world relations concern a mutual transformation via the co-shaping of the CADP. The outlined hybrid characteristics can be regarded as a convergence that specifically occurred because of how the explored methods of this ABR arose and developed from the things and the processes of the practice itself, alongside the contextual and critical research. In this view, the narrative can here benefit from an analysis of Clark’s understanding of “transparent equipment”.

How transparent can the equipment be?

Clark (2008, p.10) elaborated on this notion by building upon the ubiquitously cited Heideggerian example of how the skilled carpenter “sees through” the hammer while hammering. Heidegger affirmed that: “the less we just stare at the hammer-Thing […] the more primordial does our relationship to it become, and the more unwieldly is it encountered as that which it is – as equipment” (1962, p.98). The Heideggerian “equipment” is therefore synonym with tools as technology, and seeing the “hammer-Thing” as “equipment” is what he referred to as being “ready-to-hand” (*Ibid*., p.98). Appropriating a Heideggerian understanding to the technology of this ABR would posit that I drew with my eyes by “seeing through” the equipment, rendering it invisible/transparent. I argue that drawing-with eye-tracking technology differed from the Heideggerian “seeing through” discourse for two reasons. Describing the technology as “transparent equipment” would imply that it receded into the background, and this contrasts with the horizontality posited by the conceptualisation of the drawing-with methodology. Also, even though it is true that the more I practiced with the technology, the more accustomed to it I became, I claim that postulating the technology as co-constituent to the open-ended nature of drawing practice itself kept pushing these boundaries into uncharted territories that kept the technology in a position reciprocal to mine: horizontality.

Another way of analysing the notion of technological transparency can be through the work of Merleau-Ponty's ubiquitously cited phenomenological anecdote of the blind man's cane. He stated that the latter "ceased to be an object for him [the blind man], it is no longer perceived for itself; rather, the cane's furthest point is transformed into a sensitive zone, it increases the scope and the radius of the act of touching and has become analogous to a gaze" (1945, p.144). In other words, through the embodiment of the cane, the cane transforms into a 'prosthetic' (an appendage to the body) while the blind man mutually transforms his body architecture, and senses the surroundings. In Clark's words, there are "two key interfaces at play: the place where the stick meets the hand and the place where the extended 'biological agent + stick' meets the rest of the world" (2008, p.31). Through this notion, the tool eventually fades its material presence becoming an extension of the body. This episode has been widely interpreted through a similar discourse as the following: "When being used, the technology "withdraws," and slips silently into the background" (Adams and Thompson 2016, p.60). Other case-studies that are usually used to give this reading include the activities of driving a car or riding a bicycle. The general assumption is that like when hammering, the moment a skill-level is attained, the technology (be it a hammer or a car) withdraws in a Heideggerian sense.

Ihde referred to the Heideggerian withdrawal as the "doubled desire that, on one side, is a wish for total transparency, total embodiment, for the technology to truly 'become me'" (1999, p.75), a notion which Ihde later challenged and deromanticized

through his postphenomenological account as follows. Ihde saw a binarism in the Heideggerian claim by stating that the desire for transparency "both secretly rejects what technologies are and overlook the transformational effects which are necessarily tied to human-technology relations" (*Ibid*.). The accent here is on the mutual transformational qualities of the techno-human relations, and thus, Ihde presented this not as a full withdrawal of the technology but as a "quasi-transparency", also implying the important notion that "In that sense, all technologies in use are non-neutral" (*Ibid*.)[28].

Ihde's perspective resonates far better with the practice research than the notion of a total withdrawal of the technology, and I see it echoing posthuman scholarship. For example, Wakkary (2021) postulated such transformations via the following:

> Firstly, things transform human actions and perceptions, ... In reality, this characteristic extends to all actions and perceptions that constitute us as human animals. Secondly, and in ways that underscore the pervasive and central role of the transformative characteristic, things are *commensurate* with *being* human. Things shape humans and vice versa, such that things influence who we become as human animals.
>
> (p.132)

[28] Ihde further expanded on his critique of Heidegger's philosophy of tools in his book *Heidegger's Technologies* (2010).

By aligning to Wakkary's theorisation of things, I take it that the "quasi-transparency" of eye-tracking technology can be read as a major transformation in the entanglement of the techno-human relations co-shaping one another as a CADP. Commensurate is also an important choice of words by Wakkary, as it further enhances the mutual transformative relations between humans and things. This can bring us to a realisation that in the general utilisation of eye-tracking technology fields like science, marketing or gaming opt for a total transparency of the equipment in an attempt to 'neutralise' its presence and adopt the general tendency for the technology to become ever more 'invisible'. On the other hand, this ABR attempted to postulate the equipment from my same 'foreground', keeping it 'visible' via the positing of its commensurate contribution to the exploration of the techno-human drawing process that is conceptually relational and expansive.

4. CO-DRAWING

The aim of this chapter is to outline the contribution of this ABR as a CADP co-shaped with digital technology – without attempting a definition of contemporary drawing. A definition would risk the involvement of bold statements, and as artist and author Deanna Petherbridge[29] has posited, these suffocate drawing "into a formula" (2008, p.28). The open-ended nature of drawing practice requires disclosure; it ambivalently oscillates between being a verb (its process) and a noun (its outcome). This CADP evolved via the open-endedness of drawing, and the discussions within this chapter will focus on the questions, provocations, and reflections brought forward by the transformative aspects of digital eye-tracking technology. Drawing practice is today an established field, contrary to the historical assumption of it being secondary to other artistic major disciplines such as painting and sculpture. Over the course of the centuries, drawing practice started to attain a status of being seen as valuable in and for itself and contemporary drawing is today an autonomous artistic practice[30]; albeit consisting of an evolving complex of practices that comprise of artistic training, theory, modes of presentation/exhibiting, institutional frameworks, and academic scholarships among others.

[29] Petherbridge (2010) is author of the major study on drawing as an art form, *The Primacy of Drawing: Histories and Theories of Practice*, which is a seminal work comprising of a thorough investigation about the significance of drawing in the visual arts, highlighting its multi-modal nature.
[30] Some recent essays have also expanded on this as a field of *Drawing Studies*, specifically as theorised by professor of drawing and design Eduardo Côrte-Real (2021).

CADP was a major force in the emergence of drawing as an independent practice and still forges its paths. Several textbooks, catalogues, exhibitions, dissertations, and peer-reviewed journals have affirmed this, and are instrumental for the rather recent shift in attitude towards drawing. For example, the first lengthy companion to the field, *A Companion to Contemporary Drawing* edited by artists and writers Kelly Chorpening and Rebecca Fortnum in 2020, was published during this research. In their introduction, the editors render homage to several other publications that have informed the compilation of the companion (*Ibid*., p.2). These have equally informed my practice research, namely: *On Line: Drawing Through the Twentieth Century*, 2010, by curators Cornelia Butler and Catherine de Zegher; *The Primacy of Drawing: Histories and Theories of Practice*, 2010, by author and artist Deanna Petherbridge; and Katharine Stout's *Contemporary Drawing: From the 1960s to Now*, 2014. I would also include the following: the peer-reviewed online journal TRACEY, including their three publications (2007; 2012; 2015); the peer-reviewed journal *Drawing: Research, Theory, Practice* published by *Intellect*; artist and author John Berger's *On Drawing* from 2005; the exhibition catalogue *The Stage of Drawing* from 2003; and the exhibition catalogue *The End of the Line: Attitudes in Drawing* from 2009, together with other literature sources that will feature intext within this chapter. I also paid close attention to the activity and resources promoted by the *Drawing Center* in New York (inaugurated 1975) and *Drawing Room* in London (inaugurated 2002).

Figure 23: Rebecca Horn, *Pencil Mask*, 1972. Fabric, pencils, metal. Documentation image of Rebecca Horn's drawing performance wearing the *Pencil Mask*. Retrieved from: Tate 2004.

Drawing as an independent practice

The influential exhibition *Drawing Now* curated by art historian Bernice Rose (1976) at the Museum of Modern Art (MOMA) in New York was an important manifestation of the shift in attitude towards drawing, followed by another show at MOMA fifteen years later; *Allegories of Modernism, Contemporary Drawing* (Rose 1992). Such shows encapsulated how in the 20th century; drawing became the main exploratory practice for a number of artists. Additionally, the 1976 exhibition presented a departure from the traditional 'autographic' association of drawing, and according to artist and academic Juliet MacDonald (2016) this outlined how: "The artist's hand could play only a minor instrumental role in such production". MacDonald was referring to how contemporary drawing brought with it a level of disembodiment from the hand[31], breaking away with centuries-old conventions in Western Art History that privileged the artists' individual style when drawing, painting, or sculpting. Contemporary drawing exhibitions like *Drawing Now* significantly challenged this, which was also mirrored by artists in Europe. The film *Pencil Mask* (1972) by German artist Rebecca Horn is one evocative example of the interest to render body parts other than the hand participatory in drawing; in Horn's case via a mask with protruding pencils that the artist wore on her face as she moved her head repeatedly across a wall (Figure 23). Other explorations completely disregarded the idea of drawing with one's body and expanded on the concept of 'computer art', such as British artist Harald Cohen's

[31] This can be paralleled and contextualised with the development of Conceptual Art.

creation of the computer programme *AARON* in the 1970s that drew automatously. However, the 1992 show at MOMA (Rose 1992) also "highlighted a resurgence of gestural drawing, large-scale work, and approaches to collage and montage" (TRACEY 2007, p.ix). These examples are merely a synopsis highlighting the difficulty to trace and determine a chronological definition of what contemporary drawing is, or does. Petherbridge (2010) also acknowledged this by noting how such difficulty is due to our age of pluralism, incorporating a variety of institutions, multi-practices endeavoured by contemporary artists, structures, theories and disciplines making use of the medium (p.412). Even the term 'medium' can only partially describe drawing, as shown by Petherbridge (2008) herself when she stated that drawing carries an irresolute status, making it "neither entirely medium nor message" (p.37). Thus, CADP constantly escapes definition via its own open-ended nature. However, Petherbridge (2010) did observe that contemporary drawing generally seems to be influenced by two main factors: its conception as a time-based practice and digital technology (p.412). The practice of this PhD indeed related and expanded on the capacity of both, as will be highlighted in the forthcoming discussions.

4.1 Developing an eye-tracking drawing process

The initial stages of the practice research were characterised by an interest in contrasting the practice of eye-tracking drawing with general associations of observational drawing, involving a process of delineation – i.e. the representation of

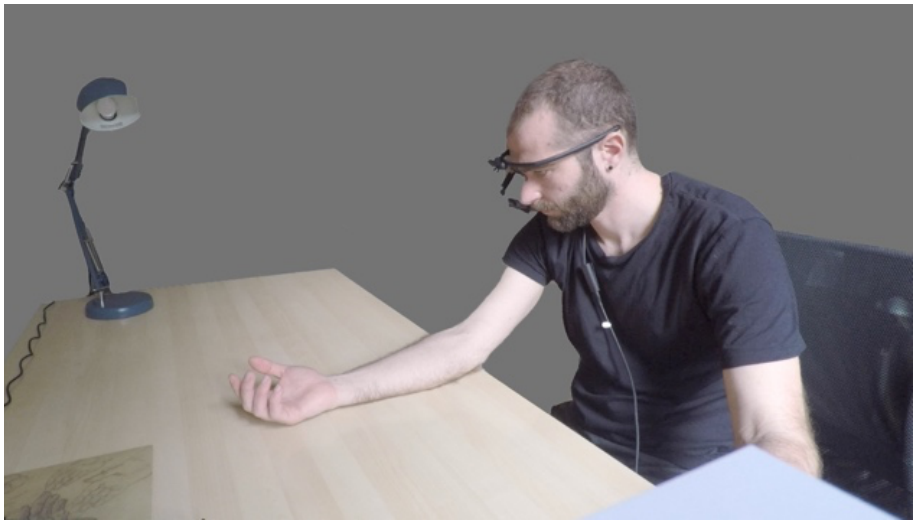


Figure 24: (*Top*) Documentation photo of myself while drawing my hand with the eye-tracker. Photo taken on 23 July 2020 at 14:07.
(*Bottom*) QR code leading to a *YouTube* video showing the eye-tracker's captured footage/process of the recounted drawing exercise. The footage was retrieved after the drawing exercise during postprocessing.
For more documentation follow: **< https://portfolio.matthewattard.com/eye-tracking-drawings-of-my-hand/>**

the observed subjects through lines. This was guided by two main notions; starting from the convergence of how eye-tracking drawing transformed my gaze into a 'continuous drawing' with how academic observational drawing asks of students to draw what they see and not what they know (for example, see p.108). Observational drawing requires specific ways of looking, and through the initial eye-tracking drawing experiments, I investigated these via the 'by-passing' of a drawing hand. This challenged the ubiquitously cited discourse that typically describes drawing as a hand-eye coordination process (for example, see Elkins 2005, p.106). In the case of eye-tracking drawing, the technology's contribution to the drawing process eliminated both page and hand, and consequentially my reference to the formation of the drawing, as the capturing of the gaze occurred digitally and in data form.

The interest in delineation grew out of the assimilation of the gaze to a continuously drawing line, and thus I found myself directing my gaze along the edges/contours of my chosen subjects/objects/things. A main subject of observation/drawing for my initial experiments was my hand itself, and I would hyper-attentively direct my gaze from one feature of the hand to the next, such as the 'outline' of my fingers (Figure 24). Through these experiments, I devised the following method of eye-tracking drawing, which I will here recount in the form of a list[32]:

[32] This is only a base guideline of the developed process, which was continuously adapted accordingly throughout this ABR.

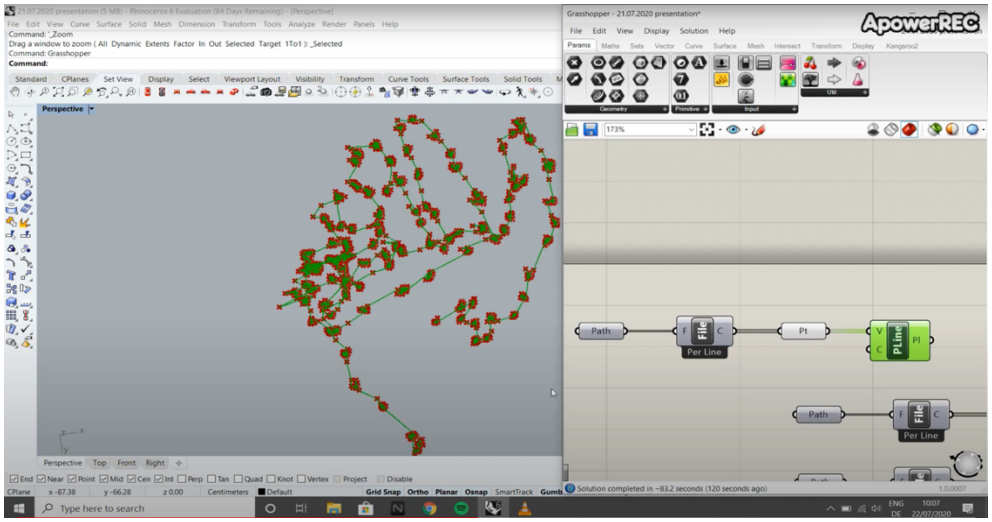


Figure 25: Screenshot taken while developing the eye-tracking data into a digital drawing. Postprocessing made by Matthew Attard, personal computer, Pupil Player, Excel, Rhino 3D and its Grasshopper extension. July 2020.
Made throughout October 2020.

1. I wore the *Pupil Core* eye-tracking device and plugged-it into the computer via its USB cable.
2. I started the *Pupil Capture* software. This live-streamed what was being captured by the eye-tracker cameras, via which I made sure that they were in focus with a clear view of the eye and pupil. The frontal camera was adjusted in the same way.
3. I looked at the computer screen and calibrated the device by following the appearing markers with my gaze, using the calibration option of *Pupil Capture* (Figure 12).
4. Once the device was calibrated, I pressed record, looked away from the computer screen and positioned my hand in front of me for drawing (Figure 24).
5. I thought of my gaze as a metaphorical pencil that was drawing the hand in mid-air with a continuous line.
6. Once the drawing was over, I stopped recording.
7. I exported the eye-tracking raw data using the software *Pupil Player*. This saved a .csv file containing a multitude of data columns. I cleaned the data by deleting all unnecessary data columns, leaving the following:

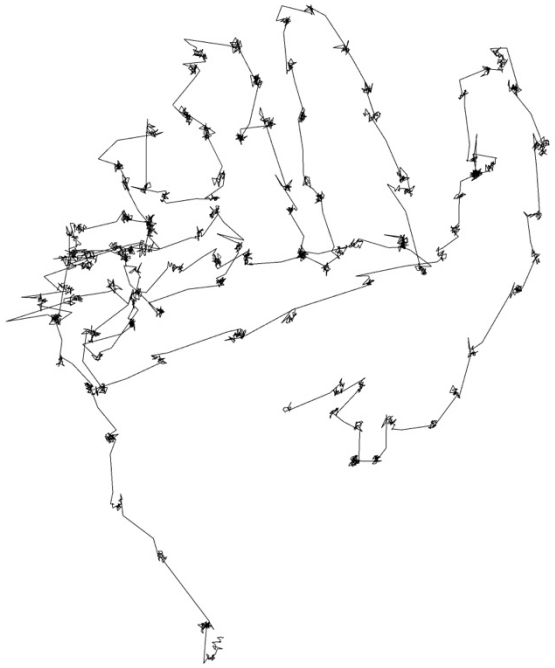


Figure 26: Eye-tracking drawing of my right hand. Drawing executed by Matthew Attard and Pupil Core. Postprocessing made by Matthew Attard, personal computer, Pupil Player, Excel, Rhino 3D and its Grasshopper extension. July 2020.

gaze_point_3d_x, *gaze_point_3d_y* and *gaze_point_3d_z*. These are representative of the x, y, z positions of my gaze in space.

8. Opened *Rhino 3D* and its plug-in *Grasshopper*.
9. In *Grasshopper*, I assembled the following components: *Path*, *Read File*, *Point* and *Polyline* (Figure 25).
10. Right clicked on *Path* and selected the eye-tracking data .csv file. The component assembly read the x, y, z columns representative of the eye movements in space, plotted them as points in the virtual space of *Rhino 3D*, and generated a digital line through the datapoints, forming the digital drawing (Figure 26).

At its simplest, the start of this PhD exploration adopted the perspective of a contemporary experimental reaction to conventions related to observational drawing. In essence, eye-tracking technology initially contributed towards the capacity of seeking out new ways challenging traditional notions of observational drawing, side-stepping the hand-eye coordination. In turn, the scientific methodology of eye-tracking was transformed into a process for an explorative observational drawing. This resulted in digital drawings that concerned the delineation of my subjects (Figure 26), and a few remarks from these early stages of the practice are worthy of reflection.

From the start of the PhD, the adaptation of eye-tracking technology regarded the practice of drawing and not the scientific methodology of measuring eye movements. Literature suggesting that artistic practice should follow its own research paradigm differing from quantitative and qualitative methodologies proved influential in this regard. In her introductory essay, Leavy (2018) noted how artistic processes usually require an element of trial and error, and thus, ABR has the malleability to be intuitive and then reflect conceptually (p.11). I found this to also align with the value given to the notion of not knowing by artistic research, as opposed to much of academic research, and as for example discussed by artist and author Emma Cocker (2013). The experimental methods of this practice research were at times indeed guided by intuition and an openness towards not knowing, and most writing and reflections wove in-between the iterative stages of the CADP. To some extent, this echoed curator Mel Gooding's (2002) observation on the nature of drawing that: "Every drawing is a kind of proposition of what is possible to know".

Gooding's remark is another indication of the open nature of drawing practice – it is fluid and can carry an inconclusive quality. Throughout its progression the practice research assumed an iterative development where at times, the 'error' itself was crucial to the unfolding of this ABR (for example, see p.35). This also aligned with drawing attitudes repeatedly shown by artists like Berger, who described the experience of a communal drawing session as being: "[…] equal in the sense that we were all failing and we were all wanting to go on" (Chorpening and Fortnum 2020,

p.6). Alongside this, drawing practice has also been defined as an act of discovery (see Berger 2005, p.3; Dillon 2009, p.8), with which I also find a subtle connection with Paul Klee's ubiquitously cited affirmation that drawing is like a line going for a walk (1961, p.105). Thus, as a CADP, the research encompassed the exploratory oscillation between drawing's errors and discovery.

4.1.1 Delineating via eye-tracking technology

Eye-tracking drawing my hand (Figure 26) contributed to a process akin to the delineation of contours, while acknowledging the traditional discourse that contours do not exist in nature. This 'non-existence' of contours has been ubiquitously discussed throughout art and philosophy, and the following passage from Merleau-Ponty's (1964) essay *Eye and Mind* is one of the most cited:

> […] already familiar to the painters, that there are no lines visible in themselves, that neither the contour of the apple nor the border between field and meadow is in this place or that, that they are always on the near or the far side of the point we look at.
>
> (p.183)

From Merleau-Ponty's quote we deduct how contouring/delineation is an abstract concept. Practitioner Lynn Imperatore (2016) discussed how, when it comes to

Figure 27: An edited image that visually recounts my visual focus while eye-tracking drawing my hand. The red cross represents my gaze, while everything else entered my peripheral vision.

observational drawing, art students are steered into isolating specific projects of looking (contour, tones, relations, etc.) and therefore engage in drawing through different ways of looking and seeing. As a result, Imperatore posits that all drawing is abstracted by its very nature. Petherbridge (2010) went as far as describing delineation as: “the most conceptual means of drawing. It is the most abstract, in that to arrive at a clarity of outline is a process of reduction and deliberate simplification and stylisation” (p.32). This does not however mean that the deliberate simplification is a simplistic process, but a complex and ambiguous act alternating between thought and chance. Other contradictions can be noted, such as intuition and observation, and attention and dreaming among others. As a practice, drawing thrives on such contradictions.

In the eye-tracking drawing exercises of my hand, the notion of delineation contributed to a way of gazing that altered my attention. I forced my eyes into envisioning an ‘abstract’ contour by following an imaginary path along physical characteristics of what was being observed. My visual attention became occupied with this specific task, while influenced by the fact that the eyes’ path was concurrently being interpreted by the technology. Figure 27 is an edited image in postproduction for the purpose of recounting my visual focus (represented by the red cross) during such exercises; with the aim of conceptualising how the view outside of my attentive/drawing gaze entered my peripheral vision.

Eye movements as drawing

The initial experimentation with the eye-tracker embodied a rather tense attitude, partly because of how the eye can be 'tamed' with limitations. For example, involuntary eye movements challenged the hyper-attentive stance, and eventually started to play an ever more important role in the drawing process. In reference to the hand-eye coordination of artistic practices, the eye had been phenomenologically described by Merleau-Ponty (1964) as:

> […] an instrument that moves itself, a means which invents its own ends; it is that which has been moved by some impact of the world, which it then restores to the visible through the offices of an agile hand.
>
> (p.165)

Merleau-Ponty was here accentuating on how during practices such as observational drawing, the eye forges its own paths of ways of looking that are translated by the moving hand on a page. By adapting this conceptualisation of the hand-eye coordination to the practice of eye-tracking drawing, I would rephrase Merleau-Ponty's claim as:

> *The eye is an instrumental co-constituent to the hybridity of the techno-human drawing process; caught between the will to move itself when impacted by the*

world, and the manoeuvring of the gaze as drawing. This tension is restored to the visible via the technological interpretation/contribution to the process.

Thus, in practical terms, the initial process of eye-tracking drawing involved a tension between the attempt to control the eye movements into projections of drawing and their natural gaze trajectories. This could only be rendered and made visible by the co-constituting digital technology, including that of postproduction, as it replaced what Merleau-Ponty described as “the offices of an agile hand”.

4.1.2 Aspects of deskilling

The motivation to tackle notions of observational drawing with eye-tracking technology can also align with what Petherbridge (2010) noted as “present-day strategies of deskilling”. She did this by mentioning *left-hand drawing* (referring to drawing with the unaccustomed hand) and *blind-drawing* (referring to drawing on a page that is concealed from the drawer’s visibility) as practices that attempt to break away from literal representations in drawing and self-conscious skill (p.416). Drawing-with an eye-tracker can posit notions of deskilling; not only because the means with which we traditionally associate drawing ‘skill’ (the hand) is by-passed by the technology, but also because of how the technology partakes/co-draws in the drawing process through its own algorithmical interpretations. In the course of my project, this evolved different levels of skilling through the acquired experience, that

Figure 28: Claude Heath, *Head (Drawing 137)*, 1995. Colored biro on paper, 70x50cm. Retrieved from: Cooper and Lampert 2009.

also steered the practice into drawing explorations differing from notions of drawing from observation (for example, see ceiling doodle, p.115).

It proves insightful to draw a comparison between eye-tracking drawing and the practice of blindfold drawing, specifically as explored by artist Claude Heath (Figure 28). Blindfold drawing can be regarded as a 'deskilling' (and reskilling) drawing strategy, where one draws via the sense of touch while blindfolded, i.e. one feels an object with one hand and draws it with the other. Heath's drawing practice predominantly investigated the method in the 1990s and early 2000s. His process was characterised using a multicoloured retractable ball-point pen as drawing tool, as he randomly changed colour with every contour iteration (Heath 2014). Therefore, the coloured lines of drawings such as *Head (Drawing 137)* carry temporal information. Heath's blindfold drawing process contrasts with the practice of drawing-with an eye-tracker: the former depends on touch and the understanding between one hand and the other, while the latter is characterised by sight and directly draws-with the technology without the intervention of the hand. However, both practices can evoke concepts discussed by philosopher Jacques Derrida (1993) in his argumentation of how drawing is blind: "how can one claim to look at both a model and the lines [*traits*] […]? Doesn't one have to be blind to one or the other?" (p.36). Derrida postulated the problem that drawing is marked by a sense of blindness, as it occurs in-between the marks forming the lines and the artist's vision. Heath embraced this problematisation by embedding his drawing process within a total (visual) blindness

for both subject/object and drawing. By contrast, while eye-tracking drawing, the eye was blind to the technological interpretation (the forming dataset to be generated into a digital drawing), which became a visible line through further technological mediation only during postprocessing. In this way, both practices can be posited as divergent methods that exploit the nature of blindness of drawing (in Derrida's sense[33]). Heath made this apparent by means of being literally blindfolded while drawing, while my project suggests this by being blind to the technology's data capture. Both drawing methods can also be regarded as an attempt to overcome a number of set limitations, such as the faithfulness of representation, in order to venture into new drawing territory.

One last comparison between both practices regards the 'scanning' of volume: the three-dimensional aspects of the resulting drawings. Heath's amassing of the drawn lines (his sensed 'paths') are not only representative of a temporal presence, but of volume: almost appearing as a 'hollowed-out' object. Art historian Andrew Patrizio (2003) saw an aesthetic resemblance with medical scanning technology and referred to their appearance as a disjuncture of colour-coded layers of lines resonating with scientific scanning visualisations such as PET and MRI (p.33). This resonates Heath's objective of attempting to think conceptually about an object and draw it as if he were a computer (Furlong 2003, p.21). Heath's aim was to explore a drawing process

[33] This is a narrow fraction of Derrida's thoughts mentioned in *Memoirs of the Blind* (1993), where through his own curated exhibition at the Louvre, he brought up notions of drawing, blindness, iconography and metaphor among others.

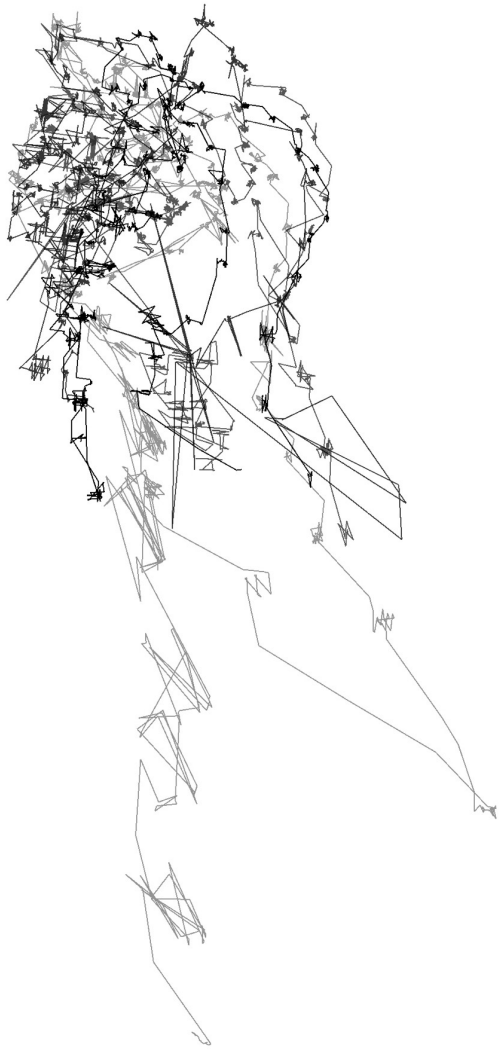


Figure 29: (*Left*) 4 superimposed eye-tracking drawings of my hand, drawn from 4 different viewpoints. Drawings executed by Matthew Attard and Pupil Core. Postprocessing made by Matthew Attard, personal computer, Pupil Player, Excel, Rhino 3D and its Grasshopper extension. A different color grade was applied to each drawing.
(*Right*) A QR code leading to a rotating video loop of the 4 superimposed drawings.

that would aesthetically mimic technologically-made images such as digital scans but remained embodied within an analogue method of drawing. Differently, the drawing results of this PhD do not imitate a technological result but stem out of the process of drawing-with digital technology. I would like to suggest that a comparable 'hollowed-out' aesthetic is yet presented by some drawing outcomes, especially after specific postprocessing that overlays different viewpoints in the digital three-dimensional space (Figure 29). Only, unlike Heath's works, these are in fact the outcome of a co-drawing exercise with digital technology – a hybrid of human and technological interpretation. As opposed to Heath's intention of humanly 'imitating' a computer, I drew-with computers, and eye-tracking drawings developed in the three-dimensional digital space that entailed its own characteristics.

4.2 Eye-tracking as a digital artistic medium

Doodling as eye-tracking drawing

With the second year of the practice research, I started to break away from certain observational drawing conventions that had conditioned the initial experiments, which mainly involved the delineation of my hand. The notion of doodling emerged as an expansion of the CADP and will be used below to highlight aspects of eye-tracking as an artistic digital medium. The term doodling is hereby adopted in its contemporary capacity to describe a form of drawing. The term has a fairly recent

history emerging somewhere at the beginning of the 20th century in order to refer to a way of drawing outside of a fine arts understanding. However, it is nowadays generally associated with drawing activity that emerges from a spontaneous and unpremeditated mindset, that can be equally practiced by both artists and non-artists. Artist and author David Maclagan (2013) compellingly compared scribbling, doodling and automatic drawing, and concluded that: “Beyond a certain point [in art history] there is no firm distinction between these extra-curricular drawings and similar drawings that could be called ‘art’” (pp.12-13). There is however an additional aspect to the definition of doodling in contemporary times, which is being reassessed as an expression carrying underlying processes of thinking, contrasting with the general misconception that ties doodling to strict moments of boredom. This is not only happening within artistic fields, but also in scientific disciplines, as shown for example in the review by physiologist Sharat Gupta (2016) who postulates doodling as a thinking process. Within the context of this PhD, doodling presented an interesting dichotomy between thinking and ‘non-thinking’, the spontaneous and the rational. Informed by such notions of doodling as drawing, I started to *doodle-with* eye-tracking technology.

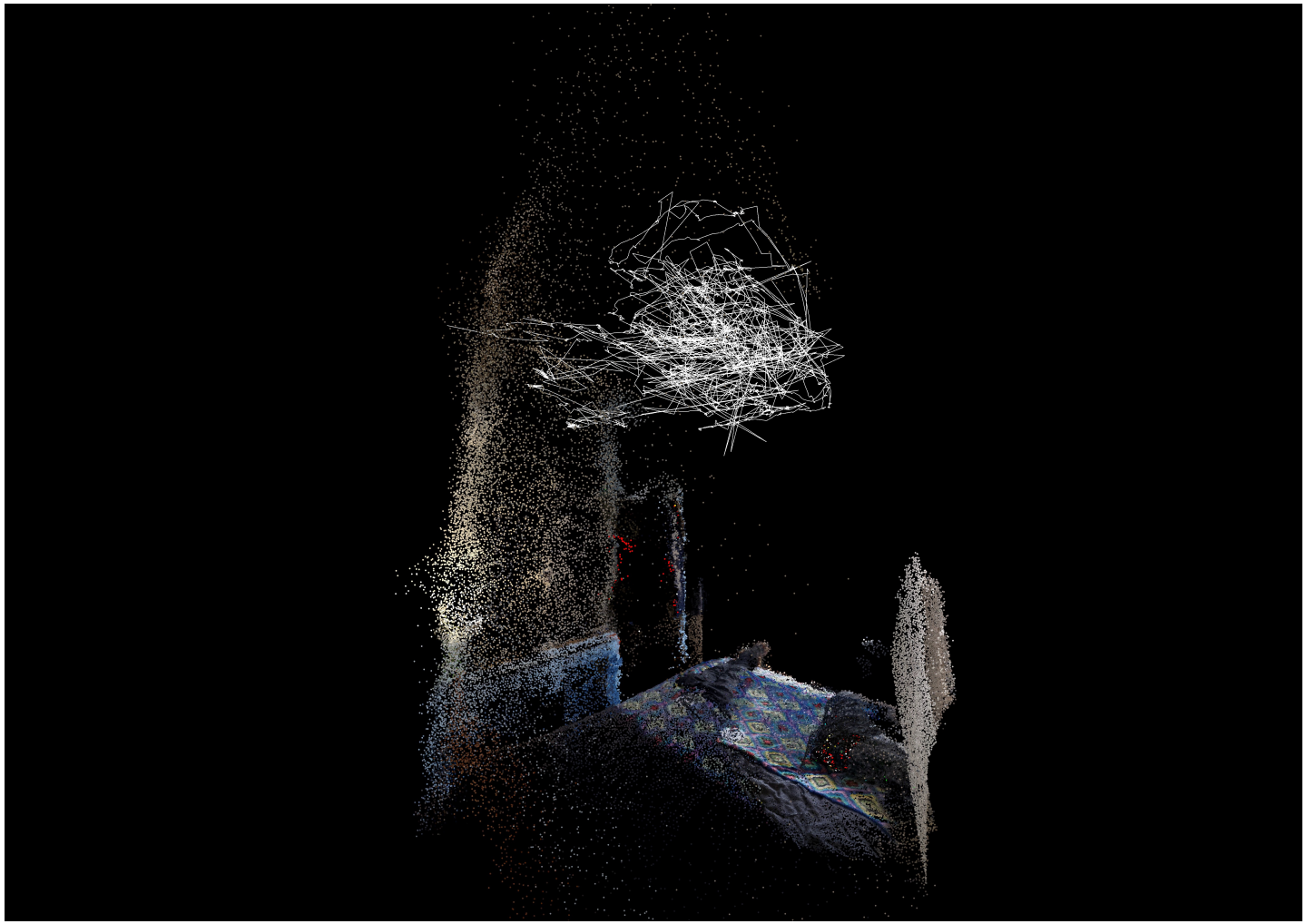


Figure 30: Eye-tracking drawing while doodling with my eyes across the ceiling. The white lines were developed with *Rhino 3D*, and the digital doodle was virtually situated within the point cloud of a 3D scan of the bedroom interior space made with *3Dim*. These doodling exercises mostly took place between November 2020 and April 2021. This drawing exercise was shortlisted for the *Lumen Prize* 2021 in September 2021 (The Lumen Prize 2021); selected for the collective exhibition *Art in Metaverse* in Seoul, Korea, in January 2022 (Artscloud 2022); and awarded the *Best Data Visualisation* Prize by The University of Edinburgh Centre for Data, Culture and Society in May 2022 (CDCS 2022).
For more documentation follow: **< https://portfolio.matthewattard.com/doodling-with-the-eye-tracker/>**

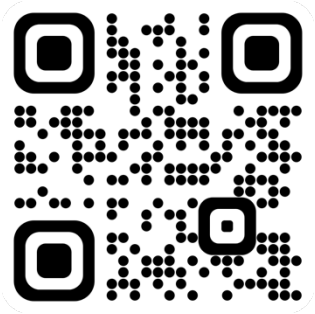


Figure 31: A QR code leading to a rotating video loop of the digital doodle in the virtual 3D space.

4.2.1 Doodling with the eye-tracker while looking at the bedroom ceiling

During the COVID-19 pandemic lockdown period, when I had the eye-tracking device at home I began to regard the technology as a drawing 'companion'. Even during the rather mundane moments, it became very difficult to not think about possible eye-tracking drawing experiments within the walls of my apartment. Mundane moments, viewpoints and spaces started to become perceived as 'drawable' with the eye-tracking device. One such particular moment was staring at my bedroom ceiling from my bed, starting from moments of boredom[34]*. I asked myself: how many times do I look up at the ceiling while lying on my bed and wander through thoughts and visualisations? This developed into the opportunity to wander through these thoughts and visualisations with the eye-tracking device, as I started a series of drawing experiments where I would wear the Pupil Core monocular device while staring at the bedroom ceiling, transforming the ceiling into a (virtual) metaphorical 'page' for doodling (Figure 30).*

Eye-tracking doodling across the bedroom ceiling portrayed a digital drawing experiment within a specific context that ascribed the wandering eyes and their datafication by the technology, to notions of doodling. The relatively 'free' movements of the eye resulted in the accumulation of digital eye-tracking data, which was generated into a digital drawing/doodle at a subsequent stage. Artist and writer

[34] During the COVID-19 pandemic moments of creativity that emerged from boredom evoked a particular attention, for example, see Holmboe and Morris (2021).

Tamarin Norwood (2020) theorised the fundamental differences between analogue and digital modes of transmission in drawing. She described analogue drawing as “the direct physical transmission of form from the movement of the hand to the mark on the page” (p.390). On the other hand, she explained how digital drawing occurs the instant such movements are abstracted as numerical form by digital technology – thus involving an “interruption” of the drawing (p.394). For example, this occurs when drawing with a graphics tablet, whereby the marks on the tablet undergo a transformation via algorithmic processes before appearing as lines on the digital screen.

In the context of this digital CADP, I am referring to what Norwood called ‘interruption’, as an interpretation. My doodling/wandering eyes were not interrupted in the same way the drawing is interrupted when drawing on a digital tablet. The eye movements were instead continuously interpreted by the algorithmic capture of the analogue eye movements as data, because of the digital technology’s agency. To analyse some main insights that can uncover specificities about the digital drawing methods of this research, I would like to first contrast aspects of this alongside graphic mark-making that has generally defined drawing. This will inevitably expand onto other notions relating to surface in view of digital technology.

Mark-making

Drawing and doodling have ubiquitously been referred to as activities that mark a surface, irrespectively of whether an observational or nonrepresentational image is portrayed. A physically made mark also has the flexibility of medium and can involve an open-ended variety of materials (from pencils to tree branches), and it is essentially considered to be the point of departure for drawing. De Zegher started the accompanying publication of the exhibition *On Line* (2010)[35] by noting how: "[…] drawing is born from an outward gesture linking inner impulses and thoughts to the other through the touching of a surface with repeated graphic marks and line" (p.23). I find this quote to synthesise specific notions of drawing. Firstly, it highlights the contemporary tendency of omitting any reference to representation of the outside world, which had been a convention of drawing in pre-20th century Western art. Secondly, it states that the gestures shaping a drawing can result from both instinctive and rational acts, and the underlying structure for both lies in a form of contact with a surface that leaves a mark – that in turn has the potential to become line/drawing. Art historians and critics such as Michael Newman (2003) have analysed what a mark is by noting how a "[…] mark seems to bring into effect an act of becoming in drawing (it becomes a line/contour/sign/writing/etc.)". A mark carries the potential for demarcations of and on a surface that in turn have the capacity of

[35] The exhibition included an extensive historical synopsis on the evolution of drawing between 1910 and 2010. It is considered to have been a highly influential exhibition and publication, in view of the reevaluation of drawing as a practice in its own right.

becoming a drawing. Practicing artists are well aware of this, and as artist Susan Morris (2012) stated: “anyone who doodles knows, a line drawn inside a frame immediately demarcates a territory: foreground and background are implied”. The first marks becoming line therefore carry an amplitude of possibilities, and in view of this, de Zegher (2010) recounted how: “[…] the first mark not only structures the blank page as an open field but also defines it temporally, as the drawing’s marks follow one another in time” (p.23). In short, the mark is that with which a drawing/doodle, takes shape and form on a surface. The mark defines the surface at least through two qualities: time (becoming) and territory (demarcation). It is therefore not uncommon to regard drawing as a practice that includes an act of mark-making, that is by marking time and space onto a surface.

I would like to highlight the differentiating aspects of the ceiling eye-tracking doodle from such discourse. Before discussing this in more depth, I would like to clarify that the above descriptions of drawing as a mark-making activity on a surface are a general theoretical/philosophical proposition tied to changing conventions and not a formula for drawing/doodling. Contemporary art has extensively shown us how artists continuously challenged what can act as a drawing surface. By moving away from notions of conventional surfaces such as a page or canvas, the line extended into architectural space, into our environment, into social space, and into the virtual world among others. For example, Stout (2014) discussed contemporary drawing that became temporal through its reaction to architectural settings, or through

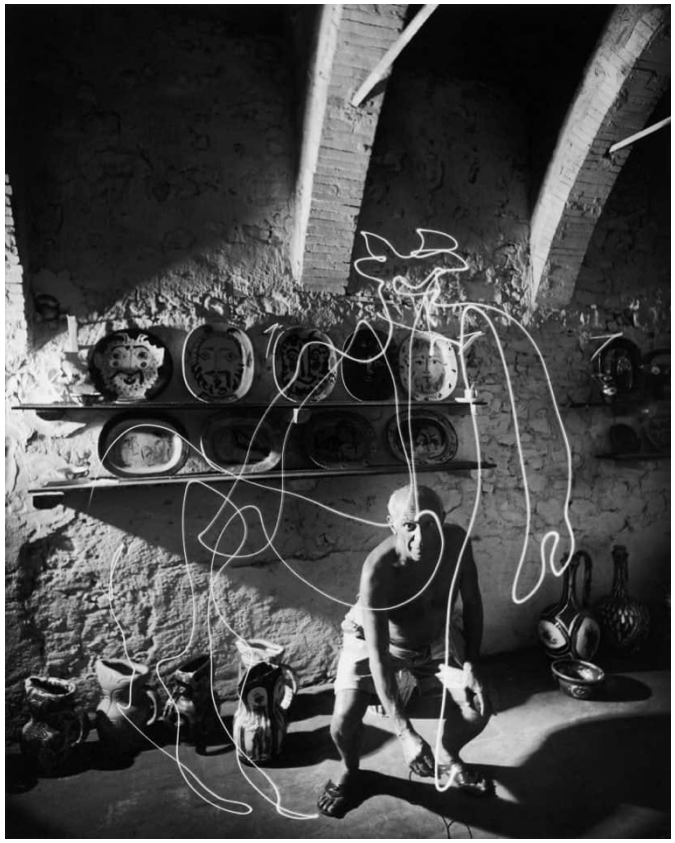


Figure 32: Photograph by Gjon Mili of Picasso Drawing with Light, 1949. The LIFE Picture Collection/Getty Images. Retrieved from Campbell 2021. Picasso had worked on a series of light drawings where he would doodle in the air with a light source in front of a camera set on a long exposure. The resulting images showed the trail of the moving light source that formed the drawings in mid-air.

performance, mentioning artists like Monika Gryzmala and Carolee Scheemann (pp.144-155). Another case in point is the exhibition *On Line* (MOMA 2010) itself, as it was instrumental in the narrative of the multitudinous ways with which contemporary artists extended the mark and the line from the surface of the page into the real and social space; through the bringing together of artists such as Alexander Calder, Eva Hesse, Pierrette Bloch and Anna Maria Maiolino to name a few.

Marking space

Eye-tracking doodling across the ceiling (Figure 30) had no surface to be marked by any kind of physical contact. Yet, the drawing exercise still resulted in notions of temporality and demarcation. In his essay *On Elements of Drawing*, Dillon (2009) highlighted how Berger once assimilated drawing on a surface to a gaseous medium, where one pilots through it as if it were air (p.12). Berger was here using a metaphor in reference to how a mark establishes a two-dimensional space with three-dimensional qualities, and the adaptation of this in view of the ceiling-doodling exercise can give valuable insight: eye-tracking doodling literally happened through space – in midair and was then represented by the digital space. The eyes 'piloted' and navigated across the visual 'real' space co-constituting the techno-human assemblage. In a way, this drawing exercise can recall other methods of drawing 'in the air'; that can range from Picasso's light drawings from 1949 (Figure 32), to even

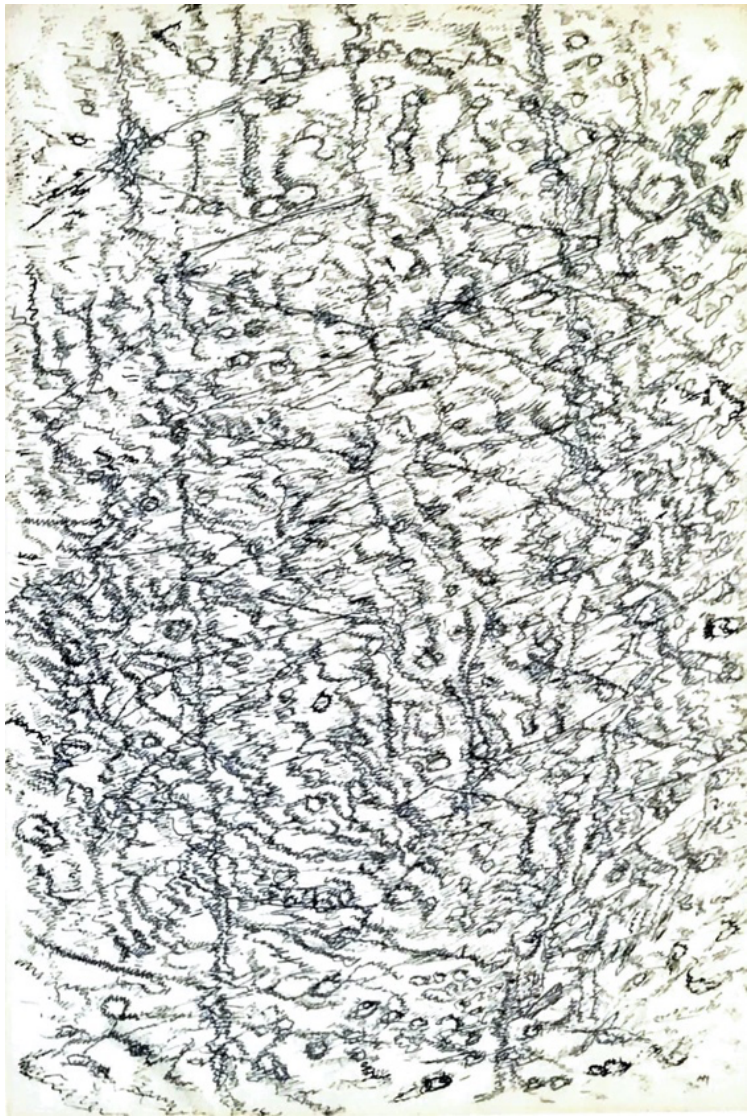


Figure 33: Henri Michaux, *Mescaline Drawing*, 1956. Retrieved from: de Zegher 2000, p.75

how children in China traditionally learn writing by gesturing in the air as anthropologically discussed by Ingold (see 2007, p.135).

Likening the ceiling doodle exercise to examples of drawing in mid-air evokes how such methods of drawing employ an envisioning process of the forming line while lacking an immediate visual reference unlike when one marks a page. However, the envisioning process can be an insightful comparison to when one marks a page and can be discussed through notions of the invisible and the visible. In one of de Zegher's quotes (see p.125), we read how drawing emerges from "inner impulses". In an interview with the same curator, artist Avis Newman spoke extensively of this as being a mental process that is coordinated by manual acts, and compared drawing to an interior monologue which emerges as marks on a page as a result of thinking and bodily gestures (de Zegher 2003, pp.67-82). I agree with Newman, as probably would most practitioners involved with doodling/drawing: drawing has the potential to give visibility to interior thoughts, even when evoked 'freely'. Several artists have repeatedly shown this through drawing, doodling or mark-making, including, famously, artists like Henri Michaux (1899-1984) who would also experiment under the influence of mescaline for a deeper inward-looking experience (Figure 33). Art critic Barry Schwabsky (1999) described these drawing experiments as a search "for the foreign territory within himself", while de Zegher (2000) saw something in Michaux's work that was akin to a voyage within the self, differentiating him from the contemporary Surrealist practice of automatism (pp.167-168). In the context of this

PhD, it is essential to address the observation that the 'interior monologue' referred to by de Zegher was more than just a 'monologue', and it was neither conveyed through the act of marking a page.

The 'interior monologue' was caught in a collaborative dance with the technology co-constituting the practice and was also affected by the contextual dimension in which the eye-tracking drawing took place. Phenomenological thought from the latter part of the 20th century posits that we embody the space around us, in particular through Merleau-Ponty's writing of how: "[…] I live in it [space] from the inside; I am immersed in it. After all, the world is all around me, not in front of me" (1964, p.178). It is very tempting to read the ceiling exercise alongside this affirmation, as it is true that while lying horizontally and doodling across the ceiling with my eye and the eye-tracker, I was immersed in such a spatially embodied context. However, this would be an incomplete analysis: digital technology was also part of the embodiment as it partook/interpreted/'co-drew' in the way I envisioned the doodle across the ceiling space. Moreover, the nonhuman things around me such as the ceiling and anything that shaped my mundane routine, exerted their influence upon the doodling eyes. The ceiling doodle can be read along Bennett's comment on her own practice of doodling, as she stated how "[…] it is somehow subjective without being the expression of an interiority all my own" (2020, p.x). In similar fashion, artist Richard Tuttle acknowledged on several occasions that if one "listens" to the material, drawing can lead to unprecedented experiences (de Zegher 2010, p.68). Eye-tracking

doodling across the ceiling also resulted in an unprecedented experience, and the 'material' of the exercise was deceivingly silent, while 'listening' to it involved a delicate operation of attending to nonhuman ways of revealing. One can argue that there is nothing novel in this, except for the fact that on a 'normal' occasion of daydreaming while looking at the ceiling, we might pay little or no attention to the process, and we do not ascribe it to a capacity for drawing – made possible by the technology. For example, being a mundane sight, the bedroom ceiling easily resided in a background, and could only be brought forward by the hyper-attention given to things by this research. Such doodling exercises also brought about the extension of the interior thoughts into embodied space, transforming the latter into an arena for gazing/wandering as a creative practice with the eye-tracking device (that ultimately interpreted the invisible as visible). This can relate back to the spontaneity of the drawn line when doodling, especially when compared with how mathematics and art professors Ricardo Nemirovsky and Tim Dibley (2021) described the doodling practitioner as a "daydreamer immersed in a reverie: an open field of reciprocating forces, desires, surprises and recollections playing themselves out as some of them encounter their way forward free to proceed, and others do not" (p.260).

The ceiling doodling exercise is evocative of such remarks: as a techno-human assemblage I immersed myself in a 'daydreaming' stance responding to the context around me in view of doodling-with the eye-tracker. I did not mark a surface via this digital practice but wandered with the gaze across the three-dimensional 'real' space

while the technology datafied the movements through its own interpretation in the digital space. This entailed a way of working with the 'unknowns' of digital technology, as will be discussed below.

4.2.2 'Not knowing' in digital technology

'Listening' (in Tuttle's sense) to digital technology throughout the drawing exploration entailed aspects of not knowing. In an essay about digital aesthetics, media professor Sean Cubitt (2016) referred to digital technology as messy and stated that: "Not only is each performance of the scripted code different depending on platform, scale, illumination, display, operating system, and so on, but every performance is 'other' than the code that in some sense also 'is' the image" (p.267). The digital image is a hybrid of code that is not image and image that is also code. It is a visualisation that can only be read, developed, and projected by the digital, and one digital device differs from another in performance and presentation. These observations are not new as such, but they highlight how the digital technology co-constituting this ABR has the potential to be as open-ended as drawing itself; especially in view of how the application of a different eye-tracking device, or a different postprocessing software, would contribute a different drawing outcome. Curator Christiane Paul (2016) discussed how digital artworks are: "computational; process-oriented, time-based, dynamic, and real time; participatory, collaborative, and performative; modular, variable, generative, and customizable, among other things" (p.1). 'Listening' to the

digital as artistic research, is therefore an open-ended exploration in itself. Moreover, it is important to acknowledge how this PhD was determined by the idiosyncrasy of the participating devices, such as the *Pupil Core* eye-tracking device and *Rhino 3D*. As co-constituents to the practice, these left their aesthetic 'signature' throughout the process.

The term 'messy' used by Cubitt (2016) to describe digital technology necessitates contextualisation. He applied it in view of how Hayles had argued that even popular software such as Microsoft's Word are so complex in their processes that we could never fully comprehend them (p.267). I agree, and my additional comment is fairly straightforward: even if we cannot fully comprehend the processes underlying such digital programmes, we still navigate ways of utilising them via their way of presentation, i.e. the way the 'messiness' of its computational processes has been polished for our understanding. I am still manoeuvring Microsoft Word while writing this dissertation, even if I do not know anything about its underlying code – its black box. Thus, I take it that Cubitt referred to the digital as messy not in the sense of how it appears to us, but because of how we can never truly apprehend its codified language with which it operates. In this sense I do agree that the digital is 'messy', but not in the shambolic sense of the term – its appearance can be in fact rather 'clean' and 'user-friendly'. In view of digital drawing practices, this can again recall Norwood's (2020) observation of how digital technology mimics the analogue appearance of a pen and paper (for example a graphics tablet), yet it undergoes a

process of interruption in the conversion of the act of drawing into the digital, which is never apparent to us unless there is the occasional glitch or delay. The digital includes code, numerical values and algorithmic processes that can only be read and performed by digital technology itself, and in the context of the dissertation, this point can relay back to the mention of the 'black box' by Flusser, regarding how apparatuses simulate thinking through computation in a way that human beings cannot (see p.32). At the same time, it is here important to reiterate that the objective of this practice research was not to open the eye-tracking technology's black box, but to explore a CADP about how to draw-with it. The adaptation of 'ready-made' technology (commonly referred to as off-the-shelf technology) for the drawing practice, moulded this.

Instead of asking questions like "how does it do this?" – which would imply an investigation into the black box – the practice research was preoccupied with questions like "what can it do?", and "what are its implications?". The exploratory methodology worked with the nature of the technology rather than customising it. The point of these clarifications is to further emphasise how through the horizontality that deemed the digital technology's agency as co-constituting the drawing practice, unknown aspects were encompassed.

In their paper, media theorists Johannes Passmann and Asher Boersma (2018) made a compelling argument about the "unknown knowledge" of an algorithm where they

posited the latter as an unopenable black box (pp.144-145). Through the reading of Merleau-Ponty's example of how a woman with a plume hat manages to not break off the feather without measuring the distance between the feather tip and the rest of the world, they devised the suggestion of an embodied "known unknown" type of knowledge. By means of this, they also concluded that finding ways to deal with the "known unknowns" of the algorithm, might deserve more attention "than the inner workings of black boxes" (*Ibid*., p.145).

This ABR adopted a similar reading as to how the known unknowns of the technology became, so to speak, the exploratory field of the CADP. I am here assimilating the 'known unknowns' to the eye-tracking algorithm in view of how this research's impetus did not revolve around the understanding of how it functions. It instead attended to the 'surprises' that the technology's agency revealed and explored their insight in terms of drawing practice.

From this perspective, the process of drawing-with eye-tracking technology finds more affinity with artistic practices that employ digital recording devices other than for example, practices of observational drawing. A case in point is artist Susan Morris, who employed forms of digital recording devices in her practice, such as the Actiwatch (a device datafying sleep patterns) and motion capture (a technology that would in fact datafy her body movements during for example her practice of drawing

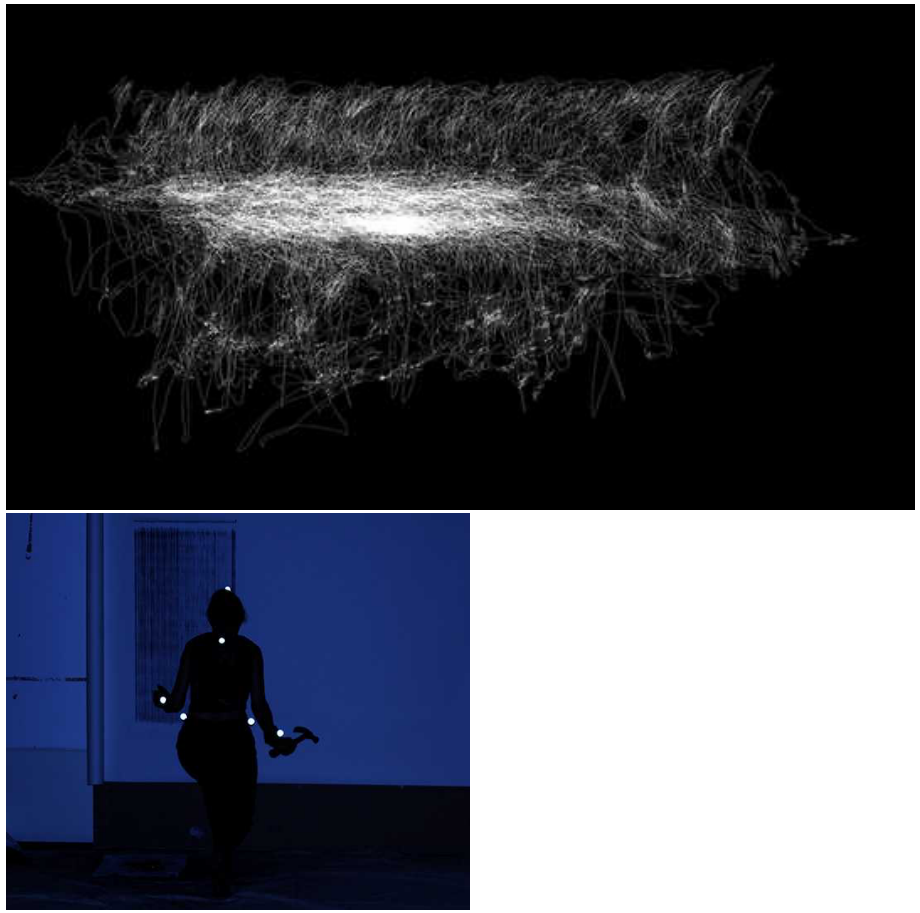


Figure 34: (*Top*) *Motion Capture Drawing_Left Elbow_Facing View*, Susan Morris, 2012. Archive inkjet on Hahnemühle paper.
(*Bottom*) Documented photograph of Susan Morris at the motion capture studio. Retrieved from: Morris 2012.

lines by means of a plumbline). Morris developed the captured data into digital drawings, depicting the artist's movements while drawing, rather than the plumbline drawing itself (Figure 34). Morris (2012) noted how:

> Digital recording produces 'Real' marks, not imaginary constructs or representations. […] Through the use of devices that stored data which is, so to speak, recorded 'in the dark', I can produce a line that demarcates emptiness, is suspended in emptiness.

I am here understanding her use of the phrase 'in the dark' as being the equivalent of Passman's and Boersma's known unknowns of the digital algorithm. Morris embodied the agency of the technology's capacity of digitising her body movements as a way of co-constituting towards a new method of drawing; and the technology did this within its 'black box'. In other words, Morris *drew-with* the known unknowns of the digital recording apparatus where she was aware that the technology would be capturing her body movements (known), but not of how its inner computations operated (unknown). I find this parallel to how while doodling/drawing with my eyes, I was aware of the technology's capacity of capturing my eye movements as data (known), but could not fully comprehend how (unknown). The known aspects concerned the capacity of the technology, but the internal mechanisms of the digital algorithmic processes remained unknown, and were considered as technological agency. Thus, as in Morris' case, the drawing methods explored within this PhD happened 'in the dark':

referring to the captured eye-tracking data. This also meant that hardly any outcome of the drawing could be anticipated, and the 'drawing' results could only be mediated through other digital processes – other 'black boxes'. For example, throughout this practice research, *Rhino 3D* mediated the captured eye-tracking data within its virtual space to a point where I was drawing-with the software during postprocessing. At this stage of the drawing process, my attitude towards the act of drawing shifted, and it became somehow closer to that of an editor. At this stage, I would be in fact drawing-with data.

Drawing in the digital space

A last remark stemming from Morris' quote regards her description of the output of the digital mark: the captured data. I read her choice as having a deliberate sense of irony, as she described it as a 'Real' mark instead of a real mark. In view of digital capturing methods, it can be very tempting to regard the technology's output as being infallible, and hence, as a direct representation of reality. Yet, as this ABR has shown, the technology's agency for capturing data operates its own estimation that is never neutral. Thus, I agree with Morris' way of framing the digitally recorded mark: it is neither an imaginary concept nor real, and for the lack of better terminology, it can be described as being 'Real' but not a direct representation of the real.

Drawing-with data is here the equivalent of drawing-with the 'Real' marks captured by eye-tracking technology, and once the data was computed as a line within *Rhino 3D*, it was the first time during the drawing process where the drawn output could be visualised. *Rhino 3D* instigated a mode of 'drawing' between myself and the computer, and it is here that the practice research can also be strongly linked to notions associated with computer art. Practitioner Angela Eames (2008) interviewed artist Michael Kidner with the aim of understanding his shift from drawing on canvas to drawing in the virtual world, and a notable observation is that when constructing a wireframe in a virtual three-dimensional programme, he still spoke of a 'drawing' state-of-mind (p.139). Thus, Eames concluded that drawing itself acts as "an essential means of prodding and probing, doing and undoing, glimpsing and maybe, seeing and experiencing reality and virtuality" (*Ibid*.); also, as a way of navigating the technological space. I too navigated *Rhino 3D* with a drawing state-of-mind and drew-with the agency of its algorithmic computations that visualise the digital space. In this way, the software revealed the capacity for the transformation of the data points into a digital drawing, but not as a static representation. As image theorists Ingrid Hoelzl and Remi Marie discussed, the digital image "is no longer a passive and fixed representational form […]", meaning that: "It is no longer a stable representation of the world, but a programmable view of a database that is updated in real-time" (2015, pp.3-4). In this context, the eye-tracking data computed into a drawing became a programmable view, and to come full-circle with Eames' observations, this

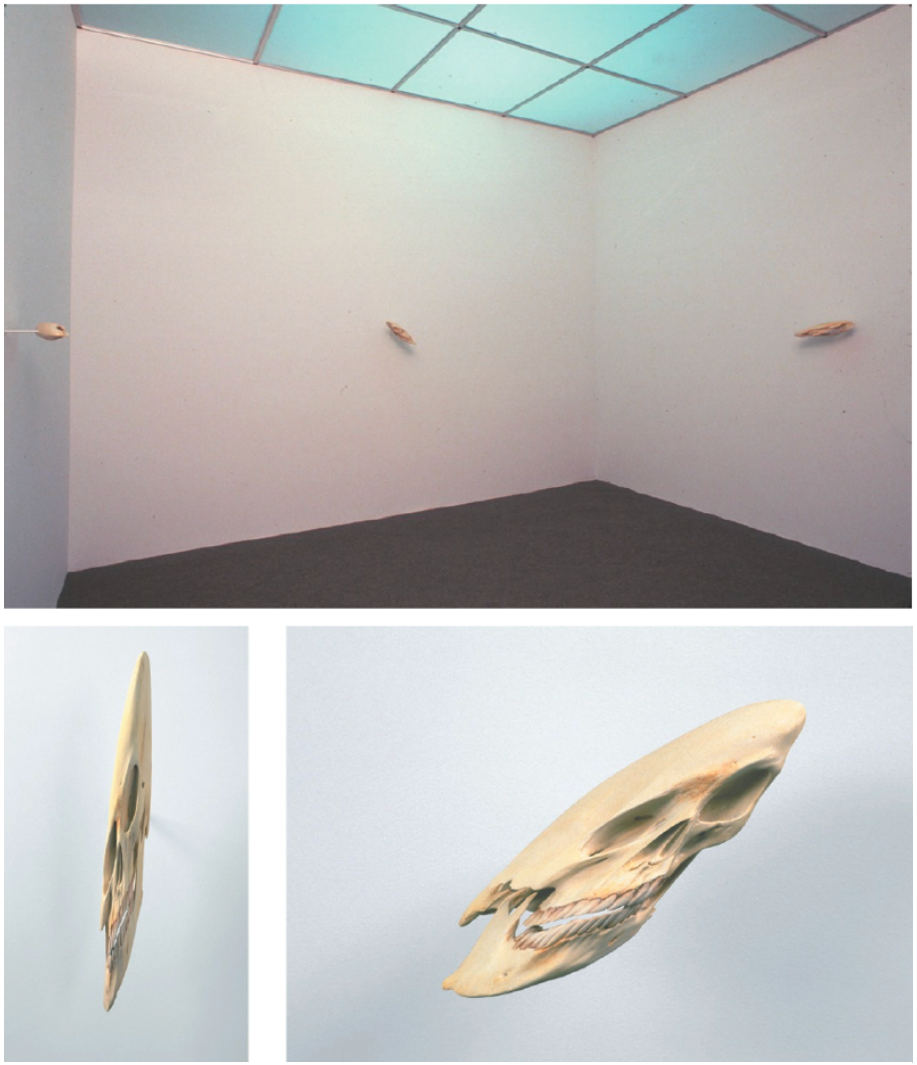


Figure 35: *Skulls*, Robert Lazzarini, 2000. Digitally warped scans of a skull fabricated with resin, bone and pigment. Retrieved from: Paul 2015, p.62.

was done with a 'drawing state-of-mind'. In other words, the drawing exploration converged with a programmable digital agency.

There is an important observation to be highlighted in view of the technological three-dimensional space, that strongly connects to the attention given to the nonhuman perspective and agency by this practice research. When discussing the series of works *Skulls* (2000) by artist Robert Lazzarini (Figure 35), Paul (2015) emphasised the fact that it was only due to the use of digital technology that the sculptures ended up portraying "a perspectival distortion that never resolves itself into a three-dimensional object as we know it" (p.62). The series *Skulls* originated from the digital warping of an actual scan of a skull, that was then cast in bone. Visual Studies professor Mark B.N. Hansen (2004) also discussed *Skulls* for their visual peculiarity, stating that when confronted with them he felt as if they could not return their gaze: "as though they existed in a space without any connection to the space you are inhabiting, a space from which they simply cannot look back at you" (p.198). I find these observations to be very compelling in view of how the generation of the drawings of this PhD occurred within the digital perspective. Even though it is true that while drawing-with the data I navigated the virtual space with a mind-set for drawing, the drawing itself was always mediated to me by the viewport of *Rhino 3D* – via its own perspective. Hansen concluded his discussion by stating that the success of the *Skulls*' imagery stemmed from: "the process of digital modulation—without channelling these through the coordinates of an image designed for interface with

(human) vision" (p.203). By digital modulation Hansen was referring to the capacity of the digital to operate within its own viewpoints, and when aligning the postprocessing phase of this practice research to his comment, it can shed light on another way how the digital technology co-constituted this exploratory artistic research. *Rhino 3D* and its plug-in, *Grasshopper*, did not only have the capacity to read the datafication of the eye movements, but the technology also revealed the process of generating the data into lines from its own perspective: a space that closely mimics mine in which I immerse and extend myself, but that has a different perspective to the one I actually inhibit. As an observation this is important in view of how the software used throughout postprocessing, left a further 'mark' on the resulting digital drawings, co-constituting to the drawing process via its own agency.

One last mention regarding art in the digital space and algorithmic processes is the definition 'generative art'. In the last two decades there have been several discussions regarding which type of art should 'generative art' refer to (for example, see Jason Bailey 2020; M. Beatrice Fazi and Matthew Fuller 2016; Philip Galanter 2016; Jon McCormack et al. 2014; Margaret A. Boden and Ernest A. Edmonds 2009), and this can perhaps raise the question whether the drawing process of the practice research is applying methods associated with generative art. As Galanter (2016) correctly noted, generative art is not necessarily computer art, but it can also be achieved with a computer. He stated how the "key element in generative art is the use of an external system to which the artist cedes partial or total control" (p.151).

Throughout this PhD, I repeatedly yielded control to the technological material agency, and embedded it within the exploratory nature of the drawing practice, however it proves difficult to categorise the process of eye-tracking drawing as generative art. However, eye-tracking data can offer the possibility for generative art developments, that would necessitate its own research study.

4.3 Eye-tracking as a CADP

This stage of the dissertation requires to trace the artistic history of the idea and desire to draw with the eyes. For example, the brother of artist Alberto Giacometti had noted how the latter was drawing with “just his eyes” on his deathbed (see Bonnefoy 2003), while artist Claude Heath described how he had approached a scientist to attempt to draw with his eyes around 2003 “so that there would be no intermediary”, but the idea of it turned out to be enough (Furlong 2003, p.23). In 1969, designer Richard Coss used the technology of Electro-Oculography to draw a car with his eyes, which led him to the conclusion that by drawing with the eyes, artists might be able to quickly record lines at the same instance they imagine them (Coss 1969).

More recently, contemporary artists have experimented with the implementation of an eye-tracking device within their artistic process. Argentinian media artist Mariano Sardón collaborated with neuroscientist Mariano Sigman on several occasions, and

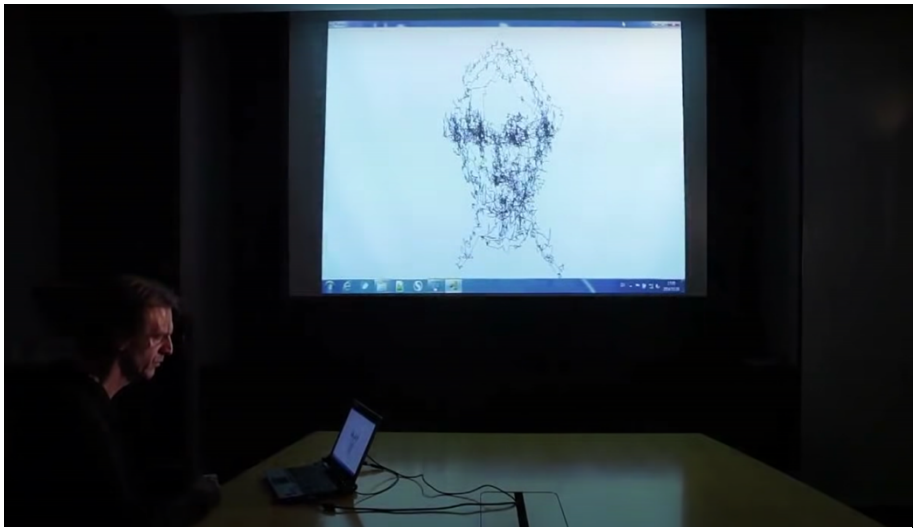


Figure 36: Screenshot from footage of Graham Fink's *Eye Drawings* performance. Retrieved from: Fink 2015.

asked individuals to look at different portraits as an eye-tracking device captured their gaze data. These experiments resulted in works like *Morphologies of Gazes* (2011) and *The Wall of Gazes* (2011), that are both video works rendering the participants' gaze paths to conceal or reveal the imagery of the portraits that had been observed. Another drawing practice that involved portraiture and eye-tracking technology is that of artist Graham Fink. His performative drawing series *Eye Drawings* (2015) was mostly conceived within a setup where a custom eye-tracking software allowed him to manoeuvre a drawing point on screen with his gaze, as he could see the responsive trace left by his gaze in real-time (Figure 36). In an interview with *VICE* reporter Leander Roet (2015) Graham stated that he would: "basically draw the lines in my [his] mind and see what develops on screen. Sooner or later a face will appear."

I would argue that some of these attitudes contrast with the drawing methods explored in this PhD. The general tendency is to position the 'mind's eye' of the artist as the major contributor to drawing practice; a notion embedded within anthropocentric tendencies. The technology is almost never credited and placed in a neutral background. Coss had only spoken of the artist's imagination, and even though Heath never tried the technology in his practice, he speculated that drawing with the eyes would have no intermediary. Comparably, Fink's interest focused on the image of his mind's eye, as he also referred to trusting his unconscious for an image to materialise (Roet 2015). Such attitudes seem to favour performative contributions

Figure 37: Photographs documenting Sougwen Chung's collaborative human-robot drawing process. Retrieved from: Chung 2020.

that focus on the ability of the artist to draw with the eyes. In this sense, the idea of drawing with the eye movements is solely celebrated as an artistic talent, eclipsing the technological participation[36]. In contrast, this practice research shifted the attention to the techno-human relations constituting the progression of the exploratory drawing practice as co-drawing. It is for this reason that I informed the ABR with theory such as Posthumanism, in an attempt to avoid falling into the temptation to regard the technology as secondary to the practice.

Drawing-with technology means that the drawing process is distributed throughout the hybrid qualities of techno-human interactions. The acknowledgment of the technology's contribution to the drawing process shares centre stage with the eye movements and marks its contribution throughout. It proves insightful to compare this to other recent artistic practices that co-draw with technology, such as that of Sougwen Chung who informs technological robots through neural networks trained on her method of drawing, to then make a collaborative human-robot drawing (Figure 37). The artist herself sees: "[…] the potential for AI systems as collaborators" (Chung 2020), where the trained robots and herself draw together in real time on the same canvas/surface. She explicitly regards her artistic process as a human-machine hybrid – something that is also reflected in the several reviews of her work (for example, see Vanessa Chang 2019).

[36] It is important to here acknowledge that I am writing this statement from the perspective of CADP. The argumentation would differ for contexts where for example eye-tracking technology helps members of the community who are physically impaired to draw or to communicate with their eyes (see p.59).

Chung's perspective comes closer to the methods developed by this practice research. It is also in this view that the description 'eye drawing' can be challenged. I myself have used the term in the past as a way to refer to the activity of drawing via an eye-tracker (for example, see Attard 2022), but by reflecting on the technology as co-constituting the practice, I now realise that the term risks giving the idea that the eye is doing all of the drawing. Afterall, when reading captions of drawings exhibited in museums, we are most likely to read something akin to 'pencil drawing' or 'charcoal drawing', and not 'hand drawing'. In this sense, 'eye-tracking drawing' is a better description than 'eye drawing'. This standpoint is also why this dissertation has been informed by Wakkary's notion of *designing-with* (see p.15), and why I have been referring to the process as an act of drawing-with technology. This shift in attitude could only develop during the course of reflecting on the practice research and was not necessarily my preliminary perspective. For example, methods such as conversing with the technology (see p.42) consolidated the technology's position as co-constituent to the practice. The preliminary drawing exercises of my hand (Figure 24) may recall in some way exercises like Fink's methods of portraiture drawing with his eyes, but, the intention of eye-tracking drawing my hand did not only result in a (human) deskilling process of drawing, but also in the acknowledgment of the technology's contribution (see p.106). In this sense, my interest was never about trusting my unconscious to make a drawing, but rather to draw-with the technology's 'unconscious'.

Figure 38: (*Left*) Documentation photography of Hendricks working on *EYE*, 2001. (*Right*) *EYE*, 2001. Eye-tracking data after reading the *San José Mercury News*, published by the *San Francisco Museum of Modern Art*. Retrieved from: Hendricks 2010.

Sardon's portraiture exercise and application of the eye-tracking device (see p.138) is different from Fink's. The artist credits the neuroscientist as collaborator to the practice, and their collaboration can conceptually relate to how we look at each other as human beings. Another compelling conceptual application of eye-tracking data as drawing is that of German artist Jochem Hendricks, who mainly worked with a stationary eye-tracker during the early 2000s. His project *EYE* consisted in reading the newspaper *San José Mercury News* issue from January 1st, 2001, while wearing the eye-tracker, after which the gaze data was reprinted in the format of the newspaper (Figure 38). I find Hendricks' work to have a noteworthy rawness to it, and by presenting the eye-tracking data as a newspaper format he showed an attention to content and medium through which the recorded gaze acquired meaning as a digital drawing. In this way, *EYE* can be both read as a contemporary art project that applied eye-tracking technology to a drawing process, but also as a project that carried conceptual conversations. In the latter respect, *EYE* had the capacity to become a visual metaphor resonating with an open interpretation regarding commentary related to news media, as the format of presentation remained familiar (that of a newspaper), while the news content was represented as abstract signals and lines.

The eye-tracker as a metaphorical witness

The engagement with concept, context and subject matter evolved significantly during this ABR. It was initially influenced by the developed method of drawing-with the eye-tracker in terms of the attention given to the hybridity of the drawing process. Strong contextual elements eventually started to percolate into the practice research, especially with occurrences of the several lockdowns as a result of the COVID-19 pandemic.

The long stay-at-home hours brought an attention to the mundane, through which the technology lent its capacity in the exploration of exercises that ranged from drawing my eye as revealed by the technology (see p.12) to drawing while going up and down the stairs (see p.79) to doodling across the ceiling (see p.119). When compared to Hendricks' eye-tracker from the late 1990s (Figure 38), the flexibility of movement provided by the wearable *Pupil Core* device also played a crucial role in the development of such contextual drawing explorations.

Thus, the first half of this practice research was largely influenced by discourse about drawing and the experimentation around mundane contexts. At the start of the second half of the ABR there was an additional shift in my way of thinking-with the eye-tracking device as a CADP. This was both fuelled by the posthuman writing

hermeneutics approach and the metaphorical perspective of regarding the technology as witnessing my way of seeing.

The emergence of this insight and its influence on the practice will shape the discussion of the following and final chapter of the thesis.

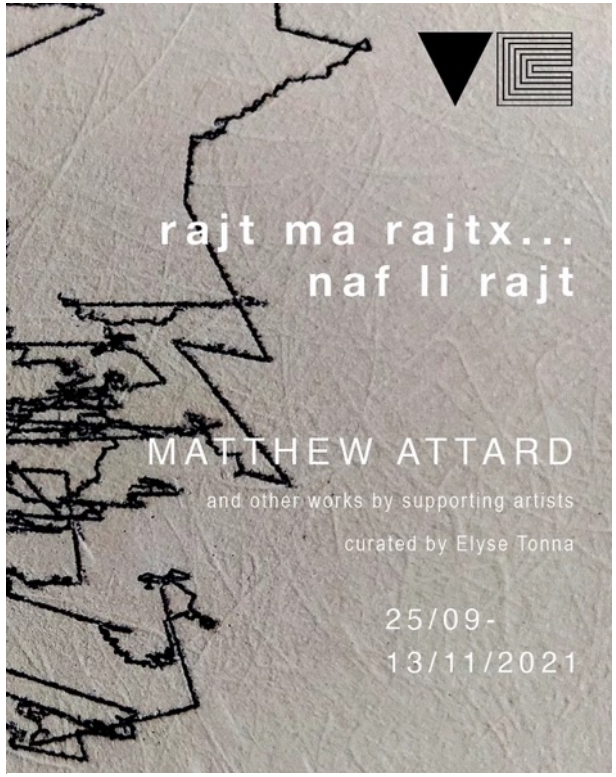


Figure 39: Exhibition poster designed by VC for the exhibition *rajt ma rajtx… naf li rajt*.
Retrieved from: VC 2021.

5. MANIFESTING

5.1 Introduction

In this final chapter I detail the selection of three eye-tracking drawing projects that took place between mid-2021 and 2022. The three projects considered build up in context from the exercises discussed so far in this dissertation, through: i) The opportunity to explore the practice of drawing-with eye-tracking technology in situ in different public places, ii) The opportunity to disseminate the eye-tracking drawing research via arising exhibition invitations. I consider these drawing projects as contribution towards a crucial development in the research by moulding a critical way of questioning in response to different contexts, concepts and conversations. The works that will be mentioned stem from two main solo exhibitions held during the course of this research: the solo exhibition *rajt ma rajtx… naf li rajt* (Figure 39) that took place at Valletta Contemporary[37] (VC), Malta, during September 2021; and the solo online exhibition *Here's How I Did Not See What You Wanted Me To See* that was hosted by Blitz Valletta (BV)[38] as a result of the international art residency programme, *OPEN*. Other eye-tracking drawing projects that were exhibited can be accessed via the portfolio accompanying this dissertation: <**https://portfolio.matthewattard.com/**>.

[37] VC's main website can be accessed through the following link: <**https://www.vallettacontemporary.com/malta-art-gallery/**>.
[38] BV's main website can be accessed through the following link: <**https://blitzvalletta.com/about/**>.

In previous chapters I posited two aspects of the research practice: i) How the nonhuman agency co-constituted the drawing exploration via the developed conceptual framework of drawing-with eye-tracking technology, ii) How the research sits and aligns as an ABR as a CADP. This was principally achieved via a multi-stranded and interdisciplinary methodology informed by the intersectioning of posthuman scholarship, OOO, postphenomenology, drawing theory and notions of digital art among other discussions. Throughout the following chapter I will shift the focus on how the selected three case studies of practice-based research expanded on the exploratory capacity of drawing-with eye-tracking technology in situ, converging with critical conversations.

By my second year of study, the practice could go beyond the confines of my living spaces as from April 2021 the COVID-19 pandemic-related restrictions had been relaxed. I had also received an invitation from VC – an independently run, non-profit contemporary art space in Valletta – to work on a solo exhibition from 25th September to 13th November 2021. VC is an art space that opened in 2018 and has established itself as one of the major contemporary art spaces on the island, with a yearly programme of temporary exhibitions that showcase a curated mix of local and international artists. The first two case studies that will be discussed were initially shown during my exhibition at VC (see pp.163;174).

In 2022, I was selected to be one of three hosted artists during the international online residency *OPEN*, curated by BV. BV is another internationally acclaimed contemporary arts space situated in Valletta. *OPEN* is its latest online platform aiming to reassess notions of public engagement and collective thinking. The third eye-tracking drawing project that will be discussed is the outcome of *OPEN*'s 2022 international residency programme (see p.182).

April 2021

In April 2021, I travelled from Edinburgh to Malta with the intention of working on the drawing practice in situ and remained there until the opening of the exhibition in September. I was granted leave of absence by the University with the aim of undergoing my practical fieldwork (drawing) on the island. Malta is my home country, and my aim of exploring and designing new eye-tracking drawing exercises was guided by a rather multi-layered site-specific question: If drawing-with eye-tracking technology had proven to be a hybrid practice driven by my inner thoughts, the technology's agency and the influence of things and objects within my surroundings, how would the practice evolve the moment it shifted from indoor spaces to specific outdoor locations? This led to an embedding of autobiographical, cultural, historical, contemporary, and socio-political layers to the practice as a form of critique; that will be accentuated in the forthcoming discussions within this chapter and posited as an act of parrhesia (see p.155).

Before delving into the discussions of the selected case studies, I would like to outline two scholarly references that contributed towards the development of the practice research during this phase: i) A critical reading of eye-tracking by art critic and author Jonathan Crary, ii) The practice-based PhD by artist and academic Heather Dewey-Hagborg. This will highlight how critical notions stemming from these two references traversed the tacit knowledge I acquired during my initial experience with drawing-with eye-tracking technology and induced the development of new projects.

Critical notes on eye-tracking

A critical reading of eye-tracking technology that highly influenced the direction of the practice was the essay written by Crary (2018) entitled *Notes on Eye Tracking*[39]. Throughout his career, Crary has notably investigated the influences and impacts of new technologies and capitalism on our visual perception and attention (for example see Crary 1992; 1999; 2014). In his critical essay about eye-tracking technology (2018) he briefly, but firmly, questioned the contemporary cultural impacts that eye-tracking data has on our visual perception via its capitalist application as objective actionable data. He specifically enquired about how eye-tracking big data has become a source of monetisation by means of a neo-liberal constant re-designing of products and displays that shape our environment in ways that direct and manipulate our visual attention for the sake of consumption. He described how the monetisation of eye

[39] Some of these 'notes' have been brought up in the *Interview with E-T* (see p.60).

movements, combined with a one-dimensional interpretation of our visual attention, influence our alleged autonomous decisions on a daily basis. He stated how: “It [the interpretation of eye-tracking data] simplistically presumes a correlation between what one is looking at and what one is thinking of, a confusion with potentially damaging cultural consequences” (2018, p.83). Crary was here exposing a fundamental underestimated problem that we currently undergo because of the assumption that gaze patterns captured by eye-tracking data can reveal our thought process constituting our attention. When this assumption is capitalised-upon, such as when marketing design companies produce adverts with ‘eye-catching’ strategies that tacitly guide our eye movements, one practically suffers the consequences of losing the gaze’s wandering freedom. Thus, visual engagement is narrowed down to specific superficial readings without full awareness, as one passively follows the inflicted non-consensual stimuli – a byproduct of eye-tracking data.

At the time of writing this dissertation, Crary (2022) published another essay that signalled the disruptive realities brought by the digital age, such as the social and environmental impacts of new networked technologies. He concluded his analysis by re-elaborating upon his critique of eye-tracking technology in view of its data’s impact on visual perception. He posited how the neo-liberal application of eye-tracking data in order to design our environment via controlled eye-catching elements – something that commonly happens on the internet during website design – deprives visual experience from anything that the dataset deems as confusing or ambiguous (Crary

2022, p.82). His argument specified how “ambiguity and indistinctiveness are fundamental for our ability to make visual discriminations of many kinds” and identified a long list of artists and thinkers ranging from Leonardo through Ruskin “for whom indistinctness and obscurity are fundamental elements of visual experience as they straddle the boundaries between vision, the flux of memory, and the creativity of reverie” (*Ibid.*, p.82). I interpret Crary’s warning as suggesting that the very jittery nature of the mechanisms of our eyes necessitates to endeavour amid a certain degree of ‘confusion’ of our environment for the fulfilment of rich visual experiences; an ambiguity that is fundamental to art doing and thus, also to drawing as art. In other words, as a co-constituent to our visual perception, the eye is ceaselessly embarked on an explorative venture via probing our surroundings. The application of eye-tracking data for display strategies hinder such exploratory probing and control our way of seeing. Therefore, these alarmingly contribute towards what Crary described as “the devaluation and routinization of vision” (*Ibid.*, p.82).

Figure 40: (*Top* and *Bottom*) Two screenshots from the documentary *Capturing Life* that show Tchalenko's eye-tracking research relating to drawing practice. Retrieved from: Tchalenko 2013.

Crary's critical flagging referred to the rather one-sided rationalised application of eye-tracking data that essentially considers the datafication of eye movements as the determining factor bridging visual perception with thought processes. This made me reflect on how, throughout my readings about the subject, I encountered several studies that scrutinised observational drawing by means of eye-tracking data. Research such as that by Tchalenko (see Tchalenko et al. 2014; Tchalenko 2009; 2001) predominantly datafied the act of drawing by estimating the gaze-points that artists tend to follow when drawing from life in a lab environment (Figure 40). While acknowledging the outcomes of these studies for fields such as cognitive science, I was reluctant to further my exploration along a similar path and methodology due to my scepticism that the end goal of research such as Tchalenko's was to describe drawing through scientific observation and data-driven conclusions (see p.67). In my opinion, this would have risked cornering my practice within a defined formula that contrasts with drawing's open-ended nature and sense of discovery and wandering. Moreover, apart from the fact that most life drawing exercises that have been scrutinised via eye-tracking technology can arguably be considered as outdated when postulated as contemporary drawing, I understand studies like Tchalenko's as a situation where the outcome of data and technology prevailed over the experience of drawing itself. In contrast, the aim of my research practice was to explore more of a mutual approach between the technology and the drawing process. Another similar example to Tchalenko's can be artist and academic Catherine Baker's PhD (2012). Baker suggested a practical exploration with eye-tracking technology where her main

interest was the observation of vision while conducting her own drawing practice. She claimed: “The importance of vision in our understanding of our environment and how eye-tracking might introduce an objective, data based truth to the development of that understanding, became a further focus for my [Baker’s] research” (*Ibid*., p.36). I believe that the exploration adopted in my research opposes this viewpoint. While I also found myself trying to understand ‘our environment’ through notions of vision, my practical exploration challenged the idea that eye-tracking is introducing me to a dataset of objective truth by intersecting eye-tracking technology, my gaze (as a subjective way of looking and seeing), and CADP. Firstly, this was done through the technological agency’s co-constitution to the practice that evolved into the conceptual framework of drawing-with eye-tracking technology. Secondly, the attention given to the nonhuman by the practice repeatedly revealed how ‘our environment’ itself carries notions of non-objectivity, such as historical and personal associations. Thus, the datasets that eye-tracking technology captured as part of this CADP permitted the identification of specific subjective viewpoints and a way of thinking about the world, thus representing it by drawing-with the technology as a techno-human hybrid.

I interpret research like Tchalenko’s and Baker’s as theorising the presupposition that eye-tracking data is representative of our thinking with the capacity to provide insight about the practice of drawing via an assumed objectivity. My methodological approach of drawing-with eye-tracking technology is instead more aligned with

Crary's criticism towards the objective presumption of eye-tracking data. Crary (2018) concluded his article about eye-tracking by stating:

> The data harvested by eye tracking is producing an immense routinization and hollowing out of perceptual experience by means of increasingly intricate algorithms. The result is not so much new forms of control but the impairment of our capacities for vision within both social and natural ecologies.
>
> (p.85)

I am aware that Crary's assertion can arguably be interpreted as demonising eye-tracking technology by some fields, but one must remember that his critique is addressed towards a very specific coercive application of eye-tracking data that manipulates our attention non-consensually. In fact, while fully agreeing with Crary's statement as a critical review of the neo-liberal capitalist application of eye-tracking big data, his claim made me realise that drawing-with eye-tracking technology had enhanced my perceptual experience of things rather than hollowed it out. For example, it was through this exploratory practice that staring at my bedroom ceiling became a creative endeavour akin to doodling as a CADP (see p.117). Drawing-with eye-tracking technology was in fact made visible and possible by the technology's estimation as data points; by means of which I also acquired the perspective of understanding how the technology's agency emerged as a fundamental part of the drawing processes of this research.

Metaphorically speaking, the technology acquired the role of an additional ‘eye’ (and ‘hand’) to the drawing practice and evoked specific ways with which to see the world and make judgements. It also emerged as a metaphorical form of ‘consciousness’ through dialogue that influenced the drawing process from a ‘witnessing’ stand of my way of seeing. By considering the eye-tracker as a metaphorical ‘witness’, as well as a co-constituent to the drawing practice happening in situ, culturally loaded inquiries added a deepened critical viewpoint to the research. It was after these reflections that I fully realised how through my positioning of drawing-with eye-tracking technology, I had not only ‘sabotaged’ the scientific methodology of eye-tracking for an artistic endeavour that involved new forms of image making but had also challenged the presumed objectivity of eye-tracking data. These disclosures eventually influenced the practical exploration of the question: what would be worth the attention of drawing-with eye-tracking technology outside the confines of my apartment?

Stranger Visions

A contemporary artistic research that strongly influenced my contextual thinking at this stage was Dewey-Hagborg’s PhD (2016). Dewey-Hagborg looked at contemporary issues relating to human genomics through a transdisciplinary approach that was informed by notions of contemporary biopolitics, surveillance, forensic

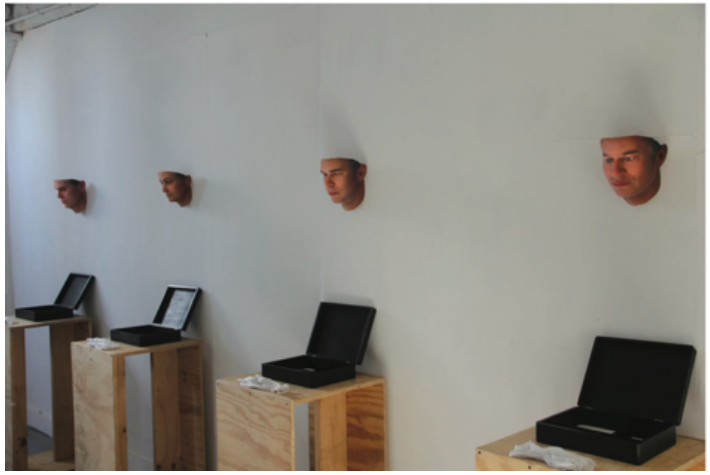


Figure 41: An installation shot of one of Dewey-Hagborg's exhibitions showing a number of 'DNA portraits'. This particular exhibition took place at *Clocktower*, New York.
Retrieved from: Dewey-Hagborg 2016, p.100.

methodologies, ethnic discrimination, institutional bias, speculative design, and engineering. Ultimately, her practical investigation subverted the biopolitical status quo by highlighting how scientific methodologies endorsed by public institutional fields such as criminology are the result of interpretative processes comprising biases, with regards to gender and race among others, that need to be openly and critically reviewed. She most notably did this by adopting amateur techniques of DNA profiling and extraction, to produce speculative reconstructions of portraits through the DNA information sampled-off cigarette butts, chewing gum or even hair that she collected from public spaces (Figure 41).

I found Dewey-Hagborg's artistic research to be telling, illuminating and powerful, and became invested in how the starting point of her investigation can be regarded as an overlapping of: i) The critique of how in our current big data era we are all being profiled, while being 'non-consensually' watched as potential consumers (see *Ibid*., p.13), ii) An in-depth reading of philosopher Michel Foucault's discussion on the role of the artist in society as a *parrhesiastes*[40] (*Ibid*., p.46). Dewey-Hagborg tackled the first point by researching aspects of genetic data to the level that she learned and developed ways of adopting and adapting gene-related amateur forensic methodologies for her artistic research. By means of this, she eventually provided a critical review of what she postulated as a type of future genetic surveillance. This made me reflect on how I had been focusing on the exploration of ways of adopting

[40] This is the term that Foucault uses for a person that uses parrhesia (Foucault 1983, p.12).

and adapting the scientific methodology of eye-tracking technology as a CADP, to the extent that I too was 'amateurly' applying the methodology. I also reflected on the difference between the nature of my practice and that of Dewey-Hagborg's, starting from the obvious acknowledgement that reading and interpreting DNA data is not the equivalent of eye-tracking data. Dewey-Hagborg's practice took place within the context of biotechnology labs, while my practice had so far happened at home and through the datafication of my own eye movements. The latter was a contributing factor for how the practice led me to see things and objects within my environment with a level of speculative attention, that made the traditionally existing human and nonhuman hierarchies visible, challenging them via an explorative way of co-drawing with technology.

The second point of how Dewey-Hagborg looked at Foucault's reassessment of parrhesia in the arts was an influential eye-opener for the development of the eye-tracking drawing exercises to come. Parrhesia is a word that first appeared in Greek literature about 2,500 years ago, and is nowadays roughly translated as 'free speech'. During a lecture series at the University of California in Berkeley in 1983, Foucault discussed the meaning and evolution of the word 'parrhesia', starting from its etymology: "In *parrhesia*, the speaker is supposed to give a complete and exact account of what he has in mind so that the audience is able to comprehend exactly what the speaker thinks" (Foucault 1983, p.12). He eventually developed an account of how parrhesia is a form of duty that relates to the will of speaking the truth by

being frank and critical, even if that would endanger the speaker's life (*Ibid*., p.19). He spoke about the following four characteristics: i) Parrhesia always comes from a position of criticism to tell a truth, ii) A parrhesiastes needs courage in order to use parrhesia, iii) Parrhesia takes place both within self-criticism and criticism towards the other, and iv) When using parrhesia, the "speaker" finds themselves in a position of disadvantage, or in a position of inferiority – for example by telling a truth that goes against public opinion (see UbuWeb 1996). In her artistic research, Dewey-Hagborg looked at Foucault's brief revaluation of the artist's role in society as a parrhesiastes; specifically, by how Foucault had identified artistic practice as being a space for critique that is both culture-oriented and self-reflexive; and hence a space that she read as having "great potential to challenge the status quo" (Dewey-Hagborg 2016, p.50). From this standpoint, art has the potential to add to, or signal conversations as a warning system in society[41].

The methods Dewey-Hagborg developed within her research, and the way she informed the practice with Foucault's discourse to ultimately form a critical enquiry that challenged aspects of the biopolitical status quo, made me ponder on the direction I should take to expand the exploration of drawing-with eye-tracking technology. Dewey-Hagborg concluded her thesis by stating: "By its very existence bioart pushes against boundaries and draws definitions into question" (2016, p.206). By bioart, she was also referring to her own practice, which essentially pushed the

[41] Similarly, the art collective Blast Theory describes their artistic work as an "early warning system", after media theorist Marshall McLuhan (see for example ArtScience Museum 2020).

boundaries between art and science with the capacity of raising uncomfortable questions directed at an established status quo: an act of parrhesia. In this view, I am here also regarding the statements about eye-tracking data presented by Crary (2018; 2022) as parrhesia, together with other works that have been previously cited within this dissertation that have the capacity for the critical questioning of technology's impact, such as; Crawford's *Atlas of AI* (2021), Haraway's *Cyborg Manifesto* (1999), Vallor's call for the need of ethical virtues relating to today's technology (2016), and theoretical concepts that flatten the hierarchies between human and nonhuman (for example see Bennet 2010; Braidotti 2022; Wakkary 2021).

All these readings were embedded within rich forms of critical enquires, and thus, my reflection about the practice also became induced with the question of how drawing-with the eye-tracker could function as a form of parrhesia. In order to start answering this I turned to some notions of seeing that sit within the cultural status quo in Malta.

5.1.1 Cultural notions on seeing

When I arrived in Malta in April 2021 my speculative approach to expanding the exploration of practice revolved around ways seeking to converge the following with the tacit knowledge I had gained by drawing-with eye-tracking technology in my apartment: Crary's critique of how eye-tracking data is potentially devaluating our visual attention and Dewey-Hagborg's use of artistic research as a form of parrhesia

that challenged a status quo via amateur ‘hacking’ of scientific methodologies. Mine was a reflective process that necessitated hours of brainstorming and a revaluation of the main signals that had stemmed out of my speculative and practical exploration of drawing-with eye-tracking technology as a CADP. The main signals emerging from my practical exploration that I wanted to reiterate were: i) My horizontal positioning of the drawing processes attained by the framework of drawing-with the technology, and the ways of attending to this, which made the nonhuman ‘visible’, ii) The expansive adaptation of eye-tracking methodology as a CADP, which had already provided novel ways to challenge the more scientific viewpoint of situating eye-tracking data as objective, and iii) The elaboration of how by positing the technology’s agency as co-constituent to the practice I was exploring a different way of drawing and seeing, and ultimately, a novel form of attending to the gaze as a CADP.

I did not know what new content the practice was going to lead me to explore, but via these reflections I knew that I was at a rich starting point. The work done prior to this stage of the PhD proved fundamental in the understanding of how I further-evolved the ‘conversation’ with eye-tracking technology. I saw this, together with the exploration of drawing-with the technology in situ as an opportunity to assert the practice as a critical inquiry that had the potential to challenge cultural notions of seeing. With this I am not implying that the previous drawing exercises of this artistic research were deprived of critical context. On the contrary, I have been discussing an exploratory ABR that evolved out of a context induced by the objects that shaped my

domestic environment and its mundanity – and this context was also largely influenced by our way of living through the COVID-19 pandemic. However, the intention to conduct a practical exploration in situ in Malta meant that I was now about to draw (and investigate) an entanglement of cultural, social, personal associations, historical and contemporary layers. In other words, my new context for drawing was somehow 'new' (for the practice), and more multi-layered than my previous one. One could argue that even mundane routines, objects and environments such as my apartment are subject to similar entanglements, but perhaps, they were felt less strongly and were more subtle.

My objective was not to expand the practical work via an analysis of my county's socio-political landscape, but to adopt the attitude of drawing-with the eye-tracker within specific public spaces – specific cultural contexts. Via the practice I was drawn to attend to things that needed critical attention. Malta is a country that consists in an archipelago in the middle of the Mediterranean Sea. It is one of the world's smallest countries as well as one of the most densely populated lands; and its strategic geographical location of being a maritime base in the Mediterranean has contributed to its history of successive colonisations. Eventually, Malta gained its independence from the British rule in 1964, becoming a Republic in 1974 and joining the European Union in 2004. Maltese and English are the two official languages of the country. Cultural tendencies have seen a nation in search of establishing its identity in a postcolonial era, and I felt that by embracing the notion of drawing-with eye-

Figure 42: An archival photo of the monument to the proverb ‘rajt ma rajtx, smajt ma smajtx’. The monument still exists but had been moved to a different location. Retrieved from: Xuereb 2003, p.110.

tracking technology in situ, I was also about to attend to, and revisit, aspects from the cultural status quo. I started this by critically and conceptually challenging the specific established oral saying of *rajt ma rajtx, smajt ma smajtx* (translated *I/you saw / I/you did not see, I/you heard / I/you did not hear*).

Rajt ma rajtx, smajt ma smajtx

In many Maltese towns, one finds numerous sites that echo an oral tradition. Most of the stories that survived are embedded within characteristics of the Catholic dogma, and eventually, their meaning took the form of proverbs. One such proverb narrates: ‘rajt ma rajtx, smajt ma smajtx’, that would roughly translate to a warning to not recount what one sees (rajt) or hears (smajt). The cautionary advice originated from a legend that started with a dispute between two men in the town of Birkirkara; after which the first of whom sought a hiding spot in a wayside field. A bystander had greeted him on his way there, and eventually the second man appeared. Oblivious of the dispute, the bystander indicated the hiding location to the former, and the story concluded in murder. An actual monument dedicated to this proverb existed in Birkirkara in the form of a crucifixion (Figure 42), and it had been recounted by a local magazine that there used to be an inscription from 1855 narrating “AUDI VIDE TACE” (translating to Hear See Skirt) at the bottom of the memorial (see Xuereb 2003, p.111). It being an oral tradition, alternative narratives exist. One variation narrates how after the bystander indicated the location of the first man, the second man still

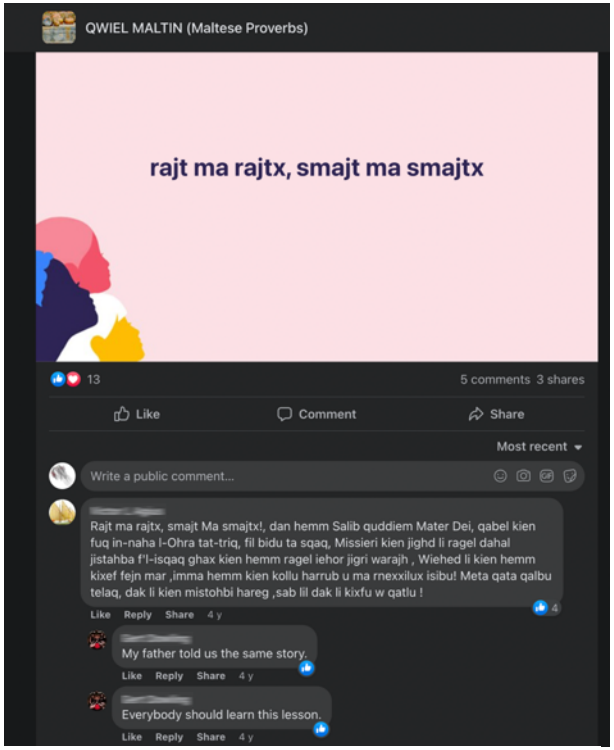


Figure 43: A screenshot of a local social media group that recalls Maltese proverbs. The first reply to the proverb recounts the oral version where the bystander was killed for indicating the hiding position. A reply to the story states that everybody should learn a lesson from this story.
Retrieved from: QWIEL MALTIN 2018.

did not manage to find his foe and abandoned his search; after which, the first man ended up murdering the bystander for having given his location away (Figure 43). This strikes a difference in tone with the previous version, as it recounts the story of an individual who became a victim because he told the truth.

I am giving account of this macabre story with the sole purpose of illustrating the origins of the proverb; a specific proverb that captivated me due to its strong relations to seeing and witnessing as an entanglement of cultural layers and meaning. Legend or not, it is a fact that the tale's cautionary tone in view of taking a witnessing stance percolated into the cultural strata and socio-political aspects; and one can find echoes across the Mediterranean. During our upbringing, my generation was still injected with an attitude of self-restraint from 'speaking-up'. This instilled a behaviour of not recounting what was witnessed in fear of getting into trouble (or of getting someone else into trouble): an induced ethos of compliancy and at times, complicity. The culture of the 'rajt ma rajtx' proverb is occasionally cited by journalists denouncing claims of alleged corruption at administrative levels (for example, see Busuttil 2015; Galea 2019). The phrase has also been used by subcultures that caricaturised the behaviour established by the proverb and how it influenced the vernacular mundanity; a case in point being the song *Rajt ma Rajtx* by the punk-rock band *Xtruppaw* (2006).

rajt ma rajtx… naf li rajt

By revisiting the origins of the proverb and the positioning of eye-tracking technology as a metaphorical witness via the practice of drawing in situ, I crafted a 'counter proverb'; that became the title of my solo exhibition at VC. This cut the original proverb short with the addition of *naf li rajt*, hence translating as: *I/you saw / I/you did not see … I know that I/you saw*.

The original proverb instils a culture of silence behaviour with a subtle hint at the reluctance of individuals to act or react to witnessed events. On the other hand, the intentional modification of the oral tradition induced a form of conscience bridging a witnessing stance with the act of seeing; reinforcing an ongoing dialogue with the technology that branched out of the fictitious *Interview with E-T* (see p.42). In response to a cautionary expression to reject a witnessing stance (*rajt ma rajtx*), there came the firm answer [from the technology] stating that it knows what I saw (*…naf li rajt*).

Through this play on words, the title immediately hinted at how the exhibited work at VC[42] would be taking on a playful yet critical approach when looking at local social and cultural landscapes (see Tonna 2022). It included the direct confrontation towards a traditional, yet problematic, proverb while expanding on my 'conversation' with the

[42] Comprehensive documentation of the exhibition can be accessed via the portfolio accompanying the PhD (see <**https://portfolio.matthewattard.com/rajt-ma-rajtx-naf-li-rajt/**>).

technology. This would ultimately pave the way for the exploration of underlying concepts of drawing-with eye-tracking technology through a critical enquiry that reinforced notions of witnessing, seeing and looking. By positing the practice in such a way, I felt that drawing-with eye-tracking technology could expand on its capacity of being an act of parrhesia.

5.2 Three eye-tracking drawing projects

The following subchapter discusses three selected drawing projects. The first two stem out of the solo exhibition *rajt ma rajtx… naf li rajt* (see pp.163;174). The third eye-tracking drawing project *Here's How I Did Not See What You Wanted Me To See* was the outcome of Blitz's *OPEN* digital residency (see p.182).

5.2.1 *Id-Dgħajjes tal-Fidili*

The first project I will be reviewing is *Id-Dgħajjes tal-Fidili*. A more detailed version of the following text has been published as a peer-reviewed research paper by the journal *Drawing: Research, Theory, Practice* (see Attard 2022). The *Id-Dgħajjes tal-Fidili* project bridged the Mediterranean historical tradition of incising ship graffiti[43] into the stone work of chapel facades with the contemporary potentials brought

[43] I am referring to these historical images as 'graffiti' and not 'drawings', following the narrative of historians and archaeologists that have written about them (for example see Muscat 2006).

Figure 44: (*Top*) Two examples of the historical *ex-voto* ship graffiti.
(*Bottom*) Documentation photo taken by curator Elyse Tonna while I was tracing an incised ship drawing with the *Pupil Capture* eye-tracking device in June 2021.

forward by the eye-tracking drawing methods explored in this PhD. I essentially attempted to redraw several of the historical ship graffiti with the eye-tracking device, developing a re-presentation of the original imagery as eye-tracking drawings (Figure 44). Moreover, the given title *Id-Dgħajjes tal-Fidili* contributed to a deliberate word play in the Maltese language, where even though it literally translates to *The Boats of the Faithful*, it can also denote *The Boats of the Fools*[44]. I will clarify this double meaning by the end of this subchapter, after providing a brief contextual description of what the original ship graffiti are, and how these influenced the practice of drawing-with eye-tracking technology.

Contextual positioning

The vernacular convention of drawing ships in public places spans a long history across the Mediterranean, and the incised drawings are not only found on chapels. On the island of Malta, the tradition extends beyond the 1500s, and as maritime historian Joseph Muscat had noted:

> Undoubtedly, the maritime traditions of the islanders and the proportion of the population employed in this sector was a contributing factor. Additionally, the soft globigerina stone extensively employed in Malta for the building of temples,

[44] An aspect of this research project has the potential to conceptually and critically link to the historical allegory of *The Ship of Fools*, which in principle speaks of problems of governance. This is something that is being fully explored separately from this dissertation as this critical aspect is vast and differs from the aims and objectives of this PhD.

Figure 45: The chapel at Wied Qirda, Ħaż-Żebbuġ.

churches, prisons, fortifications, public and private buildings is a medium that lends itself to the incision of *graffiti*, and further explains the high incidence of such *graffiti* in a relatively small space.

(2006, p.143, original emphasis)

I became specifically interested in redrawing the ship graffiti that had been incised on the outside walls of various wayside chapels, specifically because of the accepted reading that these graffiti had been etched into stone as *ex-votos*. An *ex-voto* consists of a votive offering towards a divine intervention, making the graffiti a manifestation of faith through drawing. Muscat (2006) recounted anecdotal evidence that graffiti on church facades were also considered to serve as prayers. He added that: "no priest would allow any defacing of the exterior or interior of his church, if the *graffito* was not accepted as being an *ex-voto*" (p.145, original emphasis).

I particularly focused on a wayside chapel found at Wied Qirda – a valley in the town of Ħaż-Żebbuġ – namely because of the abundance of ship graffiti decorating its façade (Figure 45). Multiple noteworthy characteristics evoked by the imagery of these ships caught my attention. The fact that they were made to manifest an act of human faith towards a religious belief is a culturally loaded and fascinating aspect, and can relate to the large history of imagery and iconographies that hold powerful forms of doctrine, present among various cultures and societies. It is also worth noting how the graffiti were vernacularly etched by individuals who were essentially

Figure 46: A screenshot of the captured footage by the *Pupil Capture* binocular device. The screenshot shows my gaze path (in white) as I tried to retrace one of the ship graffiti. It was exported via *Pupil Player* during postprocessing.

'non-artists'. Yet, this in no way diminishes the aesthetic qualities evoked by the incised representations, that at times is also aided by nonhuman elements such as the stone's weathering. Moreover, such imagery now resides in 'silent' rural areas away from main sites that can be deemed to be more 'touristic'.

To draw in situ, I wore the *Pupil Core* mobile binocular eye-tracker and attached the device to my laptop running the *Pupil Capture* software, calibrated the eye-tracker onsite, and placed my laptop in a backpack. This allowed me to roam in front of the chapel's façade as I redrew the ship graffiti with my eye movements, while the technology captured and estimated my gaze path. The drawing process consisted of following and 're-tracing' the historically etched lines with my gaze for the purpose of a re-presentation of the ship graffiti. My gaze (as drawing) was simultaneously captured (and interpreted) by the technology. As per the previously discussed eye-tracking drawing exercises, the eye-tracker's digital encoding took place away from my visibility or control and was stored on my laptop's hard-drive from where it was accessed during postprocessing (Figure 46) and re-presented as eye-tracking drawings.

Once the captured data was generated into the resulting drawings, these became evocative of the 3-dimensional characteristics of the binocular eye-tracking datasets[45] (Figure 47).

[45] See introduction to this PhD, for discussion on the different characteristics of the drawings resulting from the monocular and binocular models (see p.5).

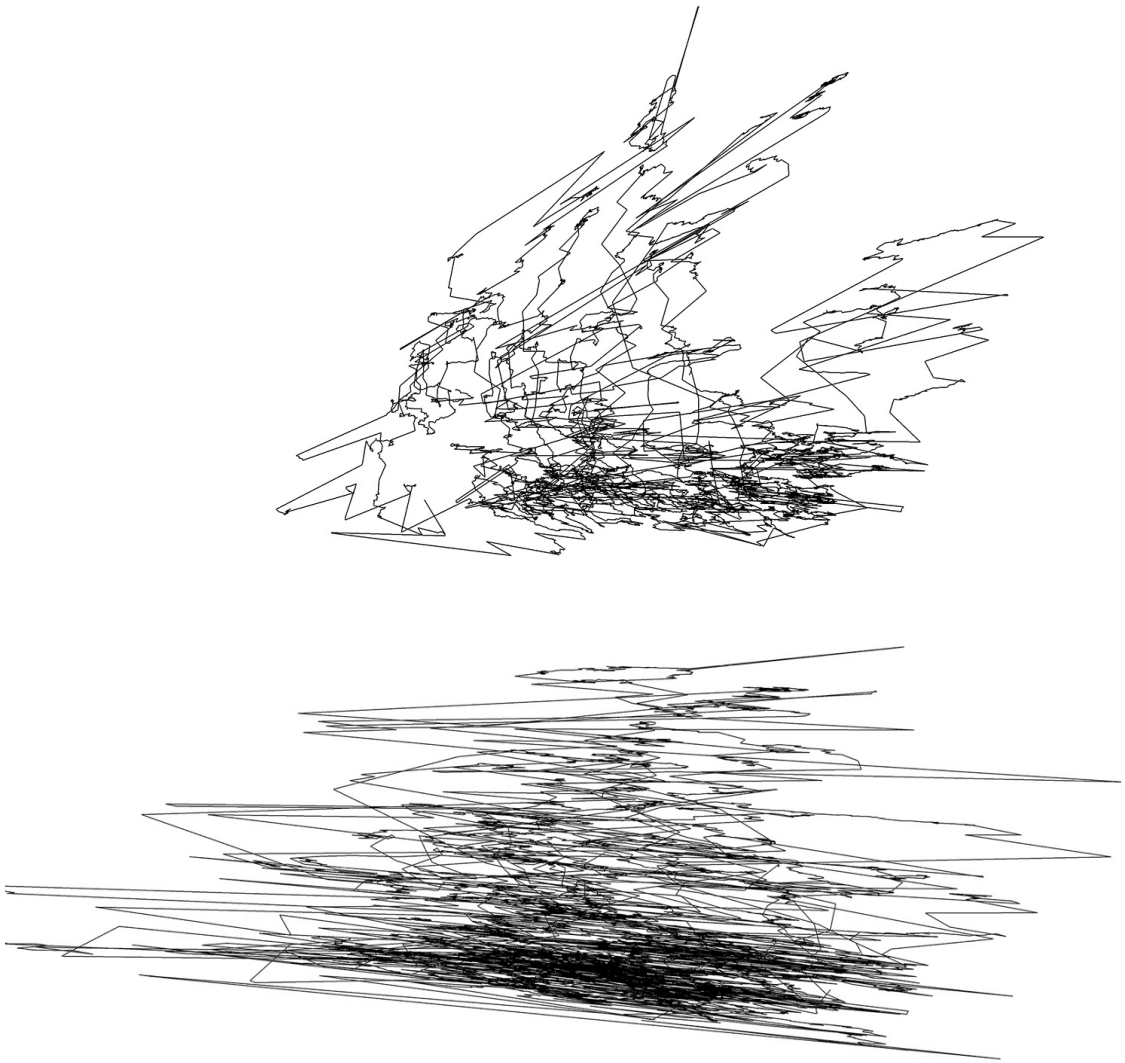


Figure 47: Two different viewpoints of an eye-tracking drawing of a ship graffiti that was made using the *Pupil Capture* binocular device and *Rhino 3D*.

Narrative and metaphorical implications of the drawing results

The title of this particular drawing exercise derived from a play on words through a nonliteral translation, interweaving cultural, historical, critical and contemporary notions. Firstly, given the contextual location of the historical graffiti, the narrative took form in the Maltese language: *Id-Dgħajjes tal-Fidili*. The language itself resonates cross-cultural influences, being the only Semitic language that developed a written Latin script over the years (Harwood 2021). *Id-Dgħajjes tal-Fidili*, would literally translate in English to something akin to, *The Boats of the Faithful*, but with an important and crucial ambiguity. The term 'fidil' in Maltese descends from the Latin word 'fidelis' meaning, 'of faith' or 'faithful'. However, in the typically spoken Maltese language, 'fidil' came to also refer to someone who is foolishly and uncritically trusting by nature: a 'fool' who can be easily and straightforwardly deceived. Therefore, the term 'fidil' can also refer to an act of mockery, satire or ridicule – giving the eye-tracking drawings an ironic play on words and meaning.

In this way, when seen from a literal perspective, *Id-Dgħajjes tal-Fidili* (Figure 47) are eye-tracking drawing re-presentations of the 're-tracing' of vernacular ship graffiti that were historically drawn by the (religious) faithful. A nonliteral perspective can give a multifaceted and metaphorical reading with the capacity for a new critical inquiry. During the process of redrawing the original etchings, it was crucial to acknowledge their devotional significance and cultural context: they were after all

Figure 48: (*Top*) A rendering showing the intersecting of different viewpoints through the circular set-up of the six plexiglass sheets.
(*Bottom*) A QR code leading to a moving image of the render.

drawings made for the purpose of acting as *ex-voto*, as a manifestation of one's blind faith. Redrawing them with the technology was thus in a way a reappropriation of a complex cultural and historical narrative via contemporary means.

Archival 'accuracy' and faithfulness of reproduction of the historical imagery were not the goals of the exercise, and the unexpectedness resulting from redrawing the graffiti as a techno-human hybrid took precedence. In this view, revisiting the ship graffiti with the eye-tracking device instigated its own meaning: one trying to correspond with an act of drawing, but differing in the belief and the devotion at the roots of the *ex-votos*. The metaphorical word play of the title presented the viewer with a subtle provocation about the subjects we become through our contemporary techno-human relations: Is drawing with a networked technological apparatus an act of 'faith' towards techno-deterministic tendencies, or an act of 'foolishness' and naive trust in data and technology? This open-ended provocation and question is where the critical meaning of this drawing project lies adding to the need for a critical conversation and assessment of the technology being drawn with.

Exhibiting the ship graffiti eye-tracking drawings

When exhibiting the digitally generated eye-tracking drawings of *Id-Dgħajjes tal-Fidili*, I became interested in exploring ways of physically manifesting the digital drawings. I reflected on how *Id-Dgħajjes tal-Fidili* emerged from a multilayering of viewpoints

Figure 49: A detail of the plexiglass installation at VC.

and cultural perspectives that were also conceptual, and how the binocular eye-tracking data reinterpreted the two-dimensionality of the original ship graffiti as a three-dimensional line in the virtual space (Figure 47). Another reflection revolved around the materiality of the stone itself onto which the graffiti had been originally engraved. These resonances led to the 'fabrication'[46] of the digital eye-tracking drawings via two modes of presentation: i) Large-scale digital prints on intersecting sheets of plexiglass, and ii) Several pen-plotted drawings on globigerina limestone.

The intersected plexiglass prints proved to be an effective snapshot of representing the three-dimensional properties of the digital eye-tracking drawings in a physical space. I digitally exported three different viewpoints of the resulting eye-tracking drawing: a frontal viewpoint, a side viewpoint as seen from the left and a side viewpoint as seen from the right. These 'flattened' perspectives[47] of the eye-tracking drawing were exported as digital images, and each viewpoint was then printed onto two sheets of transparent plexiglass (resulting in six sheets in total) measuring 2.20mx1.20m (Figures 48 and 49). Each plexiglass sheet was installed following a circular arrangement, resulting in an intersection of the multiple viewpoints of the eye-tracking drawing of the ship graffiti. The multiple viewpoints could be experienced through the different perspectival viewpoints above, below and alongside offered by the architecture of the exhibition space itself (Figure 49).

[46] Fabrication generally refers to processes like 3D printing or laser-cutting. In my case I am using the term in inverted commas as strictly speaking I did neither. In one case I assembled a sculptural form out of digital prints, while in the other I directly pen-plotted onto unconventional material (stone).
[47] These were perspectives conditioned by the 3D software's viewport, as already discussed in the case of the artwork *Skulls* by artist Robert Lazzarini (see p.129).

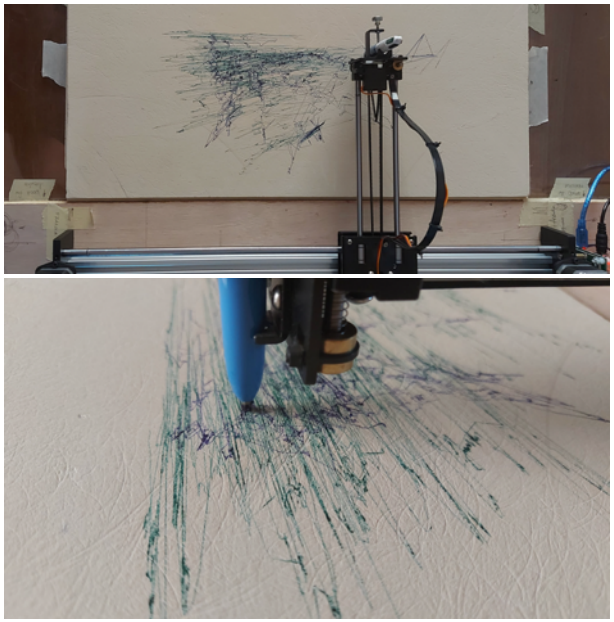


Figure 50: Two images documenting the process of pen-plotting an eye-tracking drawing of a ship graffiti onto a slab of globigerina limestone.

The second mode of re-presentation consisted in a series of drawings that were pen-plotted onto twelve slabs of globigerina limestone – reminiscent of the original type of stone onto which the historical graffiti had been originally etched (Figure 50). The nature of these works was highly experimental as a stone slab is an unconventional surface to pen-plot on. However, since pen-plotting had the capacity of redrawing the eye-tracking drawings by following the eye-tracking datasets in very high definition, by essentially moving according to the dataset as XY coordinates, I wanted to explore the idea of re-presenting the eye-tracking drawings of the ship graffiti as 'new' contemporary graffiti on stone.

The stone slabs were placed beneath the pen-plotter, which drew the eye-tracking drawings following the coordinate instructions (Figure 50). The pen-plotter and the stone slab are not what one would consider to be compatible media/material, and experimentation was needed to find ways of plotting onto the uneven and rough surface of the stone. Even more so, the behaviour of the ballpoint pen on the dusty surface of the slab created friction throughout the plotting process. By learning how to achieve a plotted image of the eye-tracking drawings via notions of 'trial-and-error', the process resulted in interesting manifestations of the materials' agency. These works also gave me the opportunity to 'flatten' different perspectives of the digital three-dimensional eye-tracking drawings by overlaying them onto the slabs'

Figure 51: An exhibited pen-plotted drawing. The difference in the tonality of the line is representative of two different viewpoints of the binocular eye-tracking drawing.

Figure 52: A screenshot of Castille Square taken from Google Street View.
Retrieved from: Google Maps 2016.

two-dimensional plane by means of tonal gradations or colour coding (Figures 50 and 51).

5.2.2 Drawing-with the eye-tracker in Pjazza Kastilja

Introduction

One of the most renowned public squares in Malta is Pjazza Kastilja (Castille Square - Figure 52). Pjazza Kastilja houses two main buildings: the Auberge de Castille and St. James Cavalier. Both are historical buildings and examples of the architecture left behind by the Knights of St. John. The Auberge de Castille has been serving as the office to the Prime Minister of Malta since 1972. On the other side of the square, the fortifications of St. James Cavalier had been transformed into the national arts and cultural centre back in 2000 – now called Spazju Kreattiv (SK), while the square itself underwent a revamp in 2015.

Anecdote

In May 2021, I was walking through the square as I paused and sat down on one of the benches overlooking both buildings. A water fountain now lies in the middle of the square, and is surrounded by public monuments reminiscent of local political recent history, their display frequently carrying a local political agenda. A police box between

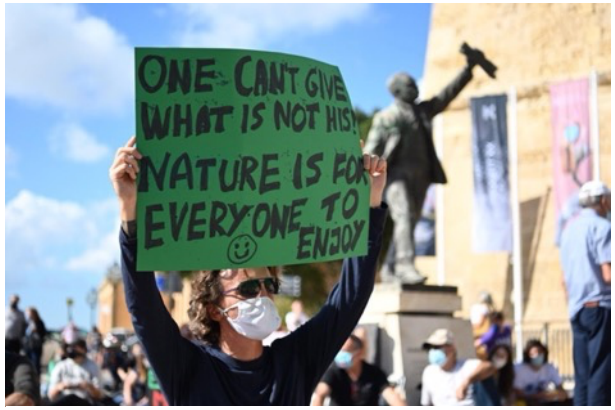


Figure 53: A photograph taken during an environmental activists' demonstration that took place in Castille Square in 2020.
Retrieved from: Arena 2020.

both buildings is still active and guards the entrance to the Auberge. As I observed the influx of tourists that were capturing their selfies in front of the main stairs leading to the Auberge, my eyes kept bouncing between the entrances to both buildings from one corner of the square to the other. The moment I became aware of my eye movements, I remembered of my eye-tracking doodling exercises such as the one of the stairs (see p.79), with the difference that my present space was public; and historically, politically and culturally rich. I therefore thought about the multi-layered meanings and functions of Castille Square as a public space. The richly decorated Baroque façade of the Auberge encases one of the highest administrative offices of present-day local politics, so much so, that the term 'Kastilja' has become a shorthand that refers to the office of the Prime Minister, or the running of the government. In this sense, it is the equivalent of what 10 Downing Street is to the U.K.

Castille Square is also a place that echoes the island's colonial history, besides being a major touristic attraction. Furthermore, it is a place in front of which members of the public have since recent times started to assemble whenever there was cause for protest[48] *(Figure 53). On the other side, SK's façade is austere, indicative of its original function as a military building. I observed the public dynamics of the Square and the differences between both the Auberge and the Fortification, while reflecting on their connections. For example both buildings are governmentally-owned, and both are protected heritage landmarks. The more I looked, the more I sensed an overlapping of*

[48] For the coverage of some recent protests in Pjazza Kastillja see Azzopardi and Meilak 2021; Agius and Hudson 2019; Borg 2019; Diacono 2017.

historical, cultural, contextual, current affairs and socio-political layers; and eventually decided that I should draw this public place/square/architecture/context with the eye-tracker.

The drawing exercise

During the months of May and June 2021, I started to repeatedly visit Castille Square as a place where to draw-with the eye-tracking device, as one of my exploratory contemporary drawing projects. My enquiry revolved around the observation of the multiple layers evoked by the dynamics of the public space. In the previous three chapters I have already discussed how the methods explored by this ABR attended to the nonhuman capacity for agency and their ways of co-constituting the drawing process, and such experience did not differ to the drawing exercise at Castille Square. The surroundings of the Square equally affected the drawing process and became a place for the gaze to wonder and wander as a contemporary drawing exercise. As a site for non-verbal protest, I am drawn to philosopher Judith Butler's (2015) notions of the performativity of bodies when they assemble in protest, how, "Human action depends upon all sorts of supports – it is always supported action" (p.72). I was not conducting a drawing exercise as an assembly with other individuals during an organised protest, but still, I consider drawing-with the eye-tracking device at Castille Square as having been a 'supported action' in similar ways to Butler's description. My actions were both supported by my assembly with the technology in terms of how

this influenced my ways of looking, seeing, drawing and reflecting, and by what the surroundings of the Square exerted on my visual attention. The latter observation can echo how Butler also noted that "[…] bodily movement is supported and facilitated by nonhuman objects and their particular capacity for agency" (*Ibid*.). In view of this, the capacity for agency of the nonhuman surroundings of Castille Square traversed across the historical, the cultural and the political.

During the multiple drawing exercises, I wore the monocular eye-tracking device activated via my mobile phone, as I covertly 'performed' different ways of drawing around Castille Square. At times I was captivated by a particular architectural detail and stared at it. Occasionally, I instead doodled with the eye-tracker across both buildings (SK and the Auberge) or around the Square itself, while at other times I attempted to follow some of the architectural outlines with my gaze. Further to this, there were moments where my gaze was captivated by the movements and activities of the other individuals who momentarily shared the space with me; like for example the tourists roaming across the square or the changing of the police guard on duty. Essentially, on different days, I drew from multiple locations around the Square via multiple ways of looking (gazing) at things and actions. Thus, the performativity of the drawing project blurred the boundaries between drawing, looking, seeing, and reflecting.

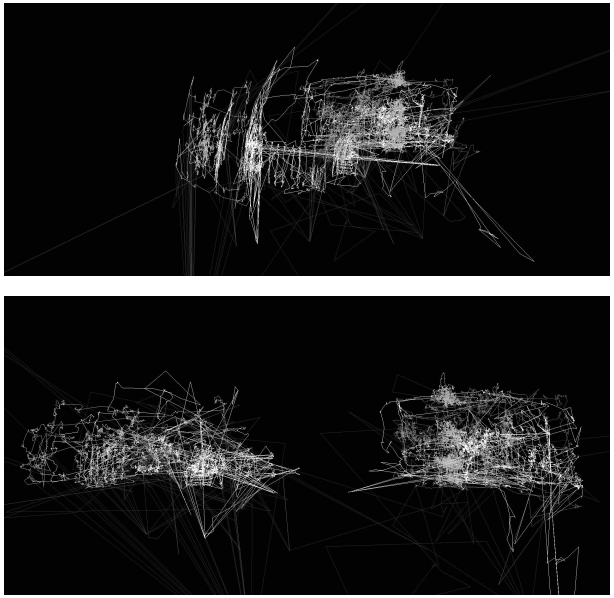


Figure 54: (*Top*) Different viewpoints of the eye-tracking drawing arrangement of Castille Square within *Rhino 3D*. (*Bottom*) A QR code leading to a video animation that oscillates the viewpoints of the eye-tracking drawings.

I eventually started to import the eye-tracking data into *Rhino 3D* during postprocessing and after the data was generated into eye-tracking drawings, I placed the resulting digital drawings within the virtual three-dimensional space of the software in an order that approximately corresponded with the viewpoint from where they had been captured. This allowed me to overlay multiple digital drawings of different perspectives, and ultimately began to form a delineated 'mapping' of my eye movements across Castille Square as a three-dimensional digital drawing (Figure 54). Thus, within the three-dimensional digital space of *Rhino 3D*, I superimposed the multiple eye-tracking drawings done in situ and formed a representation of the public place by overlaying the eye-tracking drawings.

Exhibiting the eye-tracking drawings of Castille Square

When reflecting about the possible ways of presenting the accumulated eye-tracking drawings representative of my multiple subjective points of view of the Square, the characteristic that each digital line was evocative of a different perspective became a prominent one. While orbiting around the overlayed digital drawings in *Rhino 3D* (Figure 54), it became apparent to me that their presentation was effective when manifested as a moving image due to exposing the three-dimensional characteristics of the digital lines. The digital drawings were rendered in white onto a black background and an animated loop was generated that oscillated between the 'frontal' viewpoint of the Auberge that side-viewed SK; and vice versa. These exposed multiple

Figure 55: Two different installation shots of the double projection onto two walls meeting at a corner during the exhibition at VC.

perspectives of the eye-tracking drawings (Figure 54). The oscillating loop revealed the three-dimensional nature of the eye-tracking drawings as it offered multiple viewpoints of the overlayed drawings to the viewer. At VC, the animation was projected as a digital video loop spanning two walls meeting at a corner, and the ceaseless change in the viewpoints also instigated a conceptual provocation that will be further discussed below (Figure 55).

I saw this animated perspectival movement having the potential of an open-ended critical provocation. In the case of Castille Square, the eye-tracking drawings represent a politically, historically, and culturally charged place, and thus, the loop animation also alternated between multiple perspectives relating to governance and culture. This had the capacity to evoke questions such as: What do differing point of views mean in such a place? To what extent can free thinking (or parrhesia) be exercised within a cultural institution that is governmentally-operated (SK) and situated adjacent to the Castille building that houses the highest form of governance?

Referring to Butler's discussion about the politics of the performative body, I would like to add a note regarding her statement that "Not every act of political self-determination can be translated into that verbal utterance—such a move would make the verbal domain more privileged than any other" (2015, p.170). Butler here posits the importance to attend to performative instances that cannot always be thoroughly described in words, and I align with this necessity to level the commonly assumed

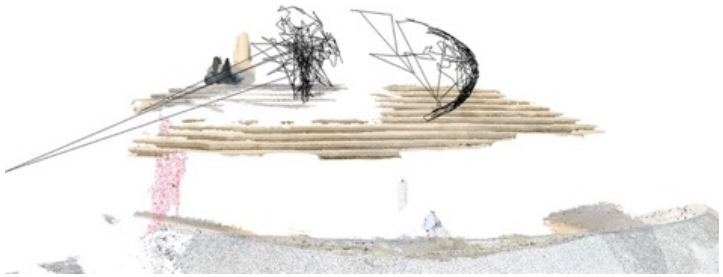


Figure 56: (*Top*) A screenshot of the resulting eye-tracking doodle after climbing up and down the Auberge de Castille stairs. The eye-tracking drawings were superimposed with a rough 3D scan of the square. (*Bottom*) A QR code leading to a rotating animation of the doodling exercise.

opposition between the verbal and nonverbal domains. The projected eye-tracking drawings of this exercise bear witness to the nonverbal actions I carried out in Castille Square. My nonverbal actions gave me a vantage point that related to the multi-layered perspectives of this prominent public place and were reinforced and exercised by drawing-with the eye-tracking device via the overlapping of looking, seeing, reflecting and drawing. Ultimately, these multiple viewpoints were relayed back to the public for their own reflection and interpretation.

An observation about privilege

Drawing-with the eye-tracker in situ at Castille Square also allowed me to exercise my right to observe, question and move within a place laden with political meaning that effectively is also surveilled and guarded. I here feel the need to acknowledge the privileged position of being able to conduct such a drawing exercise. Nobody halted or interrupted my moving around the square, so much so that at one point I also managed to repeat and adapt a drawing exercise that I had previously done on the staircase leading to my apartment (see p.79): I doodled-with the eye-tracker while walking up and down the staircases leading to both the entrance of the Auberge and that of SK (Figure 56).

5.2.3 *Here's How I Did Not See What You Wanted Me To See*

For the third project, entitled *Here's How I Did Not See What You Wanted Me To See* I explored drawing-with eye-tracking technology as a form of an 'artistic sabotage' in response to the suggested or pushed content of the social media platform *TikTok*. The project developed out of the interest to 'hack' the expected gaze patterns when we interact with social media platforms to openly and critically reflect on how these are essentially digital products driven by algorithms designed to induce us into constant engagement leading to habitual and addictive behaviours. With this project I looked at how such platforms affect us by subverting the autonomy and agency of our gaze; and in many ways I here draw a parallel with Crary's remark of how eye-tracking data has been extensively utilised to control and direct our gaze in non-consensual ways within different environments[49] (see p.147). Much has been written about the impact of digital algorithmic technology on our contemporary lives and the need for an open and critical review of issues like surveillance, discrimination, addiction, capitalistic strategies and biases such as race and gender that are covertly manifested by algorithms (for example, see Bucher 2017; 2018; Chun 2011; Crawford 2021; Marino 2020; Noble 2018; Vallor 2016; Zuboff 2019). With this project I did not intend to uncover underlying aspects of the 'black box' of social media algorithms but aimed to develop an interactive work that highlighted a satirical attempt at regaining a form of

[49] In the case of social media, eye-tracking data is merged with other forms of data collection – such as the user's mouse movements, clicks and frequency of usage among others – for the constant redesigning of the platforms in order to increase user engagement.

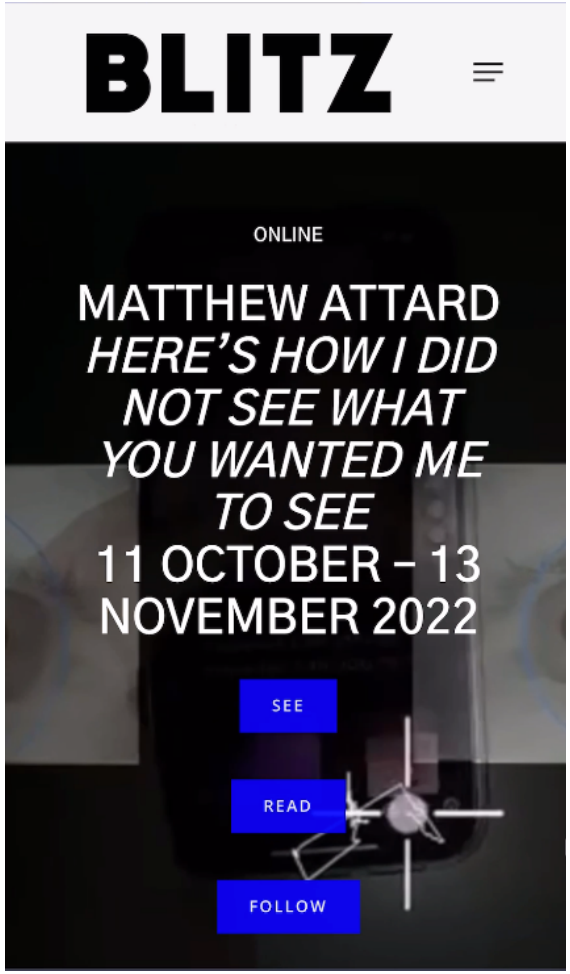


Figure 57: A screenshot from the opening page of the online exhibition *Here's How I Did Not See What You Wanted Me To See*, hosted on the *OPEN* digital platform by *Blitz Valletta*.

agency via unexpected and improvised ways of not looking at the suggested content of social media platforms. The process of attaining this will be detailed below, but in short, I scrolled through the *TikTok* feed with my thumb via my mobile phone and 'challenged' the platform's algorithm by looking away from the suggested content. The resistance to not see the content was made visible by the eye-tracking technology as a direct contrast with the general tendency that utilises eye-tracking data for further engagement in consumeristic environments. The outcome of this experience was relayed back to the Internet community in the form of an interactive website as an online contemporary art exhibition that was available for viewing between 11th October and 13th November 2022 (Figure 57).

The project developed throughout the online digital residency hosted by BV, which took place during July 2022. The residency included frequent conversations with curator Sara Dolfi Agostini and author and curator Valentina Tanni, as well as discussions with: poet and critic Kenneth Goldsmith, digital artist Ben Grosser, and digital art curator Domenico Quaranta.

The development of the project

Here's How I Did Not See What You Wanted Me To See originated from the interest to draw-with eye-tracking technology as an exploration of ways of looking as a form of resisting the suggested content presented by present day algorithms that opaquely

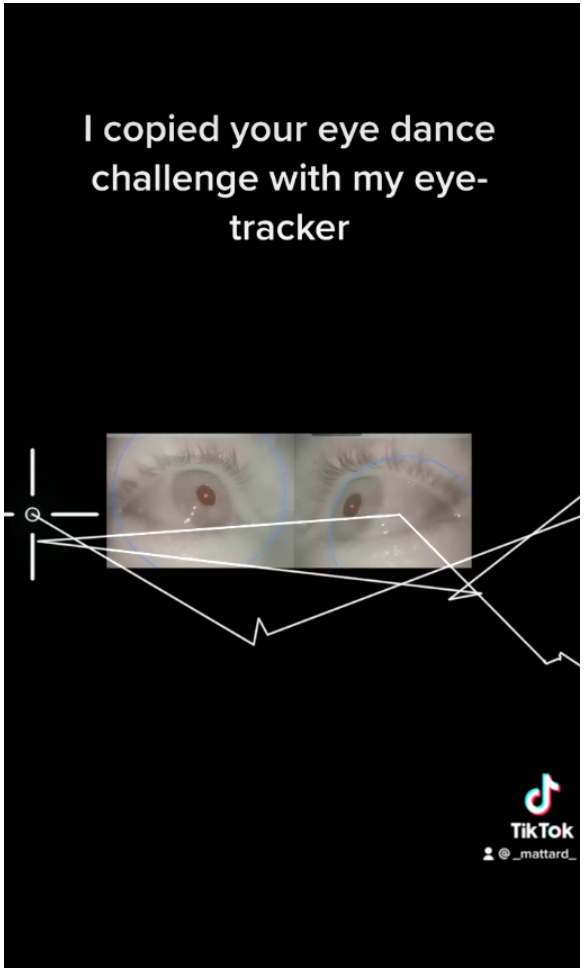


Figure 58: A screenshot from an experimental video in reaction to my *For You* suggested content. While wearing the eye-tracker, I copied the 'dancing' eye movements from another user's video that had been uploaded as *TikTok* content.

operate social media platforms such as *Facebook*, *Instagram* and *TikTok*. I explored these feeds with the intention of developing a form of 'artistic sabotage' made visible by the footage and data captured by eye-tracking technology, that highlighted and brought forward critical reflections on notions of seeing in the context of social media platforms.

As part of the project's research, I initially wandered through different social media platforms and looked at a variety of content by using the following hashtags as search keywords[50]: #eye, #eyetracking, #eyemovement, #eyedrawing, #gaze and #see. The platform algorithms started to suggest their own search indicators such as: #eyedance, #eyechallenge and #eyetrend among others.

I became particularly captivated by *TikTok* in view of how the social media platform's algorithm tailors a *For You* page targeted at each individual user. In essence, when a user registers a new *TikTok* account, the *For You* page is highly influenced by the initial interactions and searches of the user and this data becomes the basis for the recommended content towards the user. Thus, when I registered a new *TikTok* account for the exploratory purpose aimed at this project, my *For You* page suggested extensive content that included eyes. During the preliminary eye-tracking experimentation I produced several preparatory video sketches elaborated in

[50] Digital content on social media is uploaded by users with hashtag keywords that categorise the content and fuel the algorithmic search indicators.

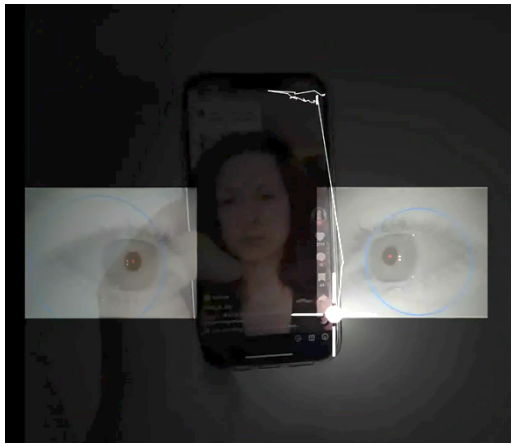


Figure 59: A screenshot from the digital video of *Here's How I Did Not See What You Wanted Me To See* where I repeatedly directed my gaze (white cross and lines) along the edge of my mobile phone.

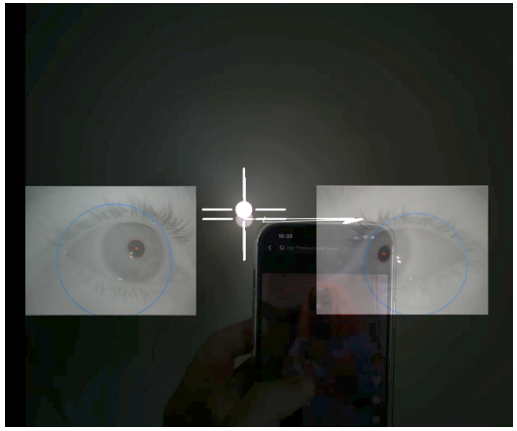


Figure 60: A screenshot from the digital video of *Here's How I Did Not See What You Wanted Me To See* where I held my gaze (white cross and lines) at a side corner of my mobile phone.

response to the suggested content[51], for example, on one occasion I replicated a *TikTok* video trend where users 'dance' via their eye movements to suggested tunes, and I attempted this challenge with the eye-tracker (Figure 58).

During the residency, I came across the statistic that the average *TikTok* user spends an hour and a half daily on the platform, and this information helped me establish the format of the project's outcome. While wearing the Pupil Core binocular eye-tracking device, I scrolled through my *For You* page for an hour and a half on my mobile phone with the intention of purposefully not looking at the suggested content. Thus, while scrolling with my thumb, I creatively improvised ways how to not see the feed. For example, at times I repeatedly directed my gaze along the edge of my mobile phone (Figure 59). On other occasions I held my gaze at a side corner of the same device (Figure 60). During the one and a half hours of scrolling I kept improvising such tactics of different ways of not seeing the suggested *For You* content. Simultaneously, the eye-tracking device captured the footage and estimated the gaze movements of my 'artistic sabotage'. The resulting data was retrieved and postprocessed into a rendered and edited digital video of the one and a half hour footage that comprised of the following composited layers: a low exposure footage resulting from the eye-tracker's frontal camera, two video overlays of the movement of both eyes resulting from the eye-tracker's 'eye cameras' (see p.47); and an overlay of the estimated gaze

[51] A selected number of video sketches and more information about this preliminary phase of this project please follow the portfolio link: <**https://portfolio.matthewattard.com/heres-how-i-did-not-see-what-you-wanted-me-to-see/**>.

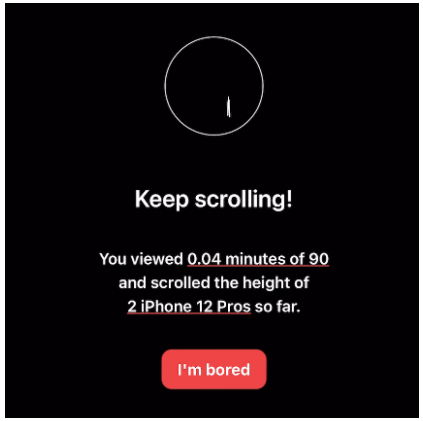


Figure 61: The pop-up window shown to the viewers when they stopped interacting with the digital video of *Here's How I Did Not See What You Wanted Me To See* via their scrolling or swiping.

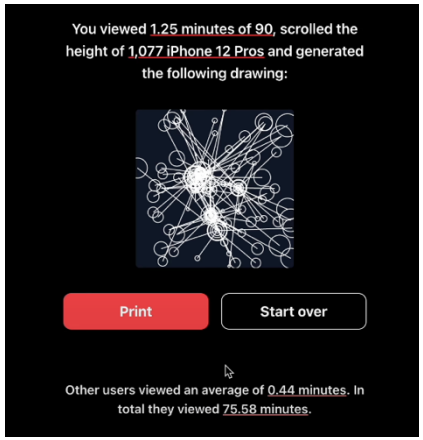


Figure 62: The pop-up window shown to the viewers when they terminated their interaction with the digital video of *Here's How I Did Not See What You Wanted Me To See.*

movements in the form of a white cross that left a trace of three seconds of my gaze trajectory resembling a drawing in motion (Figures 59 and 60).

Since the work was intended to be disseminated as an online exhibition, I considered ways of actively involving the public's participation to stimulate their own reflection about such platforms. Working closely with a website designer, engaged by BV for the project, I developed the idea of uploading the video on the exhibition page so that the viewer had to scroll in order for the footage to be activated – i.e. every time a viewer stopped scrolling, the digital video halted and the explanation to keep scrolling shown in Figure 61 appeared. The moment the scrolling continued the video proceeded from where it had paused. Users also had the option to select an *I'm bored* button in case they wanted to exit the video screening/scrolling. This prompted a statistical window that noted: the viewing time of the viewer's particular session, presented a drawing that was generated from the data-tracking of the viewer's mouse movements or scrolling fingers[52] (with an option to print), and the collective viewing time of the online exhibition audience (Figure 62). The interactive work is currently archived and not available for public interaction, but documented screen recordings of the experience can be accessed at the following portfolio link: <**https://portfolio.matthewattard.com/heres-how-i-did-not-see-what-you-wanted-me-to-see/**>.

[52] The interactive work could be experienced both on desktop and mobile devices.

Contextualisation of the project

Before I further elaborate on the decisions undertaken when developing the video work for the online presentation, I would like to briefly recount a number of influences that informed the project in order to contextualise it as a way of critically making art with eye-tracking technology: parrhesia. Firstly, I consider that we are living in an age where social media platforms are a status quo of our habitual interaction, as scrolling through our feeds has become a mundane act. Media researcher Taina Bucher has noted the number of algorithms that are mundanely present such as when checking *Facebook* and searching on *Google*, and states how:

> While there is nothing particularly eye-opening about these moments, that was exactly the point. It describes life lived with, in and through the media. Or more precisely, a life fundamentally intertwined and entangled with algorithmic media of all sorts.
>
> (2018, p.149)

Social media platforms such as *TikTok* form part of this entanglement of life and algorithmic media. Such software infiltrated our way of living and thinking about the world in ways that perhaps, we do not yet fully comprehend. Tanni (2022) referred to such moments of infiltration as algorithmic culture and outlined a number of instances where users improvised ways of 'tricking' digital algorithms on the internet as a form of resistance in her essay *The Great Algorithm*. She specifically noted how

forms of resisting and deceiving digital algorithms, no matter how weak or sparse, are "a precious resource that needs to be cultivated and amplified" – both for our understanding of the psychological, cultural, and social aspects brought forward by digital algorithms, and for the acknowledgement of the spontaneous and creative acts of resistance themselves (2022, p.14). Her examples of resistance included tailored language known as Algospeak, which consists in the avoidance of using certain words in order to bypass algorithmic filters and censorship via the application of other words: "For example, they say 'to unalive' instead of 'to kill', 'seggs' instead of 'sex' and 'nip nops' instead of 'nipples'" (*Ibid*., p.12). Other forms of resistance consist in contemporary art projects such as Grosser's *Not For You* (2020), which comprised of a plugin aimed at confusing *TikTok*'s algorithm that tailors the suggested content on the *For You* page, consequently resisting the profiling of individual users.

I see such forms of resistance as an act of parrhesia that challenge the status quo of corporate digital algorithms such as those operating social media platforms. In this view I posit the project *Here's How I Did Not See What You Wanted Me To See* to have the capacity to add to the critical conversation surrounding algorithmic culture. The *What You Wanted Me To See* expression in the project's title is double-edged as it addressed both content creators uploading onto the platform, but more importantly the *For You* algorithm suggesting content via its profiling of me. I therefore *did not* see the algorithm's recommendations for the same amount of time that the average

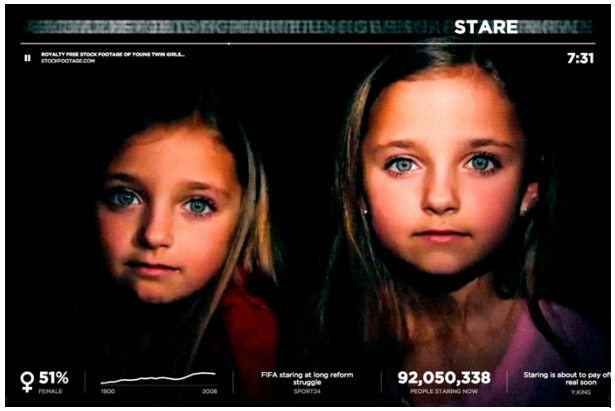


Figure 63: A screenshot from the interactive Internet-based work *Network Effect* by artist Jonathan Harris.

user tends to look at content on the platform daily – a symbolic and ironic play on the statistical insights of the platform.

The interactivity of the final mode of presentation stemmed from the interest to make the viewers active participants of my reflection, and this was informed by recent Internet-based contemporary art projects. For example, in 2015, digital artist and story-teller Jonathan Harris published the project *Network Effect* (Figure 63), which reflects on whether the internet shows a sense of 'common humanity', addressing the Internet's power to affect our lives. Upon visiting the project, viewers are given a time limit to surf through the project that is dictated by the life expectancy of the country indicated by the user's I.P. address[53]. During the allocated time, the artwork-website gives the users the possibility to scroll-through a vast amount of words that prompt footage, sound and other data such as statistics that has been scraped off the Internet in relation to each specific word (Figure 63). The artist's reflection on this noted how:

> The Internet is a miraculous tool, but all too often, it affects us like a drug. Many of its popular apps, news websites, and social networks have been carefully designed to addict and distract, so they can harvest human attention like the natural resource it is.
>
> (Harris 2015)

[53] For example, life expectancy in Malta is that of 79 years, and thus when visiting the website from Malta, one would have access to the *Network Effect* for 7.58 minutes.

By giving a time limit while assimilating the Internet to a drug (in terms of addiction), Harris induced a form of anxiety upon the viewer that was akin to the same form of anxiety induced by Internet culture – the Internet is so vast that it reels us into addictive patterns of scrolling that are sometimes a direct result of a 'fear of missing out'.

Informed by such works, I wanted the interaction of *Here's How I Did Not See What You Wanted Me To See* to highlight two aspects through the use of eye-tracking: i) The physicality of the addiction to scroll digital media in order to 'see' more, ii) The reminder that as Internet users we are constantly being profiled via the scraping of our data stemming from our usage patterns and interaction. Thus, I ironically placed viewers in a position where they had to constantly scroll in order to be able to see the digital artwork, which simultaneously depicts the way I purposefully did not see the suggested content. By doing so, the undertaking of physical activities such as gazing and scrolling that usually reside in the background of our entanglement with algorithmic culture acquired prominence for reflection. Moreover, it was only at the end of the viewers' interaction with the project that they realised how their physical activity of scrolling through the eye-tracking footage had been recorded and transformed into a drawing for them to print (Figure 62) – an ironic twist on how our interaction with digital algorithms is generally recorded and applied for further capital gains by enhancing the neo-liberal addictive strategies.

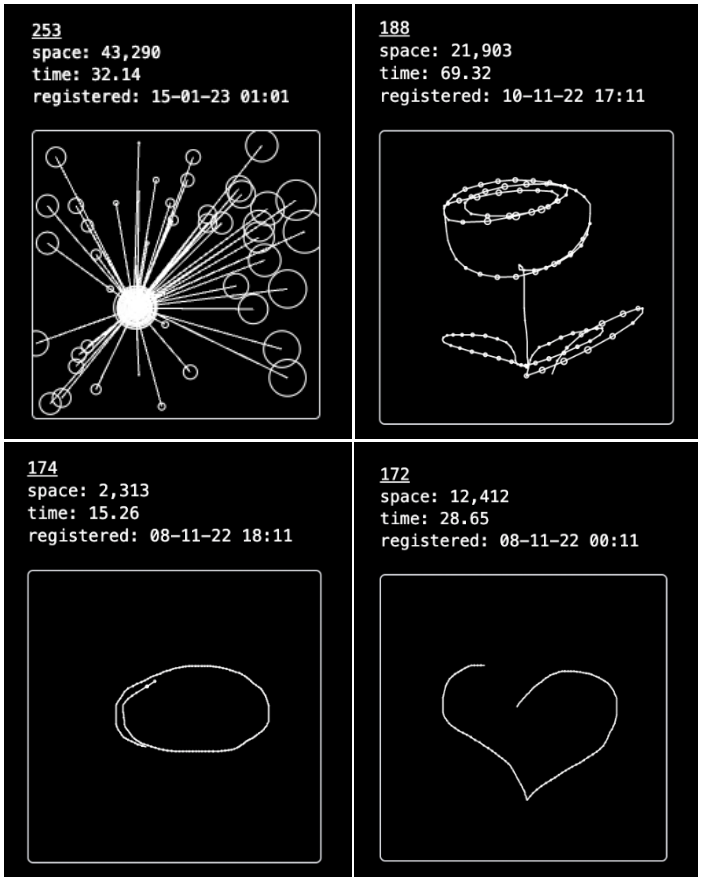


Figure 64: (*Top Left*) A resulting drawing typical of a user's scrolling interaction, followed by three resulting drawings made by viewers of the project who subverted their own way of scrolling/swiping.

A final note about the project concerns the resulting digital drawings. At the end of the project, all of the resulting drawings from the viewers' interactions where compiled and published by BV[54]. There were 188 interactions in total, and a notable aspect is how when some viewers understood that their scrolling interaction was being recorded by the website and developed into a drawing, they subverted this same aspect of the project. These viewers claimed agency and scrolled in different ways, such as in the case of the viewers who drew a flower, a circle and a heart via their way of scrolling (Figure 64).

5.2 Reflective conclusions

The eye-tracking drawing projects *Id-Dgħajjes tal-Fidili*, *Castille Square* and *Here's How I Did Not See What You Wanted Me To See* are three examples of how I expanded the research practice in order to add to critical conversations (as parrhesia) via multi-layered offering of different contexts, situations and environments. The first two discussed projects stem from the solo exhibition *rajt ma rajtx… naf li rajt*; a title that attributed a metaphorical witnessing stance to the eye-tracking technology by means of which I challenged a traditional Maltese proverb (see p.160). In *Id-Dgħajjes tal-Fidili* I bridged the historical imagery of *ex-voto* ship graffiti with the contemporary image-making methods of this research practice, as a way to draw out critical questions of whether techno-deterministic tendencies are akin to an act of faith or

[54] The compilation of the 188 drawings is available at the following portfolio link: <**https://portfolio.matthewattard.com/heres-how-i-did-not-see-what-you-wanted-me-to-see/**>.

foolishness through a play on words and images. The resulting eye-tracking drawings were manifested as a multi-viewpoint installation and as pen-plotted 'graffiti' on stone (see p.169). In the Castille Square project, I reflected on the entanglement of the multi-layered historical, political, cultural, social, and contemporary perspectives brought forward by drawing-with the eye-tracker in a public space laden with historical, cultural and political meaning. I presented these eye-tracking drawings as a moving image artwork that oscillated between points of view (see p.178). The third project *How I Did Not See What You Wanted Me To See* was developed during the course of a digital residency and resulted in an online interactive exhibition that critically highlighted the consequences of digital algorithms operating social media platforms, including addiction and individual profiling. This was done via an 'artistic sabotage', of purposefully not looking at suggested content, the act of which was made visible through the eye-tracking technology (see p.183).

Digital art academic Linda Candy wrote that "[…] there is often no perceptible difference between making and reflecting. Artists experience the act of drawing as a way of seeing, as 'a kind of reflective conversation' with the materials of a design situation" (2020, p.56). The exploratory methods of this research practice resonate strongly with Candy's statement, and the practical work developed throughout the three eye-tracking drawing projects discussed particularly evidence the blurring between making (as drawing) and reflecting. Different ways of seeing, drawing, making, exhibiting, and questioning (critically) were developed in response to the

Figure 65: An installation shot of the entrance to *Spaziogamma* during the show *Re_g(u)ard_e*. The curators opted to install the eye-tracking drawings of my passport at the entrance to the exhibition. Photograph by Jacopo Nocentini taken in April 2022.

Figure 66: (*Left*) An installation shot of the work presented at the Grandmaster's Palace. (*Right*) Detail of the installation. Photography by Semih Ökmens.

different materials, issues and situations presented by drawing-with eye-tracking technology in situ of the different contexts.

Dissemination

The exhibition *rajt ma rajtx... naf li rajt* at VC was visited by wide audiences. Curator Tonna and I, gave several guided tours of the show on request, both for individuals and institutions including: the *The Malta Arts Council*, the department of History of Art at the University of Malta, the department of Digital Arts at the University of Malta, and the department of Architecture and Urban Design at the University of Malta. Subsequently, I was also invited to participate in other shows with specific works that stemmed from the exhibition. Curators Irene Biolchini and Sofia Baldi included the projection of the Castille Square eye-tracking drawings (Figure 54) and an eye-tracking drawing of my passport in their invited collective exhibition *Re_g(u)ard_e* (Figure 65) for the non-profit space *Spaziogamma* in Milan, Italy (Spaziogamma 2022). The *Id-Dgħajjes tal-Fidili* project was included in the collective exhibition *译yì Translate* at the non-profit contemporary art space *Associazione 21*, Lodi, Italy (Associazione 21 2022), curated by Gianluca Cappellazzo. The plexiglass installation from *Id-Dgħajjes tal-Fidili* has been an invited exhibit at the historical building of the Grandmaster's Palace in Valletta, as part of a fundraising event by *RIDT Foundation* from the University of Malta in support of the restoration of the fresco frieze *Great Siege*, painted by Matteo Perez D'Aleccio between 1575 and 1581 after

Figure 67: Public talk announcement by BV for 25th October, 2022.

being commissioned by the Order of St John. The installation was used in support of the bridging of contemporary art interventions with historical sites (Figure 66). During the course of the exhibition, I was also interviewed on four different occasions (see Delia 2021; Dingli 2021; MaltArti 2021; Zammit 2021).

The online exhibition *How I Did Not See What You Wanted Me To See* had 188 viewings and interactions. During the course of the exhibition, I was invited for an online public talk on 25th October 2022, in conversation with curators Dolfi Agostini and Tanni (Figure 67).

Drawing-with eye-tracking technology as an act of parrhesia

At the beginning of this chapter, I asked whether I could posit the practice of drawing-with eye-tracking technology as an act of parrhesia, and I believe that the eye-tracking drawing projects discussed succeeded in raising questions and contributing towards critical conversations, challenging different forms of status quo. By drawing-with the technology in situ, the research practice emerged as a way of attending to things that need attention by hypothesising critical provocations according to different contexts. This was principally achieved by blurring the boundaries between seeing and drawing, and reflecting and making. Featured writer Lara Zammit (2021) from *The Times of Malta* started her review of the work exhibited during *rajt ma*

rajtx… naf li rajt by stating how the "power of looking" lay at the heart of the work that ranged from the mundane to more serious matters. She stated:

> The issue of choice is also central to the exhibition where everything ranging from what one looks at to the medium on which it is shown is somehow selected and curated. This in turn ties into the idea of perception, which is itself very much conditioned, whether by the media, our backgrounds and a whole host of external and internal forces. Given all this, then, how guilty are we for not speaking? Does the blame for our silence lie entirely with us?
>
> (*Ibid*.)

I read Zammit's analysis as a way of relaying social duties such as acts of parrhesia present to the general public. A similar reflection was found in the article for *The Malta ArtPaper*, by curator Margerita Pulè, titled *A Moving Spot of Sun* (2022, p.37). In her article, Pulè gave a brief analysis of the work of a number of contemporary artists who are active in the local scene, as work inducing a form of critical enquiry, including my drawing-with eye-tracking technology in situ. I consider all of the other artistic practices that Pulè discussed in her article, to be manifesting their own form of challenging a *rajt ma rajtx* attitude and culture. In other words, they are all using parrhesia. From this standpoint, I postulate that forms of parrhesia in art might have the power to start a chain of influence that can bring about crucial cultural changes, and perhaps this hope adjudicates a powerful place to artistic research and practice.

In conclusion to her article, Pulè stated how she regarded the works included in her article as “acts of documenting, creating, and resisting”, and compared them to what author and art historian Teju Cole would refer to as “[…] signs of hope in a place that, like all other places on the limited earth, needs hope” (*Ibid*.).

Conclusion

In this research I have speculatively explored ways of adapting eye-tracking technology as a CADP, and a major contribution of this PhD investigates the establishing of eye-tracking drawing as an artistic practice. Moreover, I developed the methodology of drawing-with the technology, as opposed to a way of using the technology to draw with. This was informed by and evolved from Wakkary's recent application of the phrase 'to design-with'; whereby, aligning to posthuman scholarship, Wakkary dismantled the practice of design and reassembled it through the lens of looking at more-than-human-centred worlds (see 2021, p.248). The adaptation of eye-tracking technology as a CADP was informed by this perspective throughout an artistic investigation that developed with the technology. The questions I set to investigate at the start of my practice research were aimed at filling a gap by undertaking a study that explored eye-tracking technology as a CADP. In order to address this, my research developed methods that embraced the technology's capacity for agency and posited it as a constituent to drawing practice. As specifically described by the practice based project examples presented in the thesis, the focus on the nonhuman also emerged out of the context induced by the COVID-19 pandemic, where, as a practitioner, I found myself mostly working in isolation during the first part of the artistic research and was largely surrounded by 'mundane' objects, together with the technology. This circumstance led me to turn my living space into a place for artistic exploration and experimentation. I looked at

the postulation that ABR belongs to its own paradigm (for example, see Leavy 2018); meaning that artistic research does not have to affiliate itself with discourse relating to quantitative and qualitative frameworks borrowed from other disciplines, but has the capacity to forge its own methodologies via, for example, its own methods of experimentation and analysis. In this regard, implementing a sense of openness through an exploratory process meant that the accidental, not knowing, and an element of trial and error could be encompassed, and became an essential part of the methods of doing of the practice research. This is inevitably reminiscent of the history of artistic practice itself, and echoes observations about how for an artistic practice to be rewarding, the artist's intentions cannot be rigid and need to acknowledge the potential for the practice to develop and generate from unexpected outcomes (as noted by authors, such as Candy 2020, p.7).

Furthermore, as I have highlighted in chapter 4, the open-ended nature of the field of contemporary drawing itself augmented the explorative methods of the PhD. The practice research overturned the general hypothesis of regarding eye-tracking methodology as an objective scientific tool with which to define and understand ways of drawing (see p.147), and posited the technology's capacity for contribution towards CADP in its own right – a method that eventually developed into a critical inquiry (see p.142). This exploratory study therefore developed multi-modal ways of research that interweaved between theory and practice, and I am writing the

following conclusions from a reflective standpoint towards the outcomes that stemmed from this practice research.

I see a number of overlapping points that have been uncovered by this artistic research, as well as a number of questions and future possibilities arising towards the further development of the practice and the forging of new research. In this view, it is important to recognise that the aim of this project was not to offer a safe and one-dimensional method or solution of how to draw with eye-tracking technology, but to outline a number of outcomes that developed from the convergence of theory (concepts), intuition (doing) and analysis (reflection). The methods of writing that moulded the thesis indicate that the study does not concern a rigid step-by-step procedure of how to implement eye-tracking technology to engage in drawing. It instead comes closer to an invitation to freely explore one's own ways of drawing-with eye-tracking technology and in this way to interrogate its multiple parameters, including its social contexts.

The thesis reflects on the exploratory nature of the study and purposefully does not recount the outcomes of the practice in a chronological order. In fact, the first piece of writing that accompanied the study was the interview with *E-T* (see chapter 2). This had evolved out of two necessities: i) The need to truly familiarise myself with a technology that is not generally associated with drawing practice, in order to metaphorically disassemble it and theorise possible ways of 'subverting' the scientific

methodology as a CADP, and ii) The need to 'animate' the nonhuman device via a fictional interview to better attend to its capacity for agency as an object of social, political and cultural influence, as suggested by posthuman scholarship. The development of the *drawing-with* framework was informed by posthuman scholarship throughout, as well as other discourses that have been highlighting the urgency to decentre the human through animism, such as Bennet's vital materialism (see p.77). The general perspective of seeing the technological device as a neutral *dead* material was thus challenged, and the technology was investigated via a characterisation that assumed other roles throughout the practice: from being constituent to drawing practice to becoming a metaphor for a critical inquiry. In short, animating the technology made it possible to truly relate to the device from a personal, transformative and speculative viewpoint.

The chapters

I started chapter 1 by investigating the agentic potentiality of eye-tracking technology and my methodological ways of seeing it. I asked about what type of nonhuman agency was acting/performing during the drawing processes explored within this study, and responded with reflective descriptions that became supported by artistic tendencies that regard the nonhuman as a creative collaborator. Through the reading of posthuman scholarship I developed a number of writing heuristics in aid of my reflection on the exploratory process of the study, specifically ones that recounted

anecdotes. This way of writing shaped the course of the thesis, as I reassembled pivotal moments of the practice that emphasised ways in which the nonhuman revealed their capacity for agency and transformed the progression of this artistic practice. In other words, chapter 1 specifically showed how the technology had the potential to 'reveal itself' in ways that strongly contributed to the practice, as for example, was illustrated by the anecdote of how I started to draw my eye with the eye-tracking device (see p.12). Towards the end of the chapter I also noted how this exploratory practice attempted to envision the programme of the technology, by looking at its technological black box – including the 'error', such as was the case with the bridge piercing (see p.35). I did this by expanding upon Flusser's writing about the technological programme, and I also sought comparisons with other practices that co-constitute the nonhuman within their artistic process; such as Knowles' tree drawings (see p.29).

Chapter 2 consisted in the fictitious conversation that helped me look into eye-tracking technology's history in a creative way that not only outlined the function and the origins of the technology, but also provoked a critical and challenging piece of writing within an academic context. Interviewing the digital object helped me look at the effects and affects of the technology in relation to this ABR, and postulated the nonhuman agency on a horizontality parallel to mine through a form of dialogue; unlike the general assumption that the nonhuman resides in a 'background'. Anthropomorphising an inanimate device might be regarded as an anthropocentric

stance by some, but this study showed how by means of this exercise I could fully attend to the agency of the technology. Moreover, it allowed me to see the application of it through a critical lens.

In chapter 3 I investigated how this research relates to things (the nonhuman) as a CADP. I answered this by looking at the hybrid assembly of myself (human) and the technology (nonhuman). With an emphasis on how technology is not neutral, the discussion evolved via a reflection on the techno-human relations emerging from the practice, as I specifically informed these with notions of cyborg, postphenomenology, embodiment and the extension of the mind. I answered the questions that arose from these reflections by highlighting how the development of the drawing process within this study was co-shaped by my role as an artist researcher and that of the acting nonhuman. By looking at notions put forward by vital materialism (see Bennet 2010), I also responded to how the nonhuman things that surrounded my environment during the first half of my practice research revealed means of contribution to the progression of the study via their own agentic qualities of 'calling' for attention.

In chapter 4 I further contextualised the study of adapting eye-tracking technology within drawing practice and defined the research as a CADP. By outlining the recent history of drawing practice, I underlined how contemporary drawing aided the shift in attending to (general) drawing as a practice within its own right. I asked questions of how drawing-with eye-tracking technology can be compared and contrasted with

established drawing methods such as blind drawing, doodling, mark-making, data capture, and digital drawing. This eventually led me to the reflective comparison between the way I had been drawing-with eye-tracking technology, and other contemporary artistic projects that have made use of an eye-tracking device in recent decades. I here evidenced a difference in attitude, specifically with how my practice posited the technology as an active component of the drawing process by decentring my (human) way of drawing. This led to the identification of this study's capacity to think critically with the technology as a method of drawing research.

In chapter 5 I outlined how the positioning of the study as a critical inquiry stemmed from readings that question the ethics of the technological pressures of our present times, such as Crary's criticism of the application of eye-tracking data by post-capitalistic ventures. Crary noted how eye-tracking data is being used for profit through the erroneous assumption that our eye movements equate our attention and thinking, and criticised how eye-tracking big data has intrinsically grown to define what is eye-catching for our attention (see Crary 2022; 2018). In other words, our eye movements are being monetised with drastic effects on our visual perception (and visual culture), that is ceaselessly capitalised upon through the way we are now regarded as 24/7 potential consumers. In this context, I specifically asked how can this drawing practice artistically counter such neoliberal applications of eye-tracking data, and add to critical conversations in an artistic way? I answered this by looking at other critical artistic research, such as Dewey-Hagborg's (see p.153), who tied her

methods to the philosophy of parrhesia. Dewey-Hagborg's research questioned the role of the artist today, specifically through the way Foucault had outlined a framework of parrhesia (free speech) during his 1983 lecture series. Informed by these theories, I came to the realisation that through the in-depth reading of the technology's capacity for agency, its non-neutrality, and, the 'hacking' of the scientific eye-tracking methodology, the practice had already been challenging a status quo. I had been undoing the operations of eye-tracking in order to reflect on the mutual techno-human transformations as a drawing practice that distilled into a critical inquiry of cultural notions related to seeing. Thus, the developed methods of this artistic research emerged as a way of attending that differed from what can be easily regarded as eye-catching. I enforced the understanding of how drawing-with eye-tracking technology expanded upon my visual attention by means of the practical exploration done in situ at a range of external sites that went beyond the earlier confines of my domestic environment. This positioned the technology as a metaphorical witness that contributed towards a critical reading of the power of looking and seeing. This intertwined cultural and subjective viewpoints, as the technology acted as a metaphorical conscience for a drawing practice that challenged an embedded status quo of looking but not seeing (see p.160). By giving the technology (and the nonhuman) such a pivotal role during the in situ practice, the explored projects bridged critical conversations across the historical, the socio-political and the cultural fabric, and contributed methods of how drawing-with eye-

tracking technology can be an act of parrhesia as an obligation and means to speak up.

The leitmotif of this arts-based research (ABR)

This brings me full circle to a clarification about the underlying leitmotif of this practice research, and it is here where the critical reader might ask the question: what would have been different if the adopted and adapted technology was not an eye-tracker? My interest in the exploration of a drawing practice with eye-tracking technology originally emerged from aspects that regard the tradition of drawing practice itself – an activity that I have personally never let go of and that grew to become an integral part of my vocabulary, a way of thinking and means of expression. Drawing literature has ubiquitously described drawing in terms of its hand-eye coordination, and I was originally interested in exploring eye-tracking technology as a drawing tool in order to bypass the hand from this frame of thinking. Moreover, the affinity between looking, seeing and drawing seemed to me to be rather 'straightforward'. However, the more I encompassed the experimental and unpremeditated methods within this research – and the more I informed the research with critical readings in view of our techno-human relations – a different perspective regarding the influence of the technological device unfolded through the positing of the *drawing-with* methodological framework.

The study took a more speculative turn, and I started to explore ways of asking critical questions with the technology both in terms of how the practice can be posited as contemporary drawing, and in terms of questions that regarded the non-neutrality of the digital technological device itself. I outlined the transformations that the progression of the research undertook as eye-tracking technology became fully embodied within my thinking, and ways of seeing and drawing. Contrary to a world where (almost) every daily action we experience is (or can be) quantified and datafied for profit, I developed methods that regarded the datafication of my eye movements as an exploratory means for drawing and critical thinking. In the current contemporary global climate of how technological pressures are inducing an ever-more techno-deterministic society, this study developed creative methods that countered the encouraged capitalistic urgency to blindfoldedly accept (digital) technology as an absolute means of consumerist 'life-enhancement'. Contrary to this, the study sought an understanding for the capacity of a mutual transformation between humans and nonhumans from a subjective viewpoint that encouraged thorough reflective thinking. Its methods undid the accepted 'mainstream' eye-tracking methodology, steering it away from the current tendency to monetise our eye movements. It instead bridged the application of the technology to cultural metaphor and an attention to the nonhuman (and the world). In other words, the technology evolved into becoming a key constituent with the capability to adjust the direction of the PhD. Thus, one outcome of the project is the developed methods that

emerged from the expansion of the exploration of drawing-with the technology as a means for a critical inquiry.

It is therefore of no surprise that a different technology than eye-tracking would have had different outcomes. As the study itself has shown, technology – here the specific technological eye-tracking device – carries its own history and agency and is not neutral. Hence, different technologies exert their effects and affects in different ways. However, the understanding and inclination to position the technological device as co-constituent to an artistic exploration would have held; namely via the application of methods stemming from posthuman scholarship and other fields that attend to the nonhuman – and hence, the development of the *drawing-with* methodological framework.

In this regard, I hope that a major contribution of this study points towards the field of ABR itself. It shows possible ways of hypothesising an interdisciplinary approach through the 'organic' development of an exploratory framework that is relational, and expand the project of drawing research across multiple layers of differing fields and topics. In this view, the outcomes of this research have contributed to the exploration of the versatile nature of drawing, interweaving it across the digital (virtual) world, the conceptual (theoretical) realm and the material (physical) world. It is my ambition that, following this PhD, I will continue to develop the methodological framework of drawing-with things, both for the purpose of drawing education and artistic practice. I

also invite other artists and academics to further the concept of *drawing-with*, as this can benefit from further research. I also hope that the study contributes to the ever-growing fields in the humanities that are currently researching our rapid, ever-changing, techno-human relations, and hope that this PhD has the capacity to add an artistic perspective to such conversations.

I also acknowledge that not all aspects of eye-tracking drawing have been explored within the PhD. For example, the adoption of the drawn line in terms of digital output as tracking, and discussions relating to the sensorial/aesthetical qualities of the eye-tracking digital line, did not find space in this research and would benefit from further investigation. Aesthetics have not been the focus of this research, and therefore, I did not look into the sensational outcomes of digital technology as digital art. I instead added to an in-depth interrogation about digital eye-tracking technology as an artistic practice, and therefore, the course of research focused on the processual. I also hope that this PhD can prove to be a point of departure for further research that will inquire about the open-ended aesthetical and postproduction capacities of eye-tracking drawing.

I would like to conclude by once again paralleling the methods of this ABR to Wakkary's study about ways of *designing-with*. In his conclusion he stated how in many views, the dominant human-centred world has always metaphorically assumed an all-seeing orientation of a hierarchically-envisaged verticality. Wakkary hence

asked of the reader/designer to embrace risk, and to humbly abandon this verticality in exchange of a more than human-centred horizontal positioning (2021, p.265). I find this metaphor to be telling, and to carry a strong invitation to assume more risk-taking methods across the arts and humanities. I acknowledge that this risk carries a greater possibility of getting lost, and of ceasing the sense of control and security that a vertical orientation offers through its suggestion of domination. However, I also acknowledge that horizontality advocates a more thought-provoking and equal world. I posit that this artistic research aligned with Wakkary's call for action, and as a CADP, did assume a horizontal orientation through the methods explored. I hope that the readers, viewers, other artists and academics can see this as an invitation for their own exploration into critically expanding our techno-human relations through more horizontal artistic research.

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