The Quest for Life and Intelligence in Digital Puppets

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Copyright Statement

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Thank-you to Chris Gesthuysen for her valuable proof-reading help.

Dedicated to Nick and Cynthia Childs.

Author’s declaration

Some of the ideas expressed in this research are explored in two previous publications:

Childs, L., 2007. The Virtual Puppeteer. Improvisation in the digital age. *Puppet notebook.* Issue 8, Spring 2007. [London]: British UNIMA. pp.16-17.

Childs, L., 2020. Hledikova, I., Astles, C., eds. 2020. *How to move from the physical to the virtual without losing your love of puppetry*. Puppetry and Multimedia. International Puppetry Research. Bratislava: Academy of Performing Arts, Theatre Faculty.

Abstract

Performers and artists wishing to make collaborative improvisations using three-dimensional computer graphics will encounter the following difficulty: the animation process lacks the functionality required for spontaneous, serendipitous, real-time interaction. While human motion capture makes such real-time interaction and the corresponding spontaneity possible, it lacks the expressivity required for non-realistic characterisation. My practice-based research study proposes digital puppetry as a solution to this problem.

My focus is on credibility as opposed to realism: the expectation is that the characters will behave in a puppet-like manner as opposed to manifesting the aesthetics – in terms of both movement and visual design – found in human actor-based motion capture and three-dimensional animated cartoons. The practical element is motivated by three imperatives: to improvise, to collaborate and to perform live. The primary question this study sets out to answer is:

> Is it possible to achieve the same spontaneity and animation[1] in digital puppets as it is with tangible puppets and, if so, what are the mechanisms involved?

Unable to find a three-dimensional computer graphics digital puppetry software and hardware solution, I have devised what I call the GLOPPID[2] method, where GLOPPID is an acronym for Goniometric[3] Live Organic Performance Puppetry Improvisation Digitalia. The GLOPPID method comprises an artistic approach and a practical solution in the form of a Human Digital Puppetry Interface. It uses off-the-shelf three-dimensional computer animation software, which I have incorporated into a pipeline customised to suit my creative process. This pipeline is configured to transform ready-made computer graphics models into digital puppets that can be used as collaborators, thereby allowing the performer to experience the same kind of spontaneity as is possible in physical puppet performance.

[1] The term *animation* used here refers not to the techniques of incremental, frame-by-frame posing of characters, but to the act of bringing them to life.

[2] 'Gloppid' is also the name of a glove-puppet character invented for an ecologically-based travelling show performed during the 1980s (Childs 1988).

[3] Goniometric refers to the measurement of the range of motion in a joint.

My thesis asserts that it *is* possible to improvise with digital puppets, and I have devised my own solution in order to do this. I argue that the real-time, improvised manipulation of digital puppets offers creatively advantageous opportunities for spontaneity and expressivity. My research presents the technique of digital puppetry as an expansion of what I call the *pro-puppetry thesis* – the idea that puppets have dramatic advantages over human actors. It also contributes to the ontological discourses surrounding the Human-Machine Interface (HMI), trans-embodiment, the post-human, the illusion of life, and cybernetics. In addition, it explores how algorithms can be used in the arts, particularly in performance (see Kleber & Trojanowska 2019, p.101). It makes a timely contribution to the pool of knowledge, because I see digital puppets as zeitgeists – apt vehicles for human hopes and fears surrounding the digital and existential angst that is part of the fabric of 21st-century life.

The professional digital puppetry practice undertaken and discussed in this study requires both general, transferable human-machine interacting skills, and the specific digital puppetry skills necessary for project phases such as rigging and manipulation. This practical approach prioritises the physical, as opposed to the psycho-physical. Informed by the theories and practice of human dramatic technique practitioners such as Decroux and Lecoq, it takes the basic building blocks of movement identifiable in the segmented anatomy and rotational articulations of the actor-as-puppet, rod, glove and string puppets, and configures them in their digital counterpart in order to accentuate the odd by means of atypical combinations, economy of motion, and asymmetry.

My approach is underpinned by the idea that a puppet is uninhibited or influenced by its own ego, backstory, or emotions. Nevertheless, these properties *are* present in a channeled, and therefore changed, form that emanates from the Human in the Loop, namely, the digital puppeteer. In digital puppetry, the protagonist is a digital puppet operated by a human who is embedded at the core of the activity, and who simultaneously witnesses their own emotional responses as they are acted out in front of them.

My work demonstrates that non-realistic, expressive approaches to movement performance derived from human physical theatre techniques (including theatre clowning), combined with the use of algorithm-assisted techniques of rigging and manipulation, mean that the puppets are not under the complete control of their puppeteers. Instead, their rogue nature and irrationality enables digital puppets to satirise and subvert notions surrounding computer-

generated imagery and artificial general intelligence, while avoiding exile in the "uncanny valley" (Mori 1970).

In this study the term puppet is used both literally and metaphorically. Deployed literally, *puppet* refers to a figure or object that is manipulated in real time in the presence of a puppeteer, in both tangible and intangible material formats. The term is used metaphorically in the sense that a puppet can be seen as an analogue of a human being that acts as a mirror, reflecting aspects of the human condition or *predicament*. My work expands upon an understanding of the quest for 'life' in physical puppets and the corresponding development of their ur-narrative – as described by Kohler & Jones (2009, p.346) – and extends this to include digital puppets. By combining the concept of this quest with Rokeby's idea of technology as a "prosthetic of philosophy" (2019, p.107) and with the notion of art as a mirror, I explore how distinctive features present in digital puppetry practice can be used to express truths about being human. The work employs a practice-as-research methodology that provides moments for reflection during the creative process, and reflection on the creative outcomes: reflection-in-action and reflection-on-action. The thesis can be expressed in the form of the following formula:

Extemporising with puppets + the ur-narrative of puppets + art as a mirror + technology as a mirror = a pro-digital-puppetry thesis on HMI, AGI + what it is to be human

How to engage with the written part of the thesis

This practice-based doctorate comprises digital puppetry performances and an exegesis in the form of a thesis. The thesis is intended to be read in conjunction with the relevant video and play artefacts.

How the thesis relates to the artworks

The research takes the form of a digital puppet theatre laboratory. The recordings of performances document experiments and are not intended to be viewed in the same way as short, animated films. Some recordings last seconds, some minutes, and some are longer versions that become shorter in live performance. The recordings should be regarded as work in progress – part of a process of continuous refinement used to evaluate what is possible with the intention that, in the future, findings and experience will be used for further projects.

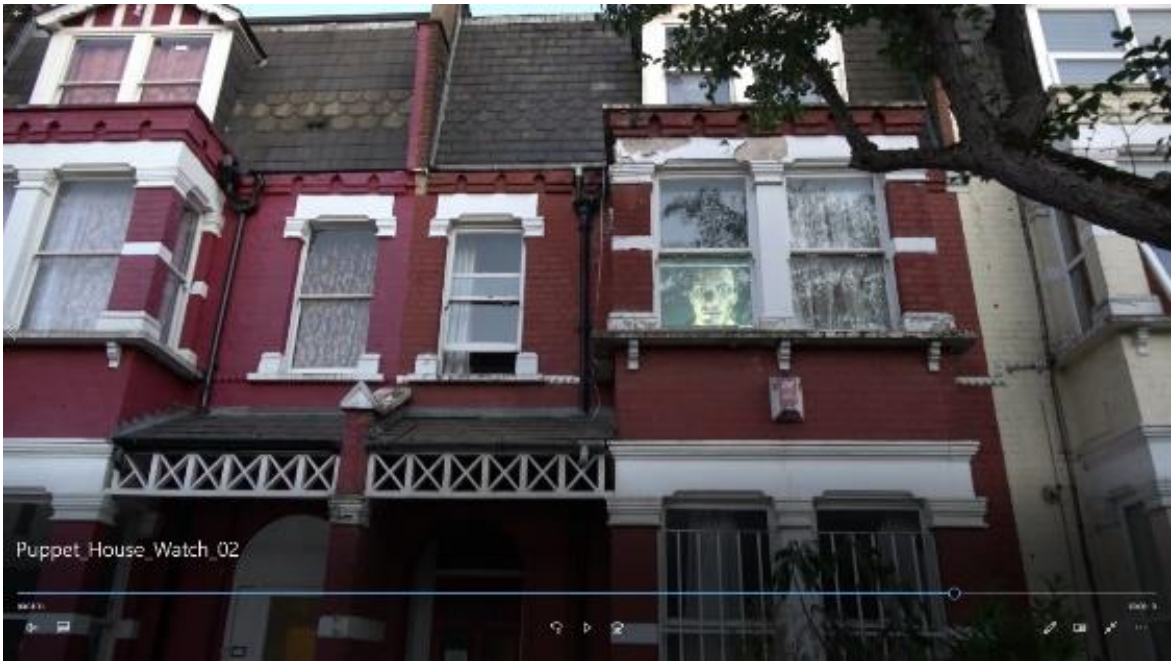

Figure 1: Halogen Hobbs looks out on the world outside (‘Victor’ model by Faceware Tech Inc.; Photo: Lucy Childs 2018).

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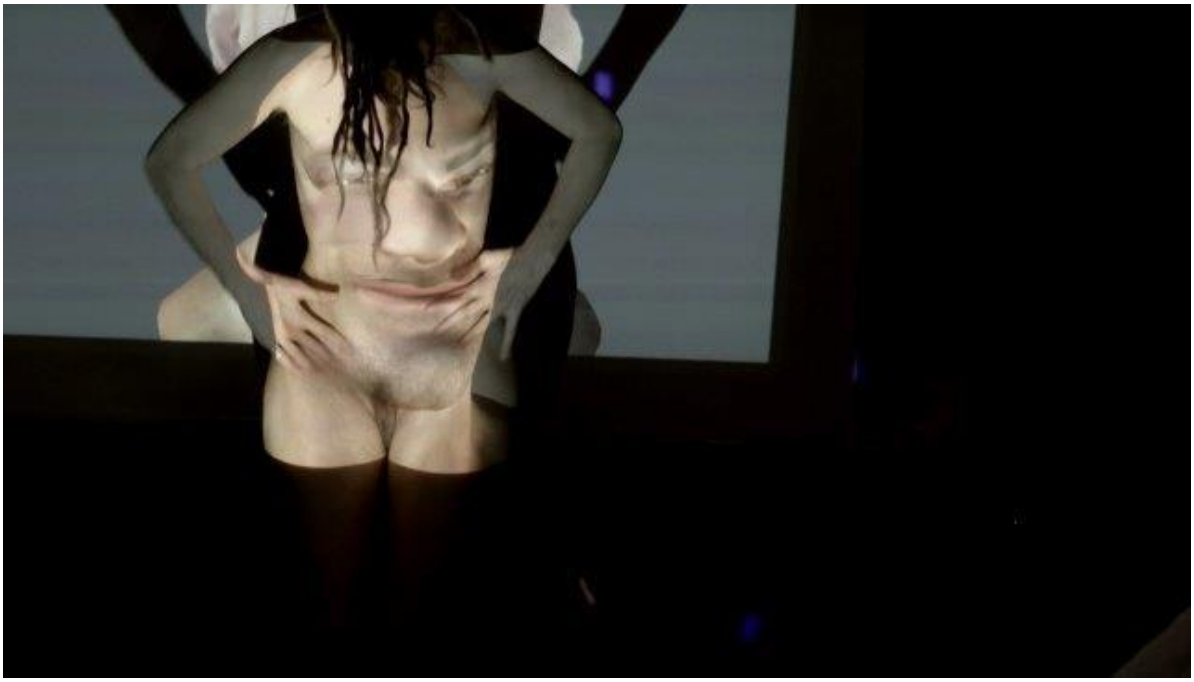
Videos	
Am I a Puppet?	https://youtu.be/28w9t8f9KSo
Control Freak 01	https://youtu.be/oPMgCV5SYe0
Control Freak 02	https://youtu.be/fQbNN31aSo0
DJ	https://youtu.be/nEczfFK4uRM
Flowering Pools	https://youtu.be/SmpZ9ijeLUs
History of the Theatre	https://youtu.be/OuSO0x1qCvo
House Watch 01 – Puppet House Watch	https://youtu.be/vsvoXrEjFTo
House Watch 02	https://youtu.be/tgj5rltD7iE
Museum of Dark Matter (MoDM)	https://youtu.be/zRR6btNtdNQ
My Friend	https://youtu.be/ZY3icmM8VmI
Nuke Your Clothes	https://youtu.be/JWGVgfdURTk
The Drummer	https://youtu.be/4-TcgLzRqQA
Miscellaneous Experiments & Tests **CF HH 01** **CF HH TEST 002** **CF HH TEST 003**	https://youtu.be/j22i1jCugxA https://youtu.be/5OGVGhap-Ys
Giacomo Marking Assignment	https://youtu.be/O9INldUBqmk
Scripts	
My Friend (2018) Script.	Appendix One
Is there anybody there? Script.	Appendix One



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Introduction

> "Digital technologies challenge us once again to ask what place we occupy in the universe: what it means to be creatures of language, self-awareness and rationality" (Chatfield, 2016).

Technological advances over the first two decades of the twenty-first century mean that a new way of working has become more accessible to performers: improvised computer graphics (CG) productions made using digital puppetry. Digital puppetry can be seen as a combination of physical puppetry, three-dimensional computer animation and motion capture, but – as my practice-based doctorate demonstrates – it is also an artform in its own right; it is, crucially, what Searls calls "a new species of make-believe" (2008, p.305). This research study explores questions relating to the intersection of computer technology and humanity by means of digital puppetry. The primary aim of this study is to research *life and intelligence* in digital puppets, using real-time improvisational algorithm-assisted techniques. The principal question this study sets out to answer is:

> Is it possible to achieve the same spontaneity and animation – by which I mean *bringing to life* – in digital puppets as it is with tangible puppets?

To shed light on this question, I found it necessary to devise a three-dimensional computer graphics (3DCG) puppetry hardware/software solution in order to ascertain whether it is possible to improvise with digital puppets. I call the proprietary method I created the GLOPPID[4] method. GLOPPID is an acronym for Goniometric[5] Live Organic Performance Puppetry Improvisation Digitalia. The GLOPPID method is a Human Digital Puppetry Interface (HDPI) comprising a customised pipeline and off-the-shelf computer animation software, which is configured to enable the transformation of ready-made, or 'found', CG models into digital puppets, thus allowing their live onstage manipulation by means of gaming controllers.

[4] 'Gloppid' is also the name of a glove puppet character invented for an ecologically based travelling show performed during the 1980's (Childs 1988).

[5] Goniometric refers to the measurement of the range of motion in a joint.

I use the GLOPPID method to devise and create digital puppetry artefacts that keep the human-in-the-loop (HITL) of the Human-Machine Interface (HMI) by simulating artificial general intelligence (AGI) in digital puppets using algorithm-assisted puppetry, resulting in what I call artificial puppet intelligence (API). The GLOPPID method promotes spontaneity by facilitating improvisational performance, and explores the psycho-physical relationship between digital puppet and puppeteer as a shared intellectual and material collaboration. In other words, the GLOPPID method is a live, improvised digital puppetry creation and performance process which is both an HDPI and a creative approach. It is underpinned by a philosophy of what I call digital *duende* (a Spanish term for a heightened state of emotion, expression and authenticity), produced by using a combination of rigging, basic movements and improvisation. This work requires a process of reconciliation and balance between two different kinds of logic: that of improvisation and duende with that of Technical Rationality, within which the mechanics of cause and effect operate differently.

The thesis asserts firstly that the real-time, improvised manipulation of digital puppets offers artistic and creative opportunities for immediate responses to stimuli from a live audience and from unpredicted influences within the work itself. Secondly, that the quest for life and intelligence in digital puppets makes a timely contribution to a pro-puppetry argument, positing puppets as expressively advantageous and introducing the notion that digital puppets are useful tools for exploring human anxieties about their own existence and their place in the digital world.

Real-time digital puppetry performance is one of five ways that the illusion of life can be created in inanimate objects and characters (Searls 2008, p.305). The other four ways are: tangible (physical) puppetry, analogue animated film-making, computer animation and motion capture, as shown in Figure 5.

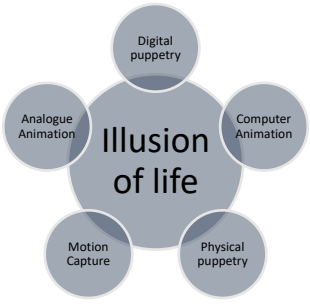

Figure 5: Diagram showing the five techniques used to simulate the illusion of life in inanimate characters (Childs 2019).

Figure 6 develops elements introduced in Figure 5 by showing the overlap between five techniques used to simulate the illusion of life in inanimate characters:

A: Digital Puppetry
B: Computer Animation
C: Physical Puppetry
D: Motion Capture
E: Analogue Animation

The common property shared by these five elements – the illusion of life – is located at the point where all the techniques intersect.

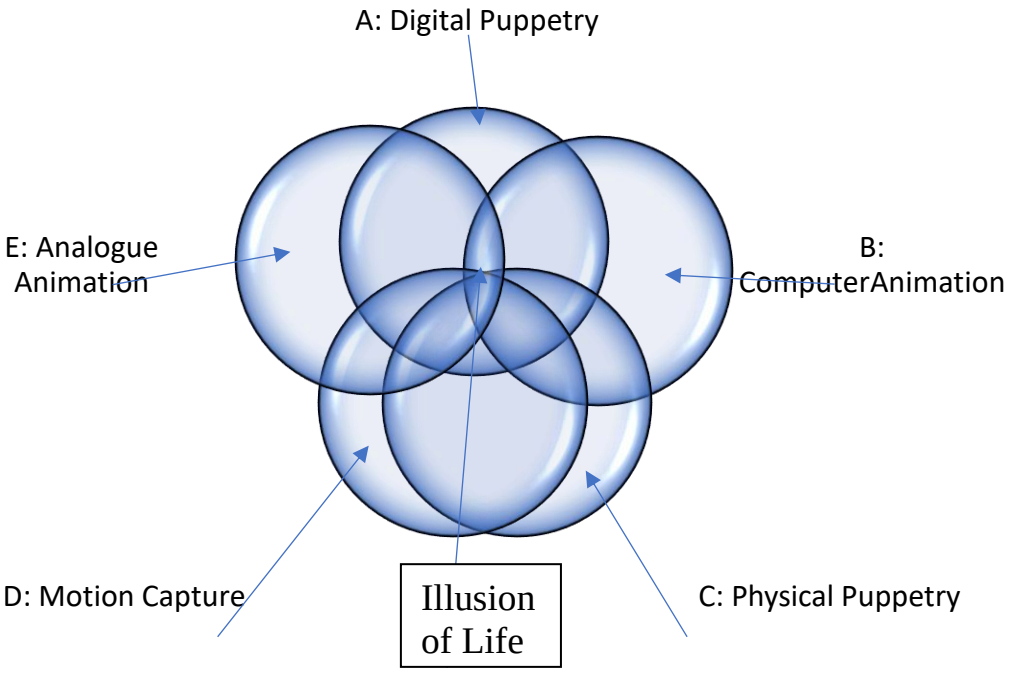

Figure 6: Diagram showing the overlap between five techniques used to simulate the illusion of life in inanimate characters (Childs 2019).

Viewed together, Figures 3 and 4 identify the common and discrete properties of each of the five techniques. The specialist attributes shared by members include the use of digital control, tangibility, tactility, real-time operation and improvisation. For example, motion capture, computer animation and digital puppetry share the ability to use digital characters and objects. The common attributes of digital puppetry (A) and physical puppetry (C) are liveness, tactility, remote control and improvisation. Digital puppetry and computer animation share the ability to use digital characters and objects, and, in addition, digital puppetry and motion capture share the ability to improvise. Digital puppetry, computer animation, physical puppetry, and analogue animation (A, B, C and E) can all be used for non-realistic movement.

A comparison between actor, physical puppet, synthespian and digital puppet shows the versatility of digital puppetry. An actor is a tangible object tangibly moved, limited by the constraints of its physicality (including gravity), and – I would argue – personality. A physical puppet is a tangible object tangibly moved, also limited by the constraints of its physicality, its movement mechanisms and the limitations of its puppeteer. A motion-captured performer is an intangible object tangibly moved, whose performance is based on human physiology affected by forces such as gravity, and interpolated by computational processes including algorithms. A digital puppet is an intangible object tangibly moved, whose performance is affected by algorithms; it is part-human, part-mathematical, but has no personal backstory.

Digital puppetry, computer animation and whole-body motion capture are three ways to create the illusion of life in CG character models. Typically, an animated performance is designed, scripted, and storyboarded in detail, as shown by Bacher (2008 pp.74-87), Laybourne (1998, pp.100-113) and Hart (2008 pp. 1-65), with the execution of the artistic component taking place in extremely slow motion. Real-time improvising is not possible using this method.

In digital puppetry, one or more puppeteers use hand and foot-operated controllers to move a digital character in real time in a process that is similar to live-action physical puppetry. The technical component of the GLOPPID HDPI comprises the direct input devices (DIDs) – the gamepads, joysticks, keyboard buttons – that are used as controllers, and the way these are rigged or connected to the CG model.

Puppetry technique is characterised by the presence of an offset between the performed and the performer; they do not occupy the same physical space. Digital puppetry technique is differentiated from human motion capture by a similar offset. In the motion capture of an actor, the origin of the performance occupies the same space as the performer in that the articulation points, linked to the markers or sensors – either physical or virtual – determining the performed object's performance, are located on the performer's body, whereas a digital puppet is operated by controllers typically manipulated by the hands (and posssibly the feet) of the puppeteer. Puppet movement differs from human actor motion capture because, instead of wearing the puppet like a suit, there is a distance between puppet and performer. By using controllers to channel movement through their hands and feet into the digital puppet, puppeteers can create an expressive, non-realistic extemporised performance, disassociated from their own physiques, and characterised by what I call its *puppetness*. In other words, the character has wider scope for ways of moving in terms of flexibility, reach, speed, and rhythm as a result of being a puppet and not a human. Maintaining distance between puppet and puppeteer results in convincing and credible movement based on a logic of puppetness achieved by channelling. In motion capture, an actor occupies the location of the performance, but CG models brought to life using digital puppetry show hybrid properties of puppetness. My goal is to implement movement in a basic form, meaning that it is driven by *movemes* – the basic building blocks of movement defined by roboticists as "repeatable segments of trajectory" (Del Vecchio, Murray & Perona 2003, p.2085). In GLOPPID, these are simple rotations around pivot points, and each puppet has a limited moveme palette consisting of a selection of movemes.

	Categories of Technique				
Attributes	**Digital puppetry**	**Computer animation**	**Physical puppetry**	**Motion capture**	**Analogue animation**
Character type	Digital/Intangible	Digital/Intangible	Physical / Tangible	Digital/Intangible synthespian	Physical / Tangible
Performance mode	Real time(live)	Frame-by-frame + sub-	Real time(live)	Real time (live)	Frame-by-frame incremental

		frame incremental			
Distance between controller and controlled	Tactility Direct input device remote control	Time	Tactility	Character is worn on the body of the performer	Time
Possible qualities in movement	Non-realistic	Non-realistic/realistic	Non-realistic	Realistic	Non-realistic/realistic
Ability to improvise?	YES	NO	YES	YES	NO
Ability to interact with audience?	YES	NO	YES	YES	NO

Table 1: The attributes of the five categories of technique used to create the illusion of life in the inanimate (Childs 2019).

The horizontal axis of Table 1 shows five categories of technique used to create the illusion of life in the inanimate, while the vertical axis shows a selection of attributes of these categories. These attributes are character type, performance mode, distance between controller and controlled, possible qualities in the movement, ability to interact with audience and ability to improvise. The table answers the following questions for each technique:

- Is the model digital or physical, intangible or tangible?
- Is the performance mode incrementally animated or in real time?
- What is the distance between controller and controlled? (Is there direct tactile contact or not?)
- Can the technique be used to produce realistic and/or non-realistic qualities in the movement?
- Is it possible to improvise using the technique, and is audience interaction possible?

As medias converge, properties previously associated with live-action puppets, computer animation and motion capture become applicable to digital puppets. The creative and logistical advantages of a digital puppet over other mediums lie in its ability to choose the most freeing aspects of each of the categories. One such advantage is the potential for scale changes identified by Schlemmer with reference to his concept of the *Kunstfigur*, or 'art figure'. In my view, the *Kunstfigur* is a close relative of digital puppets:

> "It [*the Kunstfigur*] also permits – an artistic device from the periods of greatest art – a variable relative scale for figures: important ones can be large, unimportant ones small" (Schlemmer 1925, p.19).

Digital puppets enjoy the immediacy of motion capture without physical constraints, and exploit the simplicity of non-stylised motion. Membership of the digital realm means that a digital puppet is part of a "massively distributed reality" identified by Bishop, Gansing & Parikka (2016); it is highly transmissible, nowhere, yet everywhere.

What is a Digital Puppet?

Puppetry is the technique used to create the illusion of life in the inanimate. The question 'What is a digital puppet?' is related to the question 'What is a puppet?' For me, the answer is the same in that they are both inanimate objects moved or manipulated to create the illusion of life. This is in accordance with Searls' view (2014, p.295) that: "any inanimate object or image manipulated by a performer to create the illusion of life can be termed a puppet", while Francis (2012, p.13) stipulates that for a puppet to exist, a puppeteer must be present.

Three elements must be present for a tangible puppet to exist: a decision, an object and a puppeteer, whereas in digital puppetry a fourth element is required: rigging. A digital puppet cannot move unless it is rigged, whereas a physical object can be manipulated without recourse to actuators such as strings or rods, as is the case in, for example, the object manipulation found in pieces made by the *Improbable* theatre company.

A belief in 'imagined life' (Tillis 1992, p.28) or the illusion of life in inanimate objects is largely dependent on convincing movement techniques, and this study is largely concerned with the point at which movement becomes animation. According to the puppet-maker Basil Jones, of Handspring Puppet Company (2009, p.346), in live physical (tangible) puppetry, the movements and stillness that create the illusion of life constitute its ur-narrative. This is a dramaturgical component unique to puppets, because while human actors do not necessarily need to prove they are alive – wooden acting and an actor's need to breathe life into a script aside – puppets *do*. Furthermore, two of the same qualifying factors can be applied to a digital puppet as to a physical puppet, namely the necessity for a puppeteer: "A puppet does not exist unless it is being brought to life by a puppeteer" and its purpose or goal - "its main

objective is to strive to *live"* (Kohler, Jones 2009, p. 345). Kohler and Jones elaboration on the idea of a puppet's ur-narrative is equally applicable to a digital puppet:

> "…a puppet is, by definition, an object that is manipulated in front of an audience in order to simulate life. Therefore 'seeming to be alive' is in a way the ur-narrative of any puppet. This 'striving for life' is its basic story, the story that underlies any other story that may be overlaid on it by a script" (Kohler, Jones 2009, p. 345).

This is consolidated by Jones' observation that:

> "…the puppet's ur-narrative is something quite different to, and more fundamental, than storytelling. It is the quest for life itself" (Jones 2009, p.255).

Jones identifies this "quest for life itself" as a factor in the appeal of puppets for audiences, in that it resonates with their quotidian pursuits:

> "I would suggest that it is this dignified hunt for life, exhibited by all puppets in performance, that fascinates audiences because we ourselves can identify with similar quests in our everyday lives" (2009, p.256).

The fear of superior computational ability shown by androids with artificial intelligence (AI) is related to the fear of the uncanny associated with dolls and automata, identified by Jentsch (1906, p.12) and Freud (1919, p.226), because they look like, but are not, humans. Cappelletto observes that puppets, robots, androids, dolls and mannequins are entities "who invite us to acknowledge them as figures of ourselves. They are human beings of sorts, capable of provoking a primal uneasiness" (2011, p.325). For roboticist and robot-theatre maker Dr. Hiroshi Ishiguro, robots and androids are mirrors "reflecting what it is to be human" and for Jones, puppets perform a similar function (Poulton 2014, p.283):

> "The puppet, therefore, becomes the manifest incarnation of our own struggle to live, to be human, to act. We use the imagined life of the non-living to show us something about ourselves" (Jones 2009, p.256).

Rokeby develops the concept of a computer, and what it can do, as what he calls a "prosthetic organ of philosophy", which – for me – identifies why digital puppetry technology is so apt a medium for exploring existential ideas:

> "… a computer can work as a sort of prosthetic organ of philosophy, allowing us to ask age-old philosophical questions in new ways. It's a way to avoid falling into a default form of humanism; it has to do with shaking up our overfamiliarity with our self... One can use the alienness of technology as a new mirror to consider ourselves in" (2019, p.107).

Unfettered by human experience, the GLOPPID method is a way of "shaking up our overfamiliarity with our self". Digital puppetry is a technology whose alienness is an example of such a mirror, and I hold Rokeby's statement – with my own additions – to be true, "One can use the alienness of [digital puppetry] technology as a new mirror to consider ourselves in". Digital puppets are, in my view, ideally placed to consider these questions, because they have no inner experience to call on; they are, in fact, distanced from human experience. Puppets display the signs of life, but are not alive, suggesting knowledge about being and un-being, life and death, indicated by both Benayoun quoted by Hammond (1987, p.63) and by Cardinal (1987, pp.7-9). The apparent struggle experienced by puppet characters appeals to human audiences because it mirrors their own experiences. For Budde, there are psychological and philosophical imperatives for observing ourselves through an alternative lens:

> "It is healthy for all human beings to take a step back and look at themselves from a distance, as another. Something that is helpful for me as a kind of historical translation, or transposition, are the Brechtian concepts of the "theatre for learning" and "theatre of the scientific age." Both notions contain elements that can be made productive today. This includes, of course, the idea of epic theatre, which facilitates an understanding of distancing for the purpose of analysis, better understanding, and alternative action." (2019, p.108).

Digital puppetry is also a philosophical vehicle from which to view "The Age of Anxiety" identified by McLuhan, who speaks of the electric age and the "technological simulation of consciousness" (1964, pp. 9-13).

> "During the mechanical ages we had extended our bodies in space. Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned. Rapidly, we approach the final phase of the extensions of man - the technological simulation of consciousness..." (McLuhan 1964, p.5).

For me, digital puppetry is a technological extension of the body that enables the digital puppeteer's nervous system to reach out into cyber space. McLuhan famously says: "the medium is the message" (1964, p.7), and it is digital puppets' ability in the arena of the simulation of consciousness that make digital puppetry a valuable tool for exploring these ideas.

Writing in 1929, Schlemmer (p.17) identifies three emblems of "our time": abstraction, mechanisation, and the new potentials of technology. In the third millennium the digital supersedes the mechanical, and similar fears and hopes surrounding their progress present themselves:

> "Technologies – both hard and soft – as well as the processes that they expedite are evolving at a rapid pace…what is undeniable is that all discussions of it are, inevitably, accompanied with apprehension and excitement" (Causey, Meehan & O'Dwyer 2015 p.11).

By replacing Schlemmer's word 'mechanisation' with the words 'digital simulation', the emblem of the early twenty-first century is described:

> "A further emblem of our time is mechanisation [digital simulation], the inexorable process which now lays claim to every sphere of life and art. Everything which can be mechanised [simulated] is mechanised [simulated]. The result: our recognition of that which cannot be mechanised [simulated]" (Schlemmer 1929, p.17).

Schlemmer's perspective is relevant to digital puppetry, even though the technique was not yet available in his time. It is possible to learn about what is *not* from that which *is*; in other words, insights can be gleaned from both the positive and the negative moulds of a thing. Puppets, as Astles points out, because they are *not* human, tell us something about what it is to *be* human.

> "According to Derrida, every experienced event is defined by its relationship to that which it is not; within puppetry there is a focus on the puppet in contrast to the live human beings who operate it" (Astles 2009, p.59).

The digital simulation of characters made for this research tells us about that which is not digitally simulated: us. Furthermore, the collaborations between humans and digital puppets in this study give insights into what it is that differentiates them, what digital and what human performers are good at, and how this relates to theatre:

> "What does it mean to have a human body in the face of a technology that is not constrained by human limits? This question is clearly central to the point of contact between technology and something as body centric as theatre" (Chatfield, 2016).

The GLOPPID method gives a response both to Chatfield's questions and to Rokeby's observation that "our culture has spent very little time thinking clearly about what humans are especially good at, that machines are not" (2019, p.111).

This study, therefore, explores the idea that puppetry can be seen as a quest for life. Although a human actor can appear 'wooden' onstage, they cannot be dead, since they are animated by the spark of life. In contrast, a puppet's work is *to live*. My research looks at the notions that a puppet's supposed 'life' is an illusion and a paradox, which raises existential questions about the nature of life itself. My position is that the energy transmitted from puppeteer to puppet sends a spark of life via the analogue controllers, thus animating what I call the puppets' *digitalia*. Mello's differentiation between direct and indirect embodied techniques, and their correlation to 'inner' and 'outer' in the human performer, serve as a catalyst to a consideration of performer 'motivation' and 'intentionality'. This is useful to the GLOPPID method, and informs my thinking about how I project energy into a digital puppet. According to Mello, direct trans-embodiment involves a transfer of movement between live performer and puppet, and in my view this is equally applicable to digital puppets. For me, it is the constraints designed into the digital puppet bodies that inform how the embodied practices transferred by the analogue human bodies manifest themselves (Mello 2016, p. 51). Importantly, as soon as I start to rig a CG model, it embarks upon a paradoxical existence both as a puppet that can be manipulated, and as a character that takes on a life of its own. Kohler & Jones describe puppets as engaged in a quest for life and concur with both Baker's and Fredricksson's viewpoints that it is when they seem to be *thinking* that viewers really imagine them to be alive (Kohler & Jones 2009, p. 346; Baker 2011; Fredricksson 2015, p. 244). The dramaturgical process of developing a puppet's ur-narrative involves demonstrating puppet intelligence and thinking indicates intelligence. Furthermore, *apparent* intelligence in puppets has *existential* significance because of their dead-yet-alive status.

The performances contain information and knowledge and confirm the currently little-used practice of digital puppetry as a distinct artform and offer a glimpse of its potential for future application.

Why digital puppetry?

For me, digital puppets act like mirrors that can tell us something about ourselves; humans look different seen through the eyes of a digital puppet which has a special ability to throw light on the human condition, thanks to what Tillis (1992, p.7) calls its "spurious life". The apparent struggle experienced by puppet characters as they strive to live appeals to people because it mirrors their own experiences.

> "It is in response to the signs deployed by the puppet, signs that normally signify life, that the audience accords the puppet its spurious life" (Tillis 1992, p7).

In my view, digital puppetry is a good example of a technology that can be used to challenge and inform human thought, in accordance with Chatfield's observation (2016) that "Digital technologies challenge us once again to ask what place we occupy in the universe: what it means to be creatures of language, self-awareness and rationality". Digital puppets are the human face of technology, ideally placed to consider existential questions, and can be used as a fear-mediating device. Digital puppetry performance is a way to attenuate my own, and the viewers', digital angst – human anxieties surrounding artificial life and intelligence, AI and Big Tech companies.

The digital puppetry carried out during this study is a form of extemporized animation that has more in common with the principles and processes of improvisation found in music, theatre, clowning and dance than with 3D computer animation. For example, in accordance with a core principle of theatre clowning, the GLOPPID method views accidents and mistakes as 'gifts' or 'offers' whose energy can be used in improvisations.

Searls states: "Because of digital puppetry, animated characters can, like puppets, be present. By turning the screen from a projected recording into an interactive puppet stage, cartoon creatures can act on spontaneous impulse and experience the vulnerability to accident that actors and puppets have always exploited" (2008, p.296). In other words, digital puppetry permits improvisation and collaboration, both of which have wider scope for spontaneity and happy accidents than scripted and storyboarded animated film-making. Improvisational frameworks may be built in many ways. Fragments from experimental phases may be put together into sequences, or a pre-determined plan may be based on a soundscape, an idea or theme, or a set of movements. Lorca describes the improvisational impulse in flamenco music and dance thus:

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> "Seeking the duende, there is neither map nor discipline. We only know it burns the blood like powdered glass, that it exhausts, rejects all the sweet geometry we understand…" (Lorca 1933, p.4).

The GLOPPID method encourages spontaneity by deliberately using strategies that make it easier for the puppets to take on lives of their own, whether these be illusory, delusory, or part of what might be seen as a different reality.

As previously stated, a digital puppet is a decision: once that decision has been made, a CG model is rigged and manipulated. What was 'dead' is now able to come 'alive'. CG models to be turned into digital puppets are sourced from anywhere in the massively distributed reality that is the World Wide Web. Possible candidates for this process must have digital skeletons and morph targets. This means that the CG models have some pre-decided limitations to their potential movement palettes, but this is due to choices made regarding only what has been included in the rigging, not in the range of movement. The joints in a digital skeleton have the potential to move through 360 degrees; I then choose how to limit these rotations. I also choose which morph targets to use, and the extent to which they are activated. In fact, the models are typically over-rigged, in that the number of rigged elements is far greater than that needed for a digital puppet. Their lip-synch phonemes are linked to facial and bodily movements. The GLOPPID method puppets have limited movement palettes. The method is designed to enable the puppets to develop character and a sense of puppetness by emphasising properties such as asymmetry, atypical articulation-and-motion combinations, disequilibrium and dynamic immobility, all of which are achieved through their rigging. Rigging is under constant revision as I build my code-based collaborators. Asymmetry is built in at every opportunity. Their resting stance is asymmetrical and dynamic; it is designed to give the impression that they are mid-move – about to take action, to do something. The puppets are rigged both for ease of action and for unusual muscle-group combinations. They are readily manipulated, using combinations of muscles that are atypical in humans. Combined with their segmented anatomies and arc-based articulations, these properties lead to a sense of puppetness.

Constraints are already built into the CG models for two reasons: the limited number of possible articulations on the joints/pivot points, and the limitations of two hands and two

controllers. Not all articulations can be controlled with two hands and two controllers; therefore, choices must be made as to how to restrict the puppet's movement. This can be done in two ways: by limiting the amount of moves a puppet makes, or by connecting actions together so that one lever controls two or three movemes. This results in the loss of some control, which I see as an advantage in that the puppet now takes on a life of its own.

My work is contextualized by a further premise described by Tillis: that a puppet is only a puppet when it "seems to develop a life force of its own", a feature which comes about by initiating movements without retaining absolute control (Tillis 1992, p.24).

The main contribution made to the pool of knowledge by my work is the GLOPPID method itself, which is both a creative pipeline and an artistic approach. Further contributions are the discoveries made during its devising and use, which include the concepts of digital duende, what I call *face jazz* (improvising with a character's facial features, as described in Chapter Six), and the concept of *puppet noise* (also described in Chapter Six). This research contributes to discourses surrounding the following: the dramatic advantages of puppets over actors (or, as I call it, the pro-puppetry thesis), HMI and cybernetics, the post-human, and trans-embodiment. The use of real-time manipulation techniques applied to CG characters raises questions surrounding the concept of liveness. In accordance with Phelan's (2003, p.148) understanding of liveness: "Performance in a strict ontological sense is nonreproductive", my performances are not meant to be recorded.

This research extends the pro-puppetry thesis to embrace digital puppets. Evidence for the pro-*digital* puppetry thesis is presented in the form of artefacts, which show that the direct connection between operator and object in extemporised digital puppetry performance *can* result in digital duende.

From an intellectual viewpoint, my research aims to understand digital puppetry phenomena, while from an instrumental viewpoint, it aims to use this understanding to predict and manipulate the artistic outcomes of digital puppetry practice.

The practical work tests the hypothesis that the ability to use improvisation performance techniques enhances spontaneity in CG characters. This research identifies the theoretical and practical processes involved in API, and the mechanisms by which it can be used to allay any

fears surrounding AI. The limited movement palettes and channelling necessary for my bespoke method have the effect of increasing expressivity in CG models by accentuating a puppet aesthetic that not only creates the illusion that they are alive and thinking, but also that they are flawed and vulnerable. My work offers insights into what part performance technique plays in digital puppetry practice, and into how a performance composed of empty gestures can be avoided when the protagonist has no inner life of its own to tap into for motivation.

The GLOPPID method is a novel approach. It is a robust 3D computer puppetry solution that presents a language of digital puppetry movement through experimental extemporising within limited movement vocabularies. The performances and the thesis produced during this research are evidence that it *is* possible to make collaborative digital puppetry improvisations that show life and intelligence in digital puppets.

Digital puppetry is presented as a technique that puts the human into the loop by combining the techniques of motion capture, algorithms and puppetry, while permitting the variables inherent in improvisation and collaboration, and enhancing the scope for spontaneity and happy accidents.

This research contributes to discourses surrounding critically reflective artistic research practices, human computer interfaces, AGI, a pro-puppetry thesis, and art and technology as mirrors reflecting what it is to be human.

The Scope of the Study and Liveness

My position is that the artworks produced during this research study are both real-time activities and live performances. However, entering the debate as to where my work stands in the discourse surrounding liveness is beyond the scope of this research study. I could interrogate digital puppetry's liveness in terms of a football match or a rock concert, as does Auslander (2012), and could possibly defend its status as ephemeral in the sense that it is Unmarked as espoused by Phelan (2003). Live digital-puppet performances – as distinct from recorded digital-puppet films – could serve as a useful starting point from which to enter the liveness discourse. But I have chosen to limit this research study to a philosophical and technical discussion based on my practice in the context of an emerging artform. My focus is

on the area of bringing digital puppets to life, and I look at texts that deal with the art and craft of puppetry, puppet animation and illusion. Ideas surrounding liveness in the recorded/not recorded sense are not explored here. It is my feeling that this dissertation is not the place for a debate surrounding liveness. My approach is DIY and off-the-shelf, and I have used projectors to show the puppets to an audience who otherwise would not be able to see what I am doing. Recorded pieces are included in my submission. I would argue that CG characters are inherently mediatized, because they are made out of computer code, and their motion performance is channelled through DIDs that convert analogue signals to digital. I use algorithms to process the numbers governing the ratio of the puppeteer's hand movement to movement in the puppets. For me, this is a topic too large and too complex to include in this research study. Nonetheless, it will be dealt with in subsequent work that builds on that which I have learnt and am able to show here.

1 Chapter One: The Quest and The Question

> "The [digital] puppet serves as an ambassador or pilgrim to human beings from the world of things [code]. The [digital] puppet is the material thing [code] that has got an education, that has learned to act" (Gross 2011, p.33, with inclusions by Lucy Childs).

1.1 Chapter Outline

This chapter gives an overview of the quest, the questions, the technical background, the motivations for and the anticipated results of this research study. Key concepts flowing through the thesis and the artefacts are described, including puppetness, digital duende, and digital angst.

1.2 The Quest for Life

The title of this artistic practice-based research – The Quest for Life and Intelligence in Digital Puppets – is related to a parallel scientific quest which is also concerned with the differences between living and non-living matter. The physicist Paul Davies observes that "Life looks like magic" (2019, p.1), and he and others believe that humankind is on the verge of finding an answer to the question 'What is life?' Current thinking is that it has to do with information:

> "…information…which, like energy has the ability to animate matter. Patterns of information flow can literally take on a life of their own…" (Davies 2019, p.2)

This study sets out to shine a light on the processes involved in an HDPI, driven by improvisation, where the puppets are viewed as code-based *collaborators*. Computers and the code upon which they depend are the source of the puppets with whom I share my life-force, and who I enable to take on a life of their own. For me, the creation of the illusion of life in digital puppets is a way of visualising the seemingly impossible; it is a window into bio-informatics, theoretical physics, and a means to look at the magic of life. It is also a way of allaying my own fears surrounding artificial intelligence (AI), machine learning (ML) and the digital in general.

Digital puppets have properties of otherness in that they stand at the interface between the digital and the physical; because of their puppet-like qualities they can be used to articulate human responses to twenty-first century developments in technologies such as AGI, ML, robotics, and data collection (McLuhan 1964, p.8). In the quotation given at the beginning of this chapter, I suggest replacing the word 'thing(s)' with the word 'code', with the intention that digital puppets be seen in the same way as Gross presents physical puppets: ~~namely~~ as emissaries from another world.

This study looks at the balance and tension between the control of puppetry and the letting go of improvisation in the context of an HDPI, while considering the computer and software as symbiotic performance and choreographic partners. The advantages that digital puppets have over actors and tangible puppets is presented as an extension of the pro-puppetry thesis, originating in the idea that digital puppets have the same – if not, I would argue, even more – freedom from the constraints of their anatomies and techniques of actuation.

The application of theory and practice found in Human Physical Puppet Interaction (HPPI) and in human physical dramatic movement in an HDPI setting illuminates the transferable skills common to all three disciplines, as well as defining a distinct digital puppetry skillset. Concepts including why puppetness is important and desirable, mimesis versus expressiveness, proprioception, and trans-embodiment are all explored.

My work does not use ML as understood by Russell (2021), but I claim API as an example of the future he envisages for AI when he answers his own question – "How can we ensure machines do the right thing?" – by suggesting a possible way forward, which he calls "a new model for AI, one based on machines that learn about and defer to human preferences". As an amalgam of what humans do best and what machines do best, digital puppetry puts the human into the loop of the HMI, and in so doing will also go some way towards answering Chatfield's pertinent question:

> "What does a successful collaboration between humans and machines look like? One, I would argue, in which humans remain in the loop, able transparently to assess a system's incentives – and either to influence its direction or debate its alteration" (Chatfield 2016).

This study takes a novel approach; it sees digital puppets as mirrors, giving insights into being and unbeing, and what it is to be human through collaboration.

1.3 The GLOPPID Method

My investigation is motivated by three artistic procedural imperatives: to improvise, to collaborate and to perform live while focusing on credibility as opposed to realism. Inspiration comes from Marinetti's 'Synthetic Futurist Theatre Manifesto' published in 1915; his revolt against the traditional theatre of the late nineteenth and early twentieth centuries reflects my own frustration with CG animated film-making:

> "Writers who have attempted to modernize the theatre (Ibsen, Maeterlinck, Andreyev, Claudel, Shaw) have never thought of reaching a real synthesis, of liberating themselves from theatre-technique, which implies wordiness, meticulous and excessive length of preparation" (Marinetti, Settimelli, Corra 1970, p.143).

In my method – born out of dissatisfaction with the constraints imposed by the CG-animated film-making pipeline – meticulous storyboarding and incremental animation are replaced by improvised digital puppetry frameworks, in a creative philosophy which has elements in common with that of the Italian Futurists:

> "Dynamic, simultaneous. That is, born of improvisation, lightning-like intuition, from suggestive and revealing actuality. We believe that a thing is valuable to the extent that it is improvised (hours, minutes, seconds), not extensively prepared (months, years, centuries)" (Marinetti, Settimelli, Corra 1970, p.145).

The GLOPPID method yields instant results, and the speed with which movements and facial expressions can be activated creates the temporal compression alluded to by the Futurists:

> "*Synthetic*. That is, very brief. Grasping in a few minutes, a few words, and a few gestures innumerable situations, feelings, ideas, sensations, events, and symbols" (Marinetti, Settimelli, Corra 1970, p.143).

In the GLOPPID method, a process of reduction and abstraction of movement is possible, and can be customised to emphasise the asymmetrical and the odd.

1.4 The Pro-Puppetry Thesis and Digital Duende

The eclecticism of a post-positivist approach is reflected in locating this research within the contexts of physical puppetry and physical human dramatic studies. Using a perspective on performance rooted in the physicality, as opposed to the psychology, of the actor – such as that proposed by human dramatic movement practitioners including Meyerhold (1969), Descroux (Leabhart 2007) and Lecoq (Murray 2003) – I argue that, unhindered by egotistical psychological influence, and both in spite of, and because of, its lack of physical presence, a digital puppet is at an advantage, because it uses movement in its purest form to communicate with its audience.

In my extended version of the pro-puppetry thesis, I assert that digital puppets have properties that make them more suitable for certain dramatic scenarios than human actors. Using Concepts in support of the pro-puppetry theses of, among others, Maeterlinck (Brachear, 1966), Kleist (1972, pp.22-26), Craig (1957, pp. 54-94), Schlemmer (1925, p.29), Ghelderode (Goldberg 2011, p.108) and Shaw in his forward to Boehn (1972, p.vi), this research explores ideas surrounding the superiority of the digital puppet over the actor. I make similar claims for digital puppets as Grossvogel does for the Gheldorodian marionettes:

> "The puppets have still another significance: the mystery and power of the inanimate figure. The marionette is an ideal masque, suprahuman because it brooks no human familiarity and superhuman because it is able to embrace all human precepts as well as the shadows wherein, they fade…capable of greater transmutations. He shares with all inanimate objects…the ability to acquire prosaic life and to dispense the full measure of symbolism that comes from such metamorphosis. He then casts on the human thus born the mantle of his magic" (Grossvogel 1958, pp. 261-262).

Digital puppets share with marionettes this "mystery and power of the inanimate figure", which has much to do with movement. Puppet movement is characterised by a defiance of the laws of gravity, and of human or animal anatomical constraints, as shown by bending in awkward ways, or appearing to float. Viewer appeal, and fascination, lies somewhere at the disjoint between the appearance of a puppet and the way it moves. Rather than being realistic, a puppet's movement is parodic, because it is striving to live. Cappalletto (2011, p.333) says that the comparison of a puppet with a man gives it its "artificial expressivity"; it is this sense of puppetness that drives the impression. The jittery, twitching, limb-flailing movement aesthetic of the marionette motion trope is often used to suggest the uncanny or unnatural in

horror films, but it is also used for comedic effect. In addition, when a human moves as if it were a puppet on strings, it is usually in order to give the somewhat sinister impression that it is under the control of someone or some*thing* else.

The quest for realism present in puppetry and mirrored in CG animation is identified by Boehn: "By careful moulding in wax and by clothing it in real cloth the doll could be made to assume an almost perfect resemblance to a human being" (1972, p.2). According to Boehn, the life skills necessary for the success of the illusion are the ability to walk, talk and gesture convincingly, "but before there could be any question of absolute illusion, two difficulties had to be surmounted – movement and speech had to be artificially introduced" (Boehn 1972, p.2). It took time to fully achieve these goals:

> "For centuries men struggled with this problem, which, however, has only comparatively recently found a solution. Now we have our automatic figures which can walk, move and speak – indeed, when necessary, deliver lengthy orations" (Boehn 1972, p.2).

This quest, described by North as the "Holy Grail" of CG animation, is evident in work made at the cusp of the millennium by studios such as Pixar, Disney, Digital Domain and the Moving Picture Company, all of whom have been successful in the artificial introduction of movement and speech: "…we have our automatic [CG] figures" (North 2014, p.3 with inclusion by Childs). Paradoxically, in movies about the relationship between humans and androids, the androids are often played by human actors, as is the case in *Better Than Us* and *Humans* (Kessel 2018-19; Vincent & Brackley 2015-18). Mimesis in both movement and look can be disadvantageous, in that the pursuit of realism may negate the creative potential that animation and digital puppetry offer, as Bishko describes:

> "While qualities of character movement in digital worlds continue to advance, core believability issues still exist. The bar is continuously raised by the standards of feature-film production, which strives towards a realist aesthetic due to the proliferation of visual effects that integrates digital character animation with live action performances" (2014, p.47).

This phenomenon is particularly evident in film-makers who see motion capture as a means to achieve a high level of realism by reproducing human-style acting performance in their protagonists. While Schlemmer acknowledges the benefits of autonomy experienced by an actor occupying the location of the performance:

> "From the standpoint of material, the actor has the advantages of immediacy and independence. He constitutes his own material with his body, his voice, his gestures, and his movements" (1932, p.20).

Bishko echoes Searls' position on the trend towards realism in computer-generated imagery (CGI):

> "Pursuing perfect human mimesis in animation (as in puppetry) is to misunderstand its nature. Indeed, it is a symptom of a common bias towards naturalistic human acting and a tendency to view all performance forms through its lens" (2014, p.48).

The "possibility of naturalism" (2014, p.305) of which Searls speaks can lead to a loss of credibility; Searls argues that while:

> "Successful hybrids are radically transforming what puppetry and animation can do. In some cases, however, where these fusions are used to achieve naturalistic human likeness, their creators are setting aside what is most advantageous about puppetry and animation, thus diminishing their creative impact" (2008, p.294).

My research does not seek realism in either look or movement, but the technically eligible off-the-shelf CG models I use do tend to have a semi-realistic humanoid aesthetic, as opposed to cartoon caricature. However, in my work, an expressive movement style founded in puppetness floods the scene, creating a unity of design that cancels out any mismatch.

While it takes effort for an actor to achieve autonomy and control over their physical body, a digital puppet body is fully controllable and has greater flexibility. By engineering the puppets as expressive actors, the HDPI exploits the advantages of corporeal segmentation and articulation. Properties embodied in the concept of an actor as a marionette or puppet – such as economy of motion, exaggeration, anticipation, isolation of muscles, focus, and movement trajectories found in slapstick, cartoon, and mime – produce movement styles which share some of the characteristics of glove, rod, and string puppets. The puppets' movements are not always smooth; they are sometimes excessive, exaggerated, wooden, staccato, or jerky. Qualities of puppetness give the characters a sense of awkwardness and vulnerability that makes them seem less like the cold and clinical pieces of mathematical mesh that they are. The challenge and the joy of working with a limited movement vocabulary influences and enhances movement expressivity, and contributes to the style.

1.5 Digital Angst

> "Yet all the while Man seeks meaning. Whether it is the Faustian problem whose goal is the creation of Homunculus or the anthropomorphic impulse in Man which created his gods and idols, he is incessantly seeking his likeness, his image, or the sublime. He seeks his equal, the superman, or the figures of his fancy" (Schlemmer 1925, p.22).

As Cappalletto (2011 p.325), Wood (2000, p.15) Boehn (1972, p.2) and Wiener (1948, p.39) point out, the Promethean pursuit of building artificial people in the form of puppets, homunculi, androids, and automata has existed for millennia – in ways governed by the technology available at the time – and now digital puppetry technology is available. Human experience leads to learning and knowledge, and being present at a digital puppetry performance means learning from a performance given by intangible, code-based entities; binary beings constructed from computational data that is simultaneously admired and feared. While we welcome the computational ability to perform tasks such as image recognition, finding patterns, and identifying features that could be beneficial in medical applications by analysing vast amounts of data, on the other side of the computational technology coin lie suspicion and fear. This fear takes several forms: fear of the way that data about human populations and proclivities is collected and shared, fear that the technology itself will evolve into autonomous entities able to stage a coup and take power away from humankind, fear of autonomous weaponry, and the fear that humans may actually be mere machines, robots or puppets, and free will just an illusion. This crisis of identity and invention is expressed by Wood thus:

> "Mixed in with the magic and the marvel is a fear: that we can be replicated all too easily, and that we are uncertain now of what it is that makes us human" (Wood 2000, p.xiv.).

Bill Gates and Jeff Bezos identify autonomous weapons as the most worrying application of AI (Gates 2019; Bezos 2018). Elon Musk refers to AI as humankind's "biggest existential threat", saying "With artificial intelligence we are summoning the demon" (McFarland 2014). Professor Stuart Russell flags the threat of AI, as well as its potential:

> "Artificial Intelligence sits alongside climate change as one of the great challenges we humans need to get to grips with right now. However, AI presents us with extraordinary possibilities as well as existential threat" (Bakaya 2021).

Stephen Hawking flags the self-replicating potential of AI as a threat to the human race:

> "The development of full artificial intelligence could spell the end of the human race…Humans, who are limited by slow biological evolution, couldn't compete and would be superseded…It [AI] would take off on its own, and re-design itself at an ever-increasing rate" (Hawkings in Cellan-Jones 2014).

This uneasy human-machine relationship is explored in science fiction films, TV series and literary works such as *Humans* (Vincent & Brackley 2015-18), *I Robot* (Asimov 2004), *AI* (Spielberg 2001), *Westworld* (Nolan & Joy 2016-2020), *Klara and the Sun* (Ishiguro 2021) *Machines Like Me* (McEwan 2019*)* and *Better than Us* (Kessel 2018-19). As Lepore (2020) states, people set computer models in motion, and then wait nervously to see what possible futures emerge from these prediction machines. The combination of AI and robotics produces reactions such as that seen in the "Campaign to Stop Killer Robots" (Wareham 2018). It is within this context that, as a modern version of automata, digital puppets make so useful a contribution to the discourse surrounding technophobia, autonomy, agency, and digital angst.

1.6 Fake It Till You Make It

There is a connection between AI, ML and the image of the digital puppet. It is my view that, even if not used in their performances, the existence of AI gives digital entities an illusion of autonomy *by association*. This is simply because they are all code-based. This thesis takes the position that digital puppets can be classed as artificial intelligences that can "show us something about ourselves" (Jones 2009, p.256). Digital puppets are built out of computer code, but – by collaborating with humans – can demonstrate imagined life, imagined intelligence, intentionality, desires, and the spark of curiosity: they can *counterfeit* AGI. Paradoxically, it is my contention that by simulating life and intelligence, they are demonstrating the very thing they seek to counterfeit; there is an element of 'fake it till you make it'.

The human propensity to perceive life in the inanimate is not confined to physical objects, but extends to AI. This can be seen in the human interaction experiment with a computer programme designed to mimic a therapist named Eliza, analysed by Chemers:

> "…humans are quite prone to perceive computer intelligences as possessing far greater depth, complexity, and emotional content than they possibly could…. [they] have argued that this susceptibility is due to an evolutionary imperative towards empathy that is manifested in all sorts of interactions between humans and nonhumans. It is such cognitive dissonance that theatre artists from all ages have sought to foster; it, or something like it, is what Coleridge called suspension of disbelief" (2014, p.368).

It could be argued that puppeteers exploit this "evolutionary imperative towards empathy" by using the tendency to read life and meaning into patterns and rhythms, in order to create an illusion for their audiences.

The GLOPPID-method puppets simulate the illusion of desire, curiosity, adaptability, intentionality, and irrationality that AGI has difficulty replicating, and that are missing from the interface between humans and technology for Budde and Rokeby. According to Budde:

> "We can today create algorithms that are capable of learning, of understanding patterns based on models. Such algorithms can map complex input data to desired outputs in a way that humans cannot. Still, they don't have intention. Where is the algorithm that wants to be rich, or good? What makes the human human is not only that we are capable of rationality, but that we are equally capable of irrationality" (2019, p.111).

According to Rokeby:

> "… that driving force that compels us to adapt, seems to be much harder a thing to imbue a machine with than many of the abilities we consider signs of intelligence" (2019, p.112).

By demonstrating irrationality, the GLOPPID method is able to satirise and subvert AI, and so provide insights into the HMI by reflecting "what makes the human, human", in ways that purely AI-driven models cannot.

> "Our investigation of the relationship between the arts and the frontrunner of contemporary technological advances, artificial intelligence, needs to look both at what humans can do with technology — how they can make the most of it — and what doing things with technology does to humans" (2019, p.101).

According to Rokeby, it is desires and how they change over time that are central to his understanding of his own work and its context:

> "What I was missing was not artificial intelligence – it was artificial desire…Without desire, how might an artificial intelligence handle challenging problems that lay outside the scope of its program?" (2019, p. 111)

For the purposes of my own work, an exploration of artificial puppet intelligence also requires at least the simulation of artificial puppet *desire*.

1.7 Art and Science? Methodology Prologue

I see this study as a case of reconciling the unpredictability of improvised performance, where the questions are unknown, with Technical Rationality, which must know the question and which sets out to answer that question. The investigative approach is influenced by the work of Varto (2018), Lotman 1967), Causey and O'Dwyer (2016), as well as Schön's (2017) reflections on the role of Technical Rationality in professional activity, and is driven by the position held by Paglia (2012) and Winterson (2013) that art is not a luxury: it is a necessity. According to Lotman, the solutions provided by art are essential to human understanding:

> "Play and art, both of them working towards the important goal of getting a grasp of the world, share the same common trait: the conditional solution of situations…They provide solutions, which are psychologically absolutely necessary for a man" (Lotman 1967, p.264).

According to Varto, the purpose of artistic research is "to produce information, develop skills, and add understanding about the world and the human being as part of it" (2018, p.7). Lotman says that the purpose of art models is truth, and that "The goal of art is the truth, expressed in the language of conventional rules", both of which help people to understand the world (1967, p.249). Art is a means of our holding up a mirror so that we can learn something about ourselves, in the same way that the intangible Drone Pilot digital puppet looks at himself in a tangible mirror and asks: 'Am I a puppet?' (See Figure 5).

Figure 7. The intangible Drone Pilot digital puppet observes himself in a tangible mirror (Childs 2019).

Varto cites the use of artistic practice as a tool of reflection: “Art has often been referred to as a mirror – convex or concave, distorted or coloured – showing us what we could see if we were not so set in our ways” (2018 p.88). My position is that the discipline-specific episteme of digital puppetry is unestablished, and that the GLOPPID-method episteme will contribute new knowledge to the field. Artistic research is not a problem to be solved, as defined in the Technical Rationality model, but is instead a question of information and perspective:

> “Technical Rationality depends on agreement about ends. When ends are fixed and clear, then the decision to act can present itself as an instrumental problem. But when ends are confused and conflicting, there is as yet no "problem" to solve. A conflict of ends cannot be resolved by the use of techniques derived from applied research.” (Schön 2017, p.41).

Lotman makes the distinction between the models created by scientists and artists:

> “… a scientist creates a model based on a hypothesis, whereas an artist creates a hypothesis based on a model. He models an un-comprehended (or not completely comprehended) object” (Lotman 1967, p.266).

However, in the case of a puppeteer performer who is keen to pursue a path of surprise, and who is working with an unpredictable, irrational, illogical, and mischievous API, a scientific approach requires an artistic lens. In line with the fundamental practice-based research principle described by Candy and Edmonds, the aim of this digital puppetry method is to create a feedback loop, where the process generates questions that are fed back into the practice:

> "A basic principle of practice-based research is that not only is practice embedded in the research process, but research questions arise from the process of practice, the answers to which are directed toward enlightening and enhancing practice" (Candy, Edmonds 2010, p. 63).

My research approach is one of exploration and discovery, where process is key, and experiences contribute to the artefacts. If uncertainties remain at the end of the study, then this is a positive outcome, because the research philosophy follows Rilke's recommendation to "live the questions now":

> "Be patient toward all that is unsolved in your heart and try to love the questions themselves, like locked rooms and like books that are now written in a very foreign tongue. Do not now seek the answers, which cannot be given you because you would not be able to live them. And the point is, to live everything. Live the questions now. Perhaps you will then gradually, without noticing it, live along some distant day into the answer" (Rilke 1903, p.35).

My intention is that light will be shed on the questions outlined in the introduction by allowing the puppets a life of their own. Reflection-in-practice is an integral part of the improvisational process, and reflection-on-practice through reviews of process and recordings of artefacts are the critical-analysis tools of this research. Schön's description of how a scientist observes phenomena, then builds theories based on "abstract models of an unseen world", seems not dissimilar to an artist's imagination:

> "In order to account for his observations, the scientist constructed hypotheses, abstract models of an unseen world which could be tested only indirectly through deductions susceptible to confirmation or disconfirmation by experiment." (1983, p.33).

Both live physical puppetry and digital puppetry are examples of HMIs: to puppeteer *is* to interface with a machine. Digital puppetry is a way of interfacing with complex technologies

with a visible outcome, whose immediacy informs thinking about HMIs. Digital puppetry performance is a way of working *with* the machine, and of potentially diffusing fears surrounding the machine itself:

> "I do think that we have to find ways of working with rather than against the machine, and I believe that theatre and the arts are uniquely suited to this task of paving the way for a new, integrated way of thinking about human beings and technology" (Kleber and Trojanowska 2019, p.106).

Where, in a transmedial sense, the puppet and puppeteer combine, becoming part of the same entity, digital puppetry is in accord with Cappelletto's perspective of the puppeteer as an organic prosthesis of the puppet (2011, p.1).

Regardless of the technology used, collaboration between puppet and puppeteer *without* consciously choreographed, precise manipulation allows the puppet to get sufficiently out of control in order to *live*. This is a feature in accord with Bussell's view of the proficient puppet practitioner as cited by Cappelletto (2011, p.332):

> "The good manipulator is not, as most people imagine, busily concerned with the details of which string to pull, which rod to push. He works the puppet as unconsciously as he works his own muscles: It becomes in fact an extension of himself."

The aim is to present evidence for a pro-digital puppetry thesis, by showing that the direct connection between operator and object in extemporised digital puppetry performance results in digital duende. Speaking of duende in flamenco music, Lorca describes it as an energy:

> "The duende, then, is a power, not a work. It is a struggle, not a thought. I have heard an old maestro of the guitar say, 'The duende is not in the throat; the duende climbs up inside you, from the soles of the feet.' Meaning this: it is not a question of ability, but of true, living style, of blood, of the most ancient culture, of spontaneous creation" (1998, p.57).

Digital puppetry improvisation requires the puppeteer to be at one with the puppet, and not to micro-manage its every move.

> "All arts are capable of duende, but where it finds greatest range, naturally, is in music, dance and spoken poetry, for these arts require a living body to interpret them, being forms that are born die, and open their contours against an exact present" (1998, p.63).

My study seeks to show that duende is a feature of extemporising present in real-time improvised digital puppetry, where the "living flesh" component is part of an HMI.

1.8 The Contribution to Knowledge

Searls' term "a new species of make-believe" (2008, p.305) positions digital puppets as *hybrids with the potential to cross boundaries*. In so doing, she re-defines the thinking surrounding puppets, puppetry, motion capture and computer animation. It is through *improvisation* that puppets are able to take on a life of their own and so become slightly out-of-control – the point at which they are at their most effective. The puppets engage their puppeteers in cybernetics feedback loops, as ideas are passed back and forth. Puppets created using the GLOPPID method have a rogue nature, because they combine human puppeteering with digital controls modified by algorithms: a technique of algorithmically-assisted digital puppetry. These puppets are flawed characters who do not move well in the conventional sense – their motions are neither natural nor fluid – but it is in their awkwardness that their appeal lies. This has ontological implications in that they are the vehicle for an exploration of the potential of digital puppetry as a fear-mediating device; the puppets can become the friendly face of technology.

My research shows that the GLOPPID method is what O'Dwyer calls "A genre of art specific to digital technologies" (2015 p.36) and it is, I argue, well-placed to comment on the relationships between humans and technology. The puppets' paradoxical simulated liveness can be used as a representation and an allegory for ideas and issues surrounding AI, and it speaks to the similarities and distinctions between man and machine, as Friend says:

> "Thinking about artificial intelligence can help clarify what makes us human—for better and for worse" (Friend 2018).

The real-time speech and facial expression generation components used in my research are a combination of algorithm-assisted puppetry and automated, voice-activated lip

synchronisation. The field of speech-driven facial animation is an area of intensive research for reasons of economy, as shown in the work of Vougioukas, Petridis, & Pantic:

> "In order to drive down the cost and time required to produce high quality CGI researchers are looking into automatic face synthesis using machine learning techniques" (2019, p.1398).

It must be stressed that my research study does not *use* AI or ML; it *simulates* them and calls them API. The work is made by using mathematical operations – rather similar to those used in electric bicycles or power-assisted steering – to assist the performances. The way these mathematical operators – which are simple algorithms – are connected determines aspects of the puppet's movement behaviour. For example, the linking of a wink with a certain vowel sound, or of a single eyebrow lift with a smile, creates a semi-automated performance. Reliance on non-automated, manual human intervention is identified as a problem to be solved by researchers in the field of facial animation, whose aim is to eliminate what Vougioukas, Petridis, & Pantic call the "handcrafted intermediate features" necessary to create a convincing performance (2019, p.1398). The GLOPPID method circumvents the need for ML by *puppetising* the handcrafted element, thus combining what machines do best with what humans do best; *it puts the human back in the loop*. This way of working involves an HMI that transforms the puppets into code-based collaborators, in a process that corresponds to Rokeby's account of onstage protagonists:

> "It takes much more time than most people realize to get to a point of comfort with the technology, so that you respond to it as another sort of protagonist onstage" (2019, p.101)

Digital puppetry is not simply another medium used to explore the same artistic content in another way. Content is given primacy through the improvisational nature of the workflow via a technique that enables collaboration with digital entities, "another sort of protagonist onstage", part puppeteer and part something unpredictable. This is a process that confirms Dixon's statement:

> "We are equally unequivocal that the conjunction of performance and new media has and does bring about genuinely new stylistic and aesthetic modes, and unique and unprecedented performance experiences, genres, and ontologies" (Dixon 2007, p.5).

The GLOPPID method qualifies as a "new stylistic and aesthetic mode" because within it the unpredictable side of API meets the logic of computational operations, resulting in a novel approach to improvisation using digital puppets. For example, it was during the course of this study that I discovered face jazz. Live digital puppetry performance is a case of theatricality made possible by technological development, because it makes possible real-time onstage theatre clowning with a digital puppet, in what Malone refers to as a "unique and unprecedented performance experience" (2000, p.57). Causey, Meehan & O'Dwyer (2015, p. 11) and Budde (2019, p.103) make the point that there have been price reductions in both hardware and software in the early twenty-first century. This means that digital puppetry technology is now available to the independent artist, thus making it possible to create live experimental 3D digital puppetry pieces. My research is situated at the intersection of art and technology discussed by Kleber and Trojanowska (2019, p.100), focusing on the notion that the spontaneity of this hybrid technique affords a creative versatility and latitude not previously available to performers, which Searls refers to as an "interactive puppet stage":

> 'Because of digital puppetry, animated characters can, like puppets, be present. By turning the screen from a projected recording into an interactive puppet stage, cartoon creatures can act on spontaneous impulse and experience the vulnerability to accident that actors and puppets have always exploited' (2008, p.296).

My research contributes to the ontological discourse surrounding the technique of digital puppetry as a comment on the pro-puppetry discourse, the HMI, trans-embodiment, the post-human, the illusion of life, cybernetics, "How the algorithm and the digital relate to the arts, particularly to performance" (Kleber & Trojanowska 2019, p.101), and to the human fears of – and admiration for – AGI, which is part of the fabric of twenty-first century life.

1.9 Summary

My work is concerned with the discourse surrounding digital dramaturgy, AI-mediated art, and the notion of the Anthropocene. It is pertinent to what Budde identifies as "posthuman discussions about how we define ourselves in relation to nature and culture, which includes machines and technology" (2019, p.107).

> "We want to understand the relationship between humans and the technology that humans produce and perform; we are not yet at a point where technology actually

> produces humans — it's still the other way round. What agency and responsibility do we have in this process?" (2019, p.105).

These philosophical discussions interrogate attitudes to the notion of self-replicating robots, in the same way as that which I refer to as the pro-puppetry thesis interrogates the idea of the puppet as an ideal actor.

This research demonstrates that digital puppetry exploits advantages found in three other disciplines: the immediacy, spontaneity and stylistic freedom of live puppetry, the versatility of three-dimensional digital environments and characters, and the real-time control of motion capture. By combining the concepts of the puppets' "quest for life", technology as a "prosthetic of philosophy", and art as a mirror, I explore how distinctive features in digital puppetry practice can be used to express truths about being human. By simulating AGI in digital puppets using algorithm-assisted puppetry, this study puts the HITL of the HMI. The objective of this research is – in the words of Varto – "to add knowledge and understanding", and therefore help to "explain humanity" (2018, p.9). To summarise, the thesis can be expressed in the form of the following formula:

Extemporising with puppets + the ur-narrative of puppets + art as a mirror + technology as mirror = a pro-digital-puppetry thesis on HMI, AGI + what it is to be human.

2 Chapter Two: Digital Puppetry Literature and Practitioners

2.1 Chapter Outline

This chapter provides a snapshot of the state of the art of digital puppetry, and is divided into two parts: the first reviews literary works on digital puppetry, providing the theoretical basis and the philosophy underpinning the practice, while the second looks at the technical context outlining techniques used for digital puppetry, and at a selection of digital puppetry practitioners.

2.2 Part One: Digital Puppetry Literary Works

This review covers literature on digital puppetry published only in English, and does not claim to be exhaustive. Of primary interest is material on digital puppetry as a dramatic art which looks at creative process and movement aesthetics. Additional texts of relevance come from the related fields of live, tangible (physical) puppetry, animation, human physical dramatic movement technique, and digital performance. There is overlap between the disciplines in terms of how the illusion of life is created in puppetry and animation. The approach taken is based on the belief that material on movement analysis and codification pertaining to the human body in motion, and also to inanimate object manipulation, can be extended to digital puppetry practice, especially with regard to energy-transfer and trans-embodiment.

Digital puppetry practice is largely absent from texts on puppetry, and almost completely absent from those on acting. This may be due, in part, to a competitive performance environment legacy which is dependent on definitions that use strict criteria to categorise practice and artefacts based on technique, and which fail to acknowledge the twenty-first century inter/transdisciplinary changes at play. Institutional bias concerning interdisciplinary experimental performance is reflected in the (now outdated) qualifying criteria used to identify puppetry pieces on video by Levenson in the early 1990s: “Technology must not be used to create the puppetry, only to record it” (Tillis 1999, p.184). While Levenson’s definition makes no mention of CG figures, the inference is that a digital puppet operated in real time cannot be considered a puppet, because of the use of technology in its creation. However, by redefining the qualifying criteria, valuable work by Jurkowski (1988, pp.37-50),

Kaplin (1999, pp. 30-31) and Tillis (1999, pp.182-189) locates digital puppetry within the general puppetry context. Kaplin's contribution initiates the process by means of a systematic categorisation of performing objects he calls "A Model for the Field of Puppet Theatre", which Tillis interrogates, introducing the notion of what he calls "media figures" (1999, pp.182-186). Tillis gives an account of animating the walk-cycle of a media figure in the form of a CG character, resulting in the confirmation that real-time manipulated CG characters can be classed as puppets. Jurkowski's material on definitions, aesthetics, critical analysis, process, meaning and purpose in physical puppets and puppetry, as well as puppets as sign systems, has been used as a general background and context in the formation of the thesis. Westecott (2009, p.1) looks at the sign system of player and player character in relation to computer games. Westecott's identification of the gameplayer as puppeteer, computer game space as theatre, and gameplay as performance (2009, pp. 1-2) highlights properties common to computer gaming and the digital puppetry process, with respect to HMI, agency and embodiment, in addition to the use of controllers and the manipulation of characters in real time. The relationship between puppeteer and puppet foregrounded in her analysis of the dynamics and mechanics at work in gaming is perceptive, and of great value to this thesis. Westecott emphasises the "synthetic nature of the player character", seeing it as a "live and improvised dramatic performance in which the player consists both puppet-master through her input control as well as audience through her screen gaze. The player character is a particular type of virtual puppet, one that moves within a specific game world, directed to a particular game objective, achieved through our skilful progression over time" (2009, p.5). Taken together, these texts begin to form a useful framework for digital puppetry.

The historical absence from literature of digital puppetry is reflected in the response I received from Head of 3D CG Mike Milne at the visual effects company Framestore[6] when I asked him what part digital puppetry might play in future 3D CG productions: "I don't know where you got the term digital puppetry from – it's not something we use in the industry". Yet this technology was used in professional contexts as early as 1989, in the *The Jim Henson Hour* TV programme, which featured a digital puppet character named Waldo C. Graphic. My understanding is that the kind of attitude seen in Milne's reply stems from either a misunderstanding or ignorance about what can be achieved in the hands of expert puppeteers, in spite of work such as that seen subsequently in the Diet Coke adverts (Puppet

[6] Framestore is a VFX, animation and post-production company.

Heap 2010). There is the sense that digital puppetry could not fulfil the requirements of a commercial brief, in addition to a bias against puppetry in general, as expressed by Caird:

> "There remains a resistance to puppetry that perhaps owes something to its perception as experimental and esoteric – even eccentric" (2009).

As a side note, Wordsworth included the puppet show in his concept of a "Parliament of monsters" categorising them as "out-o'-the-way, far-fetched, perverted things" (1805).

Budde's perspective on the "abyss" is reflected not only in the absence of digital puppetry from literature on puppetry, but also in its corresponding absence from literature on computer-based arts. An exception to this is the valuable and relevant commentary present in Searls' discussion of digital hybrids, in which she identifies the practice of digital puppetry as "a new species of make-believe", locating it within the contexts of motion capture and computer animation, and where she pinpoints the advantages it brings of both spontaneity and real-time interaction with audiences (2008, p.305). However, Searls' perspective is a rarity, and whilst abundant literature on digitally-mediated human actor/dance-based interactive and improvisational performance exists, it is of little relevance to my thesis. The GLOPPID method, as I have previously described, has its roots in a pro-puppetry thesis – the notion that the puppet is a superior performer to an actor. Ideas surrounding this pro-puppetry thesis are identified and explored in influential literature by Kleist (1972, pp.22-26), Craig (1957, pp. 54-94), Shaw (1972), Schlemmer (1925, p.29), Maeterlinck (1966) and Ghelderode (REF), and discussed by – amongst others – Jurkowski (1988), Levitt (1975, p.974) and Goldberg (2011, p. 108). The aforementioned notion was proposed by Kleist in 1810 in support of the string marionette as an ideal performer, and in 1907 by Craig, who used the concept of the über-marionette in the formation of what Malone calls a "solution to the inadequacy of the actor" (2000, p.58). The ideas supporting this thesis can be condensed into the approval of a set of attributes exclusive to puppets, expressed in, for example, the way marionettes jump on their strings, and the way a static face changes as it catches the light from different angles. The way puppets move, their economy of motion, immortal properties, a lack of ego and backstory are virtues described by the proponents of the pro-puppetry thesis as ideal. Kleist's take on the pro-puppetry thesis is precipitated by an unconscious and unselfconscious grace seen in marionettes, but lacking in human actors and dancers, who are only too aware of themselves and their effect on a viewer. Kleist's discussion even looks at whether the human

can be taken *out of* the loop, as in a kind of mechanical theatre. Schlemmer's work on incorporating the idea of an actor as a puppet and marionette is inspirational to my research (Schlemmer 1925, p.26; Koss 2003, p.724). Malone's identification of the growing interest in digital actors at the end of the twentieth century links directly to Kleist's theory in *Cyber-Kleist: The Virtual Actor as Über-marionette* (2000, pp.57-66). Digital pop idols and dead actors – brought back to life as synthespians – required a considerable amount of technical back-up at the time Malone wrote this piece. Two decades later, there are many more examples of commercially-produced digital puppets, but non-commercial real-time-operated digital puppets remain a rarity.

I began to describe the fusion of puppetry and computer animation in support of the pro-puppetry thesis in Childs (2007, pp.16-17), where improvisation and animation come together in an account of my early digital puppetry experiments as a virtual puppeteer. The potential this approach offers is also indicated by Kipp and Nguyen in their proposal for a "novel multi-touch interface", where they point out that "many possibilities" could become available if accessible puppet-performance capture technology were to be on offer (Kipp and Nguyen 2010, p.1). Searls dissects motion capture, CG, and animation aesthetics in terms of unity of design, citing examples where the mismatch between form and motion demonstrates flawed process and result; an obvious anomaly when human motion is mapped onto fantasy creatures. She argues that some puppetry-animation hybrids are more successful than others, and that their creative impact is reduced when directors and/or production companies try to achieve naturalistic or realistic human mimesis (2014, pp.293-305). I tend to agree with Searls' argument that difficulties arise from a failure to adhere to the principles of unity and distance, which both puppetry and animation have in common. Searls' observation of there being a danger that the movement will not match the appearance if a fantastical character is worn like a suit, instead of manipulated at a distance – like a puppet – is of direct relevance to the GLOPPID Method. Where this mismatch occurs, credibility suffers, and the illusion is broken. Her understanding of both the technology and its potential are refreshing in a field where there is often a disconcerting failure to fully comprehend CG processes, or to differentiate between digital puppetry and motion capture. At times, there is also a failure to properly research digital techniques, as appears to be the case in – to take an example – literature by the puppetry scholar and Puppet Centre Trust director, Penny Francis. Her abstention from a discussion on digital puppets and animated figures weakens the scholastic credentials of the text overall, even though she is progressive enough to accept that:

> "The figure animated electronically or even remotely is still a puppet if the performer is present at the other end of the cable or the machinery, controlling the movements, just as at the end of a simple string or rod" (Francis 2013, p.13).

Francis' problem partly lies in Tillis concatenation of CG-animated and real-time-operated CG characters, without a clear explanation of the way the keyboard is used:

> "Of the third [keyboard operated computer figures] I am less convinced; here the keyboard is the control moving the character. Can this be said to be a means of manipulation even if operated by the hands of a puppeteer? I leave it to the reader" (Francis 2013, p.17).

This account fails to pay attention to the various DIDs used with computers; a button on a keyboard and a gaming joystick have significantly different actions and effects. Although Dixon's text 'A History of New Media in Theatre, Dance Performance Art and Installation' mentions digital puppetry, it is as a technique that does not fulfil my real-time puppetry definition, and is therefore omitted from this research study (Dixon 2007, p.91). The only usefulness of Dixon's text's lies in the pro-technology argument:

> "We are equally unequivocal that the conjunction of performance and new media has and does bring about genuinely new stylistic and aesthetic modes, and unique and unprecedented performance experiences, genres, and ontologies" (Dixon 2007, p.5).

The typical approach to production design in 3D computer animation, which is – in my view – a close relation of digital puppetry, prioritises pre-planning and pre-visualisation, and places the story reel at its centre. Storyboarding is regarded as the conventional location of the devising process in animation, as can be seen in the practical production texts by Cantor (2006, pp. 125-141) and Hart (2008). However, the digital puppetry carried out during this study is a form of extemporised animation that has more in common with the principles and processes of improvisation found in music, theatre, clowning and dance than with its sister, 3D computer animation. Inspirational literature is to be found on musical improvisation, (including flamenco and jazz) in the form of the text and associated documentary series by Bailey (1993), on dance and movement by Tufnell and Crickmay (1990) and on theatre clown by Davison (2013, 2015). *The Synthetic Futurist Theatre: A Manifesto* (Marinetti, Settimelli, Corra 1970, pp. 142-146) is an inspirational text for the GLOPPID method, due to its emphasis on improvisation and military-based technology, together with its sense of impatience at the idea of pre-planning. Evidence for the thesis of spontaneity in digital puppetry is present in online material from live physical puppetry practitioners who use

improvisation, either as performance or in the devising process. The former is true in the case of ANIMO by Improbable Theatre Company, described thus: “no script, no set, just a range of everyday materials, five improvisers and a completely different show every night”. The latter is the case in the piece entitled *The Table* by the puppet theatre company Blind Summit.

In this thesis, reference is made to literature on transferable psycho-physiological skills – present in both live physical puppetry and human theatre practice – that can be used to bring an intangible digital puppet to life. These skills include proprioception, an awareness of peri-personal space, the use of trans-embodiment, and energy-transference techniques.

A combination of three texts facilitates the classification of digital puppetry as the live manipulation of code-based signs of life. These texts are as follows: the explicit identification of puppetry as an act of trans-embodiment explored by Mello (2016, pp. 49-58), Astles’ (2009, p.54-55) identification of puppetry as an act of energy transference and Tillis’s (2001, p.175) definition of a puppet as a location. Astles’ work on puppetry training provides valuable insights on how a puppeteer sends energy to a puppet in order to “create a sense of presence beyond their own bodies” (Astles 2009, p.54). The ability to transmit energy – where the energy must be focused on an intangible idea of a thing – is central to digital puppetry; as Astles says: “contemporary puppet theatre is defined through a continuum of energy transference. This is achieved through intense concentration on the thing that is animated and on those relationships that emphasize this continuum” (Astles 2009, pp. 58-59). Notions of embodiment and trans-embodiment in improvisation are apparently more prevalent in the fields of dance and physical theatre than in puppetry. Detailed descriptions of specific approaches taken on these notions can be found in Bugeja’s texts on dance, and Mello’s texts on tangible puppetry. Fredricksson’s (2015, pp. 234-246) insights on the application of the Feldenkrais Method to tangible puppetry performance is another example of transferable knowledge pertaining to human dramatic technique, but also applicable to digital puppetry. Mello’s analysis of the structured improvisational techniques used in the physical puppetry work of Tranter, Genty and Underwood provides rare insights into the preparatory work undertaken by puppeteers as they condition their bodies and minds for performance (Mello 2016, p53). However, these observations also highlight the limited amount of material on puppetry training, as identified by Astles. Mello’s (2016, p.49) proposition that “puppet and material performance is an embodied practice that can be understood as a theory and technique of trans-embodiment – meaning the transference of

direct and indirect embodied techniques among actor-puppeteers, puppets, and materials" correlates to Astles' idea of "law of continuum" (2009, p.57-58), in which everything on the stage is seen as part of the same whole, where energy is placed and fuelled in order to maintain interest and engagement.

Bugeja's (2015, p. 6-9) comparison of Bausch and Lindh, where improvisation is used as a method of devising in the former, and as actual performance in the latter, are informative and liberating for a digital puppeteer. Bugeja's treatment of the embodied mind in Lindh's dance work gives definitions of motivation and intention, and also provide an account of Lindh's belief in the non-existence of "empty gestures" (subject to certain qualifying factors), which inform the reductionist approach to movement used in the GLOPPID method (2015, p. 6-9).

Inspiration comes from the puppet-makers Jones and Kohler (2009; 2011), whose insights into the craft of puppeteering and the mechanics of the dialogue between puppeteer and audience are invaluable. Information on practical puppetry process comes from the online training materials of Mottram and Baker. Mottram's workshop materials on the logic of movement examines the role movement plays in the creation of the illusion of life in the inanimate, by simulating forces and effects such as gravity, effort, momentum, and energy.

Texts coming from the two fields of puppetry theatre performance and new media dramaturgy (NMD) combine to help illuminate a path towards a digital dramaturgy model (Eckersall, Grehan and Scheer 2015, p. 375). Jones and Posner identify dramaturgical components and perspectives that give structural insights into tangible puppet theatre; these can be applied to the digital puppetry paradigm, thus placing the GLOPPID method within an NMD context. Posner's contribution to the topic defines a puppet as **"**a repository of visual dramaturgy; the puppet is character and contains story even before it is set in motion" (2015, p.336). Jones identifies two levels – the macrolevel and the microlevel – while Posner breaks puppet theatre down further, into three levels: 'narrative', 'meta narrative' and 'ur-narrative' (Jones 2009, p.257; Posner 2015 p.335). The term microlevel refers to a "performance of the ur-narrative: the performance of life". Jones defines the ur-narrative as a dramaturgical element unique to the inanimate, who – unlike living actors – must work to create the illusion of life, and I am in agreement with his perspective. The fact that the movement data in digital character models derived from suit-based and limb-based motion capture DIDs have differing

properties is identified in North's (2008, pp. 148-178) analysis of virtual actors and synthespians.

It is often easier to see when something is missing or anomalous than to identify traits and properties from what is present, so by identifying the differences between inanimate machines, puppets, androids, robots and humans, it is possible to pinpoint exclusively human properties and qualities. AI can therefore act as a mirror for human consciousness and ways of thinking.

Kleber and Trojanowska's insightful conversation with Antje Budde and David Rokeby proposes computational technologies as reflective media with which to gain knowledge about what it is to be human (Kleber, Trojanowska, 2019). Jones and Kohler (2009; 2011) explicitly identify puppets as possible mirrors that perform a similar function. Ishiguro (2015) and Poulton (2014) cast robots, androids and actoids in this role, as does Wood (2002) in the case of automata. Lotman (2011) and Nikolchina (2006) explore the idea that art and technology can be used as mirrors into which people can look and think about themselves, and thereby gain insights into what it is that makes them human. Lotman's discussion of art and play as modelling systems looks at art as an analogue of reality (2011, p.250), stating that "the goal of art is truth" (2011, p.265)

As previously discussed in relation to tangible puppetry, inter-disciplinary creative performance practices involving hybrids or multimedia – though attractive to some – are problematic to purists and supporters of strict definitions. The existence of distinct categories for live-action and animated film-making, and the increasing use of motion capture has implications in, for example, the Oscar Film Awards. The performance of the character *Gollum* in *The Hobbit* (Jackson 2012) was created by a team of people, including the actor Andy Serkis, whose performance is cited as a reason for permitting nominations of motion-capture actors for the 'Oscar Best Actor' category. This is an idea that has support in the film industry:

> "Andy Serkis, one of the greatest actors of our generation, has called for motion-captured performances to finally be eligible for a nomination at the Academy Awards … Many will be unaware that movies using significant motion-captured performances are currently deemed ineligible for Best Animated Feature nominations. Furthermore, motion-captured roles in both animated and more "traditional" features have never been nominated in Best Actor categories" (Delbridge 2016).

My research is informed by pragmatic techno-philosophical analysis by practitioner-thinkers with first-hand experience of software, algorithms, and the mechanisms of HMIs. Both the practice and the underpinning theory are influenced by Kleber and Trojanowska's conversation with Antje Budde and David Rokeby, in which they consider "what the algorithm brings to performance from the perspective of interactivity in the performing arts" (Kleber, Trojanowska 2019, p.101). The algorithmic element in the GLOPPID method is limited to mathematical operators that govern the connections between the puppetry controllers and the puppets. The limited public exhibition of the artefacts means that interactivity is confined to puppeteer collaborators, rather than also involving audience members. There is no AI in the GLOPPID method in the computational sense of the word; however, as previously stated, puppets *can* be viewed as artificial intelligences, and the GLOPPID method is "a way to integrate the technology so it becomes a protagonist with the actors", although not precisely in the sense I believe Kleber intends (Kleber and Trojanowska 2019, p.101).

Of great value to this research study are Budde's account of the philosophy that drives the Digital Dramaturgy Laboratory (2012-18), now known as the Digital Dramaturgy Lab^{squared}, Rokeby's account of his working relationship with digital technology, and Kleber and Trojanowska's insights into the artistic relationship between technology and HMI.

Central to the GLOPPID method are notions surrounding "bodies of technology meeting human bodies", and the creation of human-like irrational desires, intentionality, adaptability and curiosity that give a sense of – albeit counterfeit – intelligence in non-humans (Kleber, Trojanowska 2019, p.111). Literature on the twin concepts of collaborating with technology and technology-as-collaborator – encompassing notions surrounding the HITL and the HMI – are highly relevant to this study. Rokeby's analysis of collaborating with technology, and the computer's value as what he terms a "prosthetic organ of philosophy" bring into focus the mechanisms and – inevitably – the relationships that build between participants in an HMI (2019, p.107). Even though no mention is made of digital puppetry in Causey, Meehan & O'Dwyer (2015), the computer as symbiotic performance partner and the consideration of computer software as choreographic partner (O'Dwyer 2015, p.35) are both features of digital puppetry for the independent artist.

Oliver's discussion surrounding her own practice includes accounts of working with gaming technology in performance, and deals with HMI, inter-mediality, and the tyranny of pre-recorded material. Her work mirrors my own in its use of gaming technology and screen-based imagery onstage, but her accounts also highlight the differences between our ways of working with these technologies. In *The Emancipating Possibilities of Performing with Cartoons* (2008), Oliver looks at the meeting-point between actual and pre-recorded digital performer; work which has some commonalities with my own. In her piece entitled *Not Waving but Drowning: The Affect of Random Programming on the Creation of a Digital Performance Work*, she summarises "the affect" as a combination of two themes: "emancipation and enslavement". Oliver's proposition (2015, p.125) that gaming technologies only facilitate an *illusion* of interaction with onscreen digital characters is highly relevant to my research, and serves as a catalyst to some of my counter-arguments regarding code-based collaborators. Where my work is concerned with the afore-mentioned tension between the letting-go of improvisation and the control of real-time digital puppetry, Oliver's looks at the spontaneity and "agony" of working with randomly-triggered recordings (Oliver 2015, p.125). The difference between our approaches lies in the complete liveness of my work, as opposed to the pre-recorded cartoon and video element in Oliver's.

Texts by Cardinal and Hammond (1987, pp.4-9; 1987, pp. 54-67), and O'Pray (1989 pp. 245-264) on animating the fantastic are influential on this thesis, because they deal with the illusory and paradoxical nature of puppetry and puppets. O'Pray's identification of the film-making group the Alchemists of the Surreal locates the discourse surrounding the properties of puppets and their relationships with those who manipulate them within the surrealist landscape inhabited by puppet animators Svankmajer and the Quay brothers. These texts discuss how the dead-yet-alive ambiguity of puppets enables the animators in the group to bring the mystery of death and life closer to our comprehension (O'Pray 1989). The idea that puppets have souls is not questioned by Gross (2011, p.63), whereas O'Pray (1989, p.260) sees their otherness as a kind of soullessness. The notion that an audience watching a puppetry performance experiences an effect peculiar to puppets, in which the latter are seen simultaneously as assemblies of lifeless matter and living beings, is recognised by scholars. Tillis calls this effect "double- vision" (1992, p.7), Jurkowski (1988, p.42) "opalescence", and Green and Pepicello "oscillation" (1983, p.148). The ontological implications of physical live puppets and puppetry as existential and metaphysical actuators, as discussed by

Jurkowski and Gross (1988, pp.1-84; 2011, pp.1-25), have parallels with the commentaries on stop-motion animated puppets by Cardinal and Hammond (1987, pp. 4-9; pp.54-60).

Material on the technicalities of construction of animated content, and a certain amount of material on design (in the form of 'The Making of …' publications on drawn, stop-frame, and 3D computer animation) can be found, but considerably less is available on the critical analysis of the content itself, particularly in terms of process and aesthetics. Scholarly material on animation by Furniss (1998 pp.165-197), Kitson (2005, pp.75-98) and Wells (1998, pp.21-28) has limited coverage of the aesthetics of movement. Movement as an aspect of performance aesthetics is discussed in the more technical literature on animation, where the methods of achieving different qualities in animated motion by means of the specific drawing, posing, rigging or filming techniques involved are described, but is of limited use in the service of extemporised digital puppetry practice. The mechanics of animation require that a piece of movement be analysed and broken down into component parts, a process described in detail by Williams (2009, pp.174-188), Laybourne (1998) and Webster (2008 pp. 74-103). The pioneering animators Thomas and Johnston are responsible for defining the twelve principles of animation used to create the illusion of life through movement in drawn cartooning (1981, p.47). However, these texts are less useful in this research context, where the combination of live action and puppet dynamics is a somewhat different process. Theory and practice regarding the actor as puppet are of greater relevance for puppet anatomies.

For this research I have drawn on literature on human dramatic movement systems, particularly on approaches that deal with performance technique characterised by an absence of classically-codified styles of movement. This can be found in Descroux's concept of Corporeal Mime, Meyerhold's work on biomechanics, Laban's work on movement analysis, and Lecoq's Action Mime (Leabhart 2007, pp.13-72, pp.113-138; Murray 2003, pp.78-96). Laban Movement Analysis (LMA) is a human-actor training tool, but Bishko applies it to digital work, describing it as "the glue between the continuity of my real-world movement experience and the discontinuous process of creating animation frame by frame" (2014, p.47). Bishko proposes LMA as a useful tool for the animator in terms of enhancing the believability of characters. She explores the relationship between movement and empathy, and how believability in characters is at least partly induced by empathy in the viewer – an attribute closely related to "appeal", one of the twelve principles of animation (Thomas & Johnston 1981, p.47). The LMA concept of a "Movement Signature", together with exercises

and ideas proposed by Grotowski, are used in the artefacts made during my research (Grotowski 1969, pp. 15-24; 101-184). On a different note, the theatre anthropologist and director Barba refers to performance technique as "extra-daily", and identifies strategies used by physical dramatic performers, actors and dancers from Eastern classical contexts – including traditional Asian and Japanese Noh performers, who "work with a network of codified rules" (Barba & Savarese 1991, p.220) – to enhance or amplify their onstage presence.

With regard to methodology, my research draws extensively on texts by Lotman, Schon and Varto. Although largely based on literary works, Lotman's (2011) analyses of scientific and artistic modelling activities have assisted in my understanding of digital puppetry practice. Schon's (1983, p.49) critique of technical rationality in professional practice identifies "tacit knowing", which is encouraging for the purposes of a practice-based research study. Varto's (2018) work on artistic research – what it is, who does it and why – is of particular value to my methodology. According to Varto, individual professional skills pertinent to the specialist area being investigated are key to objectivity in artistic practice, but – in addition to skills and actions – Varto also values the importance of happy accidents in finding new knowledge and information (2018, p.8).

2.3 Part Two: Digital Puppetry Technical Context and Practitioners

2.4 Definitions, Scope and Exclusions

In animated film-making, an animator records successive poses of a character incrementally over time, so that when the increments are played in rapid succession, the character appears to move. In whole-body suit-based motion capture used in CG film-making, positional data from motion-tracking sensors placed on a human performer's body is mapped onto the corresponding parts on a digital character, so that its movement replicates that of the human performer in real time. This kind of motion capture is constrained by the underlying physiology of the human anatomy, meaning that however stylised the motion, the bipedal form beneath is always recognisable, as seen in *King Kong* (Jackson 2005) where – despite the use of body modification in the form of arm extensions, and the ape-like movement skills

of the performer – humanoid physicality is discernible, and the movement produced is that of a human mimicking an ape. Other suit-based motion capture examples include Jim Carrey as Scrooge in *A Christmas Carol* (2009), Tom Hanks as multiple characters in *The Polar Express* (2004), Crispin Glover as the Grendell character in *Beowulf* (2007), Andy Serkis as Gollum in *The Hobbit* (2012-2014) and the *Lord of the Rings* trilogy (2001-2003), Andy Serkis as Caesar in *Planet of the Apes* (2014), and Jamie Bell as Tintin in *The Adventures of Tintin* (2011).

In digital puppetry, controllers are used to manipulate a digital character via levers and buttons connected to articulation points on the puppet's body (see Figure 8). The movement telemetry is mediated by a puppeteer, giving an opportunity for expressivity that is absent in motion capture, where the operator wears the character – directly mapped to corresponding points on the puppet – rather than manipulating it remotely. Digital puppetry can be carried out using digital puppetry DIDs such as joysticks, gamepads, touch screens, Wii controllers and custom-built solutions. The most sophisticated DID is the Character Shop's (Finger 2015) patented solution called the Waldo®, which has been used for controlling both digital and physical puppets. Versions of the Waldo® are supplied to clients including Rhythm and Hues, Pacific Data Imaging and Walt Disney Imagineering, but they are all prohibitively expensive for the independent artist on a limited budget. For reasons of economy and accessibility, this research project uses gamepads and joysticks as DIDs. This digital puppetry method can be replicated using readily available hardware and software, even by a performer who is not necessarily 'tech-savvy'.

Figure 8: The digital puppet named La G is operated live by two puppeteers using gaming controllers and a steering wheel (Photo courtesy of RedandBlackRose).

Digital puppetry is present in film-making and television production, but its use by independent artists is still not commonplace, and a digital puppet in a live clown setting is – as far as I am aware – unknown. Searls points out commercial examples of digital puppetry that can be found in theme parks and trade shows, with the aesthetic of what she terms "computer game style characters" (Searls 2008, p.297). Theme Park examples include *Magic Mirror* (Strike, 2009) – derived from *Shrek* (2001) – and *Turtle Talk with Crush* (Walt Disney Imagineering & Pixar 2004), from *Finding Nemo* (2003). The Henson Digital Puppetry Studio, a commercial enterprise, makes digital puppetry content, including the TV series featuring the cartoon character Sid the Science Kid (2008-2013). It is important to note that they use digital puppetry to cut down on post-production costs in the creation of recorded content.

Tartaglia's portrayal of Farquaad's 'Magic Mirror' character is not true digital puppetry, because the actor's own facial motions are captured by means of markers and transferred onto the mirror's face.

Over the last ten years, software and hardware solutions have progressed enough to allow independent artists to begin experimenting with digital puppetry. Examples can be seen in work by Childs, Gilbert and Hancock, and small-scale commercial emergent operations such as *Bit* (Verde, 2013), made as children's entertainment. In *Bit* (Verde, 2010) and *Turtle Talk with Crush* a digital puppet interacts with the audience; the puppeteer can see the audience and personalize the interaction, but the audience cannot see the puppeteer. In these cases, the relationship between the puppet and the audience is dependent on the covert puppeteer's ability to control the puppet, aiming its gaze in the right direction, timing the performance and – depending to the situation – conversing with the audience:

> "…the animated character makes eye contact with people, calls them by name, and engages in actual conversations" (Searls 2008, p.297).

'Bit' (Verde 2010) is a whole-body puppet whose uncomplicated design (See Figure 9) limits the rigging challenges. The limbless Bit has a spring for a body and simple facial expressions, making his manipulation straightforward for the puppeteer. Bit sometimes appears with a second performer, who interacts with him live onstage, asking him questions and telling parts of the story.

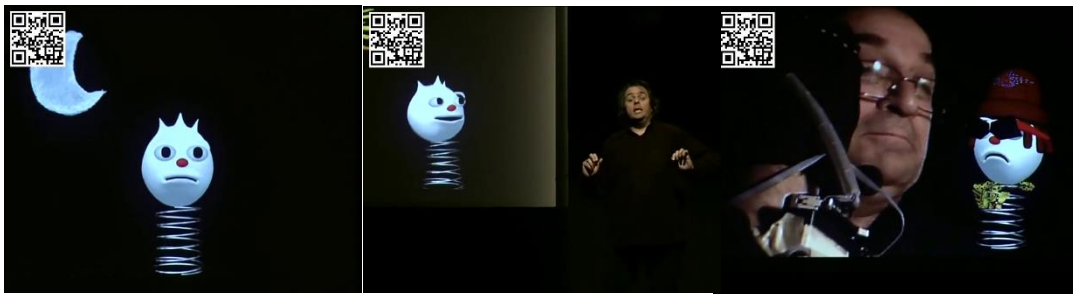

Figure 9. Scenes featuring Bit, Giallo Mare Minimal Teatro & E-tica (Verde 2010).

The technical challenges of operating a head-and-torso puppet anatomy are demonstrated in work by Dellmour (see Figure 10).

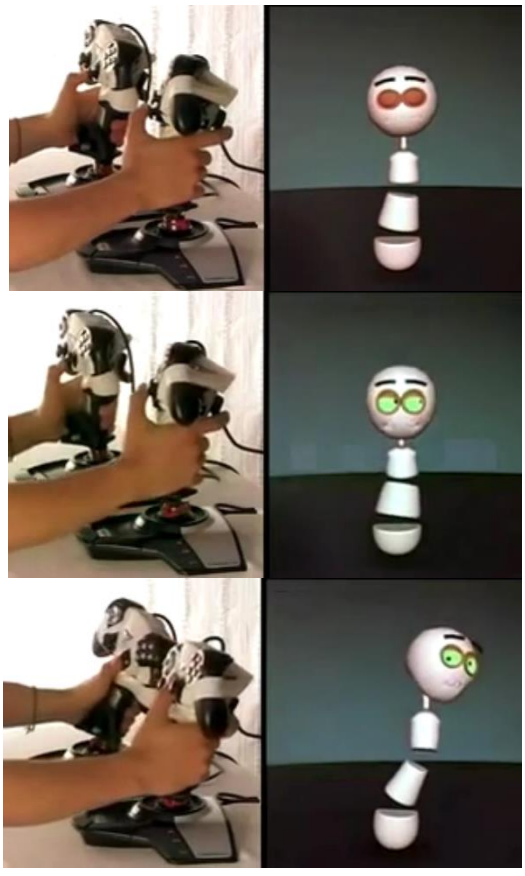

Figure 10: A digital puppet and its direct input devices (Dellmour 2007).

As can be seen in Figure 9, Dellmour maximises the puppeteering potential of two hands by tying together four controllers – two gamepads and two joysticks – thus enabling a single puppeteer to operate an entire digital puppet character, including body and face, in time to music.

Examples of hand-driven DIDs using off-the-shelf 3D animation software together with gamepads and joysticks to capture movement can be seen in work by Childs, del Ponte, Gilbert, Hancock, and Cresshead. *Weirdo* (Childs 2007) and *Swearing Man* (Childs 2007) are two proof-of-concept pieces made by the author, in which the voiceovers are pre-recorded and animated automatically (see Figure 11). The digital puppet heads are controlled by using two joysticks, configured in such a way that the eye-blinks and smile are operated by buttons on the top of the joystick, while the neck is controlled by the orientation of the stick itself. These examples demonstrate how several takes can be recorded and, as the performance improves, the best take can be chosen for exhibition.

Figure 11: *Weirdo* (Screenshot by Childs 2007).

Hancock – founder of Machinima.com and author of *Machinima for Dummies*, who coined the term 'Machinima' (meaning 'making films from computer games') – experimented with puppeteering a woman's face (2013), demonstrating high levels of controllability, including eye movement, blink, and mouth-shape controls. However, this example highlights the need for a sufficiently high command of puppeteering technique when using a gamepad: Hancock has difficulty maintaining control of the mini joystick that operates the mouth with one finger whilst manipulating the eye-blink button with another. Either further practice is needed in order to master the controller, or another method is required.

In *Toucan* by Cresshead (2013), a toucan's neck and beak are manipulated using a single gamepad, demonstrating the high levels of control and sensitivity that are possible with this relatively simple approach (See Figure 12).

Figure 12: *Toucan* (Cresshead 2013).

A rare insight into research and development of puppeteering using DIDs is to be found in the Geppetto digital puppetry system devised by Erbiceanu, Mapes and Hughes (2014 pp.269-287), where three case studies describe the use of a technology in different digital reality scenarios. The technical aspects of the live, real-time interaction with the digital worlds are described:

> “The head orientation is directly tracked by an infrared camera system. Facial pose blending is triggered with a Logitech G13 advanced game board, allowing facial morphing …. smile, frown, sneer, wink and open mouth that can all be blended to create combinations. These poses are weighted by the length of the key press and have a soft decay to allow rich blending. Blinking is automatic” (Erbiceanu, Mapes and Hughes 2014, pp. 269-287).

This workflow has similarities to that used in GLOPPID in that it includes face-morphing and weighting. The two diverge in that I choose to semi-automate atypical combinations.

2.5 Summary.

This brief overview of real-time 3D digital puppetry techniques and practitioners shows the spectrum of complexity. The spectrum, which includes commercially developed and homemade solutions, ranging from the Waldo® through to a single gamepad, all share the common trait of live puppeteering.

3 Chapter Three: Methodology

3.1 Chapter Outline

Chapter Three delineates the underpinning theories and processes used to define the structure, elements, and rules that determine the GLOPPID method, and how the latter are applied in the making of the artefacts produced. These elements are digital puppet anatomy, digital puppet rigging, digital puppetry skills, and moveme and visime palettes. The rules of their combination are based on principles and ideas in the areas of improvisation, impulse and reaction, and the geometry of movement involving contrasts, rhythms, and patterns of the palette members. This chapter places the GLOPPID method and accompanying exegesis within a digital puppetry professional practice-as-research context. The digital puppeteer is deemed a competent practitioner as per Schön's (2017, p. 49) account, and the practice is explored in relation to artistic research paradigms and the Technical Rationality model.

3.2 A Modelling System

For the purposes of this research, the GLOPPID method is viewed as an artistic modelling system. Lotman defines a modelling system thus:

> "A modelling system is a structure of elements and rules of their combination, existing in a state of fixed analogy to the whole sphere of the object of perception, cognition, or organization. For this reason, a modelling system may be treated as a language" (Lotman 2011, p.250).

The GLOPPID method, which is composed of an HDPI and a philosophy, is seen as a language with its own "structure of elements and rules of their combination". It is a modelling system in that it treats digital puppet 'reality' as a fragment of human 'reality', performs experiments using digital-puppet data, and returns results that reflect humans back at themselves in a human-to-puppet analogy.

> "…art is always an analogue of reality (of an object), translated to the language of the given system. Therefore, a work of art is always conventional and, at the same time, must be intuitively recognized as an analogue of a certain object, that is, it must be

> "similar" and "dissimilar" at the same time. Emphasizing only one of these two inseparable aspects breaks the modelling function of art. The formula of art is: "I know that it is not what it depicts, but I clearly see that it is what it depicts". (Lotman 2011, p.250).

Although Lotman's work is largely literature-based, I find the modelling perspective useful as a tool. Lotman identifies the importance of art as information (1967, p.252):

> "Art is a special type of modelling system, since it is on one hand suitable for storing very large amount of complex information, but on the other hand it can increase the stored information and transform the consumer" (Lotman 1967).

Digital puppets store information through their appearance, motion, and performance, transforming the consumer by modifying their perception. It is my contention that the analogous nature of puppetry is appropriate to the analogue of an artistic model. The paradoxical nature of puppets directly maps to the modelling system proposed, in that this idea of analogue is present in the aforementioned three properties of 'double-vision', 'opalescence' and 'oscillation', peculiar to the alive-yet-dead status of puppets identified by Tillis (1992, p.7), Jurkowski (1988, p.42) and Green and Pepicello (1983, p.148).

3.3 The GLOPPID Method: I Am Rigged, Therefore I am.

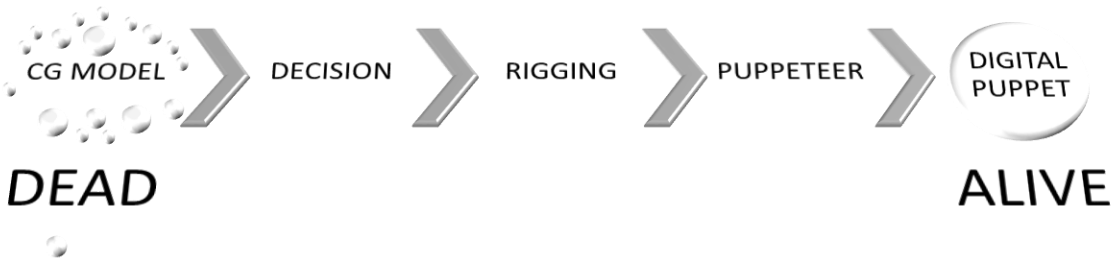

Figure 13: Diagram showing the transformation of a CG model into a digital puppet (Childs 2020).

According to Jurkowski, creating a puppet is an act of transformation (1986, pp. 72-73). The method therefore involves a rigging stage, in which a CG model is transformed into a digital puppet (See Figure 13).

Figure 14. Diagram showing the GLOPPID method (Childs 2020).

The CG model starts out wholly immobile, but once a point of articulation is rigged and operated via the activation of a controller, the puppet shows signs of imagined life; the transformation of model into puppet and its metamorphosis from ‘dead’ to ‘alive’ begins (see figure 14).

A methodology of integrity, situated within the framework of my practice and of learning through experience, frames this inquiry (Maguire 2019, p.103). In this research I describe and analyse both the daily routines of my digital puppetry practice, and the methodology unique to my process. The identification of the definitions, choices and theories underpinning the procedures, and a pathway of the work in terms of the designing, thinking, materials, methods, representations – in addition to the justification of choices made – will inform the evaluation of my hypotheses. The tools to be used are reflection-in-action and reflection-on-action.

> “When someone reflects-in-action, he becomes a researcher in the practice context. He is not dependent on the categories of established theory and technique but constructs a new theory of the unique case” (Schön 1983, p. 68).

Schön gives an account of the feedback loop experienced by practitioners who work with variables, uncertainties, unpredicted outcomes, and surprise. His “talk-back” and “choice-points” are part of the reflection-in-action process.

> “…the designer’s moves tend, happily or unhappily, to produce consequences other than those intended. When this happens, the designer may take account of the unintended changes he has made in the situation by forming new appreciations and understandings and by making new moves. He shapes the situation, in accordance with his initial appreciation of it, the situation "talks back," and he responds to the situation's back-talk” (Schön 1983, p.79).

In the feedback loop occurring during digital puppetry improvisation, there is a dialogue between the puppeteer and the puppets:

> "In a good process of design, this conversation with the situation is reflective. In answer to the situation's backtalk, the designer reflects-in-action on the construction of the problem, the strategies of action, or the model of the phenomena, which have been implicit in his moves" (Schön 1983, p.99).

The model involves decisions, that he calls "choice-points":

> "These are choice-points. As he reflects-in-action on the situation created by his earlier moves, the designer must consider not only the present choice but the tree of further choices to which it leads, each of which has different meanings in relation to the systems of implications set up by earlier moves" (Schön 1983, 100).

ACTIVITY	CHOICE POINTS	EFFECT	RESULT
Load CG Model	Model aesthetic, technical suitability.	Surprise	First meeting
Examine model attributes	Technical suitability, base list	Motion	Anatomical familiarisation
Commence connections	Qualities of movements	Imagined life	Rigging
Test movements - reflection-in-action	Reflection-in-action	Surprise	Surprise
Further connections	Reflection-on-action	Digital puppet collaborator emerges	Improv Sequences
Test movements - reflection-in-action	Reflection-on-action	Surprise	Rigged
Improvisation - Take 1	Reflection-on-action	Imagined life	Surprise
Reflection-on-action	Signature moves	Surprise	Performance
Improvisation - Take 2	Reflection-on-action	Imagined thought	Puppet Collaborator
Reflection-on-action	Moveme palette	Life of its own	Performance
Improvised performance	Improvised performance	Improvised performance	Improvised performance

Table 2: The phases and features of the GLOPPID method (Childs 2020).

As a digital puppetry researcher, I am constructing a new theory of a unique case. Table 2 shows the activities, effects, choice-points (as defined by Schön 1983, p.100) and predicted results present in the process. The method comprises these elements: the initial choice and loading of a CG model into the software, where it is examined and connection points are identified, the rigging, and movement-testing. The familiarisation phase marks the point where the puppeteer gets to know the puppet's movement characteristics. Then follows an iterative process of the repeated creation of an improvised sequence, using reflection-in-action and reflection-on-action critical analysis, until final performance decisions surrounding the emergent digital puppet, or code-based collaborator, have been reached. Choice-points are located throughout the process, starting with the aesthetic and technical suitability of the CG model for transformation into a digital puppet. This is followed by decisions regarding the qualities and properties of the movement produced by the rig, the discovery of signature moves, and the selection of the moveme palette. The third column indicates anticipated effects created during the process: surprise, imagined life, imagined thought, and imagined autonomy (belief that the puppet has a life of its own). The results column identifies the expected outcomes at each stage of the process. Malkin believes that it is through the relinquishing of some control that a puppet takes on a life of its own:

> "The animated object becomes a puppet not when the operator assumes complete control of it, but at the infinitely more subtle moment when the object seems to develop a life force of its own" (Tillis 1992, p.24).

Professional puppetry practice involves expressivity, but it is through being slightly out of control of the puppet that expressivity emerges. The puppeteer Vialon sees keeping total control over the puppet as a 'masculine' approach, because "it's about closed circuits and having complete control over the movement", which Fredricksson says "doesn't give control over the expressivity" (2015, p.239).

> "…we initiate movements in a puppet without absolutely controlling all the movements that come out. This is also true of ourselves if we allow it to happen; the skeleton can be set in motion with a minimum of impetus" (Fredricksson 2015, p.243).

3.4 Technical Rationality

The improvisation component in the GLOPPID method is unpredictable, and while I do not see this as a problem, it *is* a challenge, in that it requires strategies for the avoidance of both empty gestures and a mechanical feeling in the artefacts.

The commercial CGI-animated film production is a combination of art and science, involving computer science, design, and storytelling. Scriptwriters, art directors, character and environment designers, modellers, riggers, and animators all have skillsets that straddle the scientific and artistic, in which sculpture, drawing, anatomy, motion studies and lighting are part of the process. The technical side of the pipeline fits the Technical Rationality model in that it is rooted in computer science, where any problems to be solved are clearly defined, and the methodology for their solution logical and systematic. This study is situated in what Budde calls the "interdisciplinary abyss of knowledge":

> "Scholars both in computer science and in drama, theatre, and performance studies are often faced with an interdisciplinary abyss of knowledge systems and knowledge translation. Raising awareness to bridge this divide is essentially what the Digital Dramaturgy Lab [DDL] is interested in — this connection, engaging in this translational labor while testing, experimenting, critically making digital dramaturgy in and as performance" (2019, p.102).

For me, on one side of this abyss stand what I term the 'physical puppetry purists', on the other, the computer science technologists, who have a deep understanding of the hardware and software, but also a very conventional approach to the dramatic arts, as described by Budde:

> "…the appropriation of theatrical terms by computer science is based in the most conventional, Aristotelian definitions of actor, character, and story" (2019, p.102).

The commercial production pipeline comprises the three components of professional knowledge: basic science, applied science and "a skills and attitudinal component that concerns the actual performance of services to the client, using the underlying basic and applied knowledge" (Schön 1983, p.24). The pipeline is divided into specialisms that deal with large-scale complex data using computational machinery and methods (Schön 1983, p.22). Schön says "medicine is the prototypical example" of professions, and proposes architecture as a prototype for design in other professions (Schön 1983, p.28):

> "It [architecture] is perhaps the oldest recognized design profession and, as such, functions as prototype for design in other professions. If there is a fundamental process underlying the differences among design professions, it is in architecture that we are most likely to find it" (Schön 1983, p. 77**).**

This "fundamental process" is applicable to character and environment designers where the outcome is pre-defined.

In the GLOPPID method each part of the process is adjusted according to "a new theory of its unique case". The workflow is based on the premise that theory drives practice, which is then evaluated by means of critical reflection, and the results – in the form of modified theory – are fed back into the work. Critical reflection is a tool used to identify "fixed and potentially restrictive ways of thinking and may indicate avenues for change" (Fook 1996, p.199). In this workflow, theory-driven initial impulses set in motion a creative process wherein the combination of an improvisational component and repeated versioning of the material enable evaluation, reflection, and change. According to Smith "Reflection requires space in the present and the promise of space in the future" (Smith 1994, p.150).

> "In 'reflection-in-action,' doing and thinking are complementary. Doing extends thinking in the tests, moves, and probes of experimental action, and reflection feeds on doing and its results. Each feeds the other, and each sets boundaries for the other" (Schön, 1983, p. 280).

Figure 15 shows the points of reflection-in-action (RIA) and reflection-on-action (ROA) in the GLOPPID method (Schön 1983, p. 68).

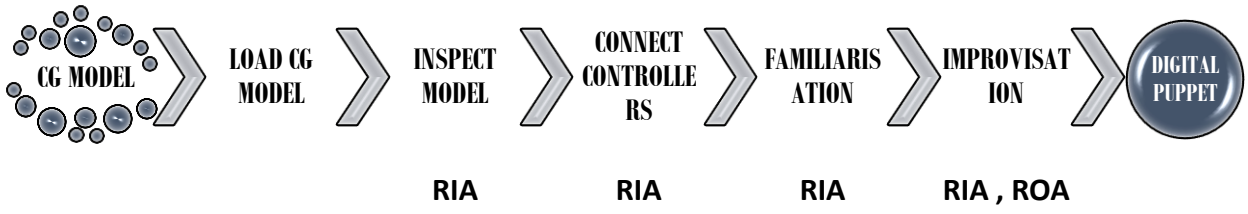

Figure 15. Diagram showing points of reflection-in-action (RIA) and reflection-on-action (ROA) in the GLOPPID method (Childs).

In professions such as medicine and architecture, professional practice involves processes of problem-solving where, according to Schön, the problems are clear and well-defined (1983, p.39). However, where there is uncertainty about possible results, the model of Technical Rationality is problematic. Artistic endeavour is not a 'problem to be solved'; nevertheless, questions can still be asked surrounding the processes involved in the work. The challenge is to devise a model – in which process is prioritised – that will satisfy the requirements of both rigour in research and a professional artistic approach.

> "The dilemma of rigor or relevance may be dissolved if we can develop an epistemology of practice which places technical problem solving within a broader context of reflective inquiry, shows how reflection-in-action may be rigorous in its own right, and links the art of practice in uncertainty and uniqueness to the scientist's art of research" (Schön 1983, p.69).

I borrow the concept of a "scientist's art of research", together with Lotman's explanations of scientific and artistic models, and organise them to suit my own purpose. As an exercise in my own understanding, I can even take them quite literally – digital puppets are an analogue of humans, and they can speak as if they are autonomous beings. For me, there are insights to be gained from experiencing the way the digital puppets play with my perceptions that informs my understanding of Lotman's differentiations:

> "This leads us to the most essential characteristic of a work of art as a model. A scientific model recreates the system of the object in a descriptive form. It models the "language" of the system being studied. An artistic model recreates the "speech" of the object. In relation to the reality that is perceived in the light of an already mastered artistic model, however, this model functions as a language that discreetly organizes the new perceptions (speech)" (Lotman p.266).

The puppets' performances in my digital puppetry work make mischief with my understanding of reality and what I see at times as an arbitrary division between art and science. Creative challenges are overcome by the application of principles and theories found in tangible puppetry practice, coupled with a use of improvisation techniques that constitute the indescribable unidentifiable elements upon which professional digital practice relies, but which are not written down, and are unpredicted. Schön identifies what he calls "a crisis in Technical Rationality" which, he found, could not explain all the processes at work in professional practice, and which he identifies as mysterious:

> "Professionals have been disturbed to find that they cannot account for processes they have come to see as central to professional competence. It is difficult for them to imagine how to describe and teach what might be meant by making sense of uncertainty, performing artistically, setting problems, and choosing among competing professional paradigms, when these processes seem mysterious in the light of the prevailing model of professional knowledge" (1983, p.20).

For me, there is no crisis; this research aims to throw light on the mysterious aspects of digital puppetry by looking at the professional competences involved based in the skills and knowledge it requires outside of, or in addition to, Technical Rationality.

> "Every competent practitioner… displays skills for which he cannot state the rules and procedures" (Schön 2017, p. 49).

In my digital puppetry practice, I develop skills – for which I cannot always state the rules – that emerge through making the work first, then analysing it during and afterwards. This is in opposition to the fact that, as Schön observes, "according to the Positivist epistemology of practice, craft and artistry had no lasting place in rigorous practical knowledge", because the Technical Rationality premise is that real knowledge is based in science, with skills coming into play later in the process (Schön 1983, p.34).

> "From the point of view of the model of Technical Rationality institutionalized in the professional curriculum, real knowledge lies in the theories and techniques of basic and applied science. Hence, these disciplines should come first. "Skills" in the use of theory and technique to solve concrete problems should come later on, when the student has learned the relevant science" (Schön 1983, p.27).

However, I agree with Varto, who points out that in artistic practice, individual skills are key to human understanding, and the methodology is – in part – reversed:

> "…an important part of human knowledge is based on skills, moreover individual skills, not general rules or regularities. Individual skills and knowledge became central factors in understanding artistic practice" (Varto 2018, p.7).

The GLOPPID method takes an eclectic professional approach, founded both in a rigour that focuses on the digital puppeteer as a "competent practitioner", and in a digital puppetry professional practice skillset that reflects its origins as a hybrid of motion capture and puppetry. I accept that this hybrid is closely related to computer animation and analogue animation, but would argue that it has more in common with live performance in the human

dramatic arts and physical puppetry. Performers develop awareness through experience, in the same way as medical practitioners and architects do by undertaking practical activities.

> "Our knowing is ordinarily tacit, implicit in our patterns of action and in our feel for the stuff with which we are dealing. It seems right to say that our knowing is in our action" (Schön 2017, p.49).

It is anticipated that becoming fluent in languages of digital puppetry will create similar neural pathways – a tacit knowing, and knowing-in-action. My research highlights the skills and knowledge in terms of the creative experience and outcomes accrued during controlled digital puppetry experiments. This experimentation involves limited sets of variables that allow input to be descibed, and results to be analysed. Difference and change can be measured by adjusting variables in a systematic manner, so that a causal relationship can be determined. The use of limited movement vocabularies in the form of moveme palettes means that the adjustment of variables can be monitored. Repeated experiments in digital puppet manipulation constitute a constructivist approach to knowledge formation, and enable the capabilities and affinities of digital puppets and puppetry to be demonstrated (Causey, Meehan & O'Dwyer 2015, p.6). The long-term goal is "to produce information, develop digital puppetry skills, add understanding about the world and the human being as part of it" (Varto 2018, p.7). My skills as a practitioner will be subjected to evaluation, and will act as a context and foundation for research (Varto 2018, p.6). Observational data is captured through digital puppetry activity, collected using sensors which monitor and record movement in real time. Experimental data is collected in the form of audio-visual recordings of digital puppetry performances, within which active intervention to produce and measure change, or to create difference when a variable is altered, is possible.

Schön thinks of the design environment as a "reflective conversation with a unique and uncertain situation", in which reflection-in-action is key to the discovery of a "fundamental structure of professional inquiry which underlies the many varieties of design [or therapy] advocated by the contending schools of practice**"** (1983, p.130). The GLOPPID method involves design decisions in the following areas:

- the qualities and properties of the movement
- the HDPI
- the puppets

- the selection of moveme palette members
- the improvisational framework

The properties of the movement are influenced by the human corporeal mechanics theories of Grotowski, Descroux, Lecoq, and Laban, together with ideas used in tangible puppetry and robotics. The goal is to implement movement in a basic form, meaning that it is driven by simple rotations around pivot points. According to the dancer and choreographer Margaret Morris:

> "All human movement takes place around an imaginary central axis, thus the limit of movement of the limbs can only be in circles around the joints to which they are attached" (Hutchinson-Guest 1974, p.79).

In the GLOPPID method, these simple arc-forming rotations are sub-divided into movemes. For the purposes of this research, movemes, visimes and phonemes are defined as follows. A moveme is a joystick-operated segment of movement trajectory controlling a body part or facial feature, in which the skin-mesh is held rigid, resulting in a 'wooden' facial movement that is more puppet-like. A phoneme is a mouth shape associated with speech. Phonemes are the basic building-blocks of sounds from which speech is composed, and visimes are the shapes made by the mouth in order to voice those sounds. The mesh is warped and stretched as one shape morphs to another, resulting in a less puppet-like motion. A visime is either one or a combination of several facial features that may or may not create a recognisable facial expression.

Movemes (style-neutral, simple, and unembellished segments of movement trajectory) are connected to algorithmically modifiable digital actuators. This replicates the economy of motion of repeated manual labour and simple – but not easy – gymnastics, alluded to by Descroux and Lecoq in their human body dynamics work. The aim is to accentuate the puppetness of their movement both through a combination of the use of movemes, and by limiting the movement vocabularies of the characters.

> "Using tools from dynamical systems and systems identification we develop a framework for the study of primitives for human motion, which we refer to as movemes" (Del Vecchio, Murray & Perona 2003, p.2085).

The basic units of movement used in computer-game libraries, for example kicks and punches – which, according to Lavalle (2008), are known as motion primitives – and the actions of LMA (Hutchinson 1984, p.19), are sub-divisible into movemes. Movemes are true primitives of motion that cannot be further decomposed. Del Vecchio, Murray & Perona refer to these as an alphabet:

> "Our aim is then to build an alphabet of movemes, which one can compose to represent and describe human motion similar to the way phonemes are used in speech" (Del Vecchio, Murray & Perona 2003, p.2085).

The concept of the moveme is applicable to all kinds of human motion: sportive or therapeutical biomechanics, theatrical, digital or physical puppet motion. In GLOPPID, each puppet's movement is restricted to a limited vocabulary of movemes. When operated at various speeds, rhythms, and cadences, these movemes result in non-stylised, non-realistic movement: they are the building-blocks of complex manoeuvres.

In a human actor a muscle is flexed or contracted, whereas in digital puppetry – as in CG animation – movement is initiated by the skeleton rather than the muscles; a joint is rotated, resulting in motion in the bones of a limb, the pelvis, or the spine. The operation of an entire bipedal humanoid figure requires rotation (and sometimes, translation) controls in either two or three dimensions for the limbs, the spine, the pelvis, the neck, and the eyeballs. Each of the four limbs has three articulation points – at the shoulder/hip, knee/elbow, and ankle/wrist – in the form of ball-and-socket and hinge joints, and their degrees of freedom determine part of the qualities to be found in the puppet's movement. The hips and lower spine combined form the core area. The puppet anatomy is divided into a simplified set of rotational articulations at the fourteen joints as follows:

- five rotations – in two or three planes – at the ball and socket joints in the shoulders and hips, and at the atlas joint in the neck/head
- nine rotations – in one or two planes – at the hinge joints in the knees, elbows, wrists, ankles, and one spine joint

A pair of gamepads has a total of four mini-joysticks, meaning that they can accomplish control of only, for example, the rotation of the arms and torso of a puppet in two dimensions. A single digital puppet can be operated by more than one person, and requires a working

rapport between the puppeteers in order to achieve the necessary coordination and choreography. A digital puppet head can be operated by one person, using the joysticks for rotations on the neck and head, and buttons to operate movement of the features – either in isolation or in unison – to create specific facial expressions.

The two kinds of movement used in gaming controllers are joystick and button presses. In the GLOPPID method, mathematical operators are used to amplify what Kohler calls, in a tangible puppetry context, the "driving distance that human fingers can control" or "to increase the ratio of the movement of a controlling finger to the larger movement in a part of the puppet" (Kohler, Jones, Luther 2009, p.349). This has the effect of making it much easier to create a rapid succession of large movements in a puppet. For example, in mapping the forward and backward movement of a joystick to control the nodding of a head, I apply a multiplication algorithm, choosing a factor to suit the sensitivity of movement required. This means it is easy to make extensive and rapid movements. Operators, such as damping factors, are placed between the joysticks and the puppet body parts. It is during this rigging phase that the resistance of the material of the digital puppet is determined. Fredricksson quotes Vialon who speaks of "trusting matter", with reference to the link between the material and the structure of the puppet. In a digital puppet, this link lies in the digital mesh and way it is rigged. Vialon says:

> "Mechanisms can be interesting, but not on their own. There must be a link between the material and the structure of the puppet. It has allowed me to accept that I can trust matter and my materials and their way of functioning and moving. To trust that the ground really supports me, that my weight, which is a constraint, also gives me structure, gesture, and movement" (Fredricksson 2015, p.239).

There is a limit to how many operations can be carried out by the hands of one person, and this applies to intangible and tangible puppet-riggers and puppeteers alike. "Controlling a high-dimensional structure like a three-dimensional humanoid skeleton is a challenging task" (Kipp and Nguyen 2010, p. 147). A string puppet is a very efficient use of the ten fingers of the human hands, and the operator's feet and knees can also be brought into service.

3.5 Design and Distance: Digital Puppet Anatomy

When compared with human movement, live-action physical puppet movement appears non-realistic and stylised; it is inherently expressive. The qualities of physical puppet movement are dictated by properties particular to the types of controllers used; different types of puppets have specific attributes resulting from the physics of their manipulation. String puppets have qualities attributable to the pendulum effect arising from their construction, using flexible actuators in the form of strings. Movement in glove puppets is characterized by the dimensions and articulations of the fingers and thumbs of the hands within. The movement of finger puppets is characterized by the fingers, which are constrained by the degrees of freedom of the joints within. A string puppet whose knee joints use a hinge made of leather, limiting it to movement in one plane, will have different qualities of motion to those using leather thongs, cylindrical in cross section, that give it movement in two dimensions. Physical puppets can defy the laws of physics, thanks to their manipulators – who are themselves, of course, subject to those laws. Unless deliberately invoked by means of dynamic simulation, digital puppets can be exempt from the laws of physics – for example there is no gravity in 3D digital space.

The physical performance of an actor is distinct from that of a puppeteer in that a physical human actor occupies the same space as the character they portray, whereas a puppeteer has the character at arm's length; there is distance between the puppeteer and the character. The element of remote-control forms part of the appeal of puppetry. Even in the case of the glove or the finger puppet (Figure 23 *Mario*), there is an offset between the core of the performer and the core of the performed object. A puppeteer channels the effort and energy of the performance through some form of transmission, typically along strings or rods and into the hands and the fingers.

Figure 16. Mario the finger puppet (Photo: Lucy Childs, 2019).

Movement that is channeled through part of the human body in order to be transmitted to a performed object of a different form and scale has different qualities to that produced by the whole body. The channeling requires proprioceptive competences, focus, and performance sense, all of which are affected by the distance between the performer and the performed object. The puppeteer employs a specific proprioceptive ability to map their own articulation points (joints) to those on a puppet. In Wood and Waterfall, Astles asks pertinent questions surrounding the training of the puppeteer:

> "…what is the training of a sensibility that requires the performer to locate their focus of expression outside the body while keeping the source of energy within the body?" (Astles 2009, p.54).

Not only must a puppeteer offset their own centre of energy, but they must also project a designed version of their interpretation into the puppet.

> 'There are so many parameters for each gesture and change of position, which we can learn to exploit as puppeteers. These things offer reliable tools for the puppeteer, which permit a verifiable expression of all things, animal and human. Consciousness of these things allows the performer to decide what to show and what not to show and to stay in control of the information going from the stage to the audience. This in turn should lead to better reading of the movement of the puppets' *(*Mottram, 2016).

Here Mottram identifies the technical skill required in puppetry, where the puppeteer is in complete control of what the viewer sees.

3.6 Design: Impulse and Reaction

The GLOPPID method seeks to implement a simple cycle of impulse and reaction, as espoused by Grotowski:

> "Something stimulates you and you react: that is the whole secret" (1969, p. 185).

The puppeteer must be at one with the puppet. The main principle that guided Grotowski's work is the process of stripping away the non-essential to reach pure presence. In order to eliminate the body's resistances, "The actor should be able to decipher all the problems of his body which are accessible to him" (Grotowski 2002, p.35). For human actors working with their own bodies, the approach to actor training advocated by Grotowski – known as the "via negativa" – is a response to a perceived physical and psychological resistance that inhibits the process of learning:

> "Grotowski's version of the acting process might be broken down into something like this: Stimulation-Impulse-Action-Contact The problem, however, is that actors' bodies seldom are receptive to stimulations; or if they happen to receive the stimulus, something blocks the flow of impulses; and if the impulses do occur, often the actor does not know how to channel these impulses into precise actions or forms in order to make contact with a partner" (Slowiak 2002, p.121).

In the process of "Stimulation-Impulse-Action-Contact", it is both the puppet and the puppeteer that must be "receptive to stimulations". Once the stimulus has been received, the flow of impulses passes from the puppeteer to the puppet via the DID. The puppet is the partner in the process, and it is 'learning' "how to channel these impulses into precise actions or forms in order to make contact with a partner". That is the essence of digital puppetry. The eradication of blocks means that the digital puppeteer must open a direct link with the puppet. The "via negativa" is a method of removing, or peeling away, these blocks and resistance, thus freeing the actor within and beyond.

> “The education of an actor in our theatre is not a matter of teaching him something; we attempt to eliminate his organism's resistance to this psychic process. The result is freedom from the time-lapse between inner impulse and outer reaction in such a way that the impulse is already an outer reaction. Impulse and action are concurrent; the body vanishes, burns, and the spectator sees only a series of visible impulses” (Grotowski 1969, p.16).

In digital puppet improvisation work, impulse and action are concurrent, and it is the freedom “from the time-lapse between inner impulse and outer reaction”, of which Grotowski speaks, that results in the variations of elements such as timing and rhythm patterns, which in turn give rise to expressive performance.

A physical puppet is an assembly of matter, arranged and rigged for movement with controllers. Materials typically used in a physical puppet’s construction are wood, fabric, papier-mâché, foam rubber and latex. Controllers take the form of strings, rods and/or levers, and are operated by parts of the human body, often the hands and fingers. A digital puppet is assembled from computer code – digital matter – arranged and rigged for movement with controllers. The materials typically used in a digital puppet’s construction are mathematically-defined, computer-generated meshes, arranged as characters or objects, which are then skinned and textured as shown in Figure 17.

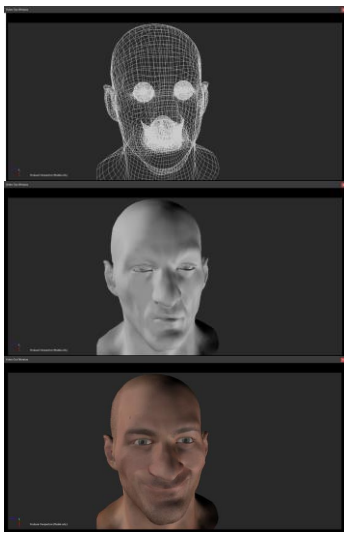

Figure 17. Digital puppet head mesh, skin and texture (‘Victor’ model by Faceware Tech Inc.).

Digital and stop-frame animation puppets have armatures mimicking the skeletal structure of a humanoid biped, as shown in Figure 18. The 3D digital character models used in the GLOPPID method are similar to those used in computer-animated filmmaking, but the main difference lies in their rigging and manipulation. If movement is captured live, the result is puppetry; if it is incremental and recorded, it is animation.

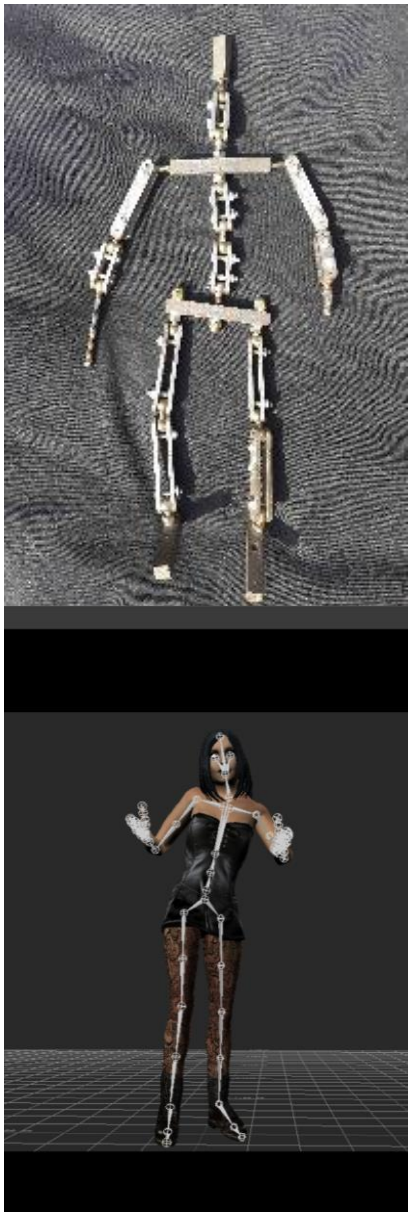

Figure 18. Digital and stop-frame animation puppets armatures (Photo: Lucy Childs 2018).

The emphasis of my work is on performance; therefore, I do not build the models myself, sourcing instead ready-made ones typically intended for gaming and animation. This affects my relationship with the characters in that there are pre-ordained properties associated with

purpose-built puppets regarding characterization and movement, and historical and cultural identity. Jurkowski posits that in a purpose-built physical puppet there is an implied program of acting, a way of moving and a set of behaviours stemming from its cultural and historical context, which is not the case in the object designated as a puppet (1986, p.42). In the former, the puppeteer must submit to the puppet, whilst in the latter, the puppeteer supplies the creative lead. I use off-the-shelf CG objects, not originally intended for puppetry. I then make them into digital puppets, and while these characters do come with some cultural and historical context, my decision to make them into puppets means that – paradoxically – I supply the creative lead: this is part of my method.

During this research, I have found myself building parts of the technology, which means learning about the mechanics and philosophy of off-the-shelf software, and how it can be used for experimental digital puppetry workflow environments. This is a process that influences and expands my practice. I identify with Rokeby when he says: "I also discover things of value through the process of actually building the technology". The phase in which I design the rigging is very different to the one in which I perform with the puppet. The rigging is determined by the node network, but tested while viewing the puppet itself – a stage characterised by switching from one mode to another. As Rokeby states:

> "I've observed how my brain works when I am engaged in programming, and how differently it functions when I'm engaged in the more conventionally 'artistic' side of my projects. I consider it a privilege to have direct experience of this conflict, and to have been able to reflect on it from a position of experience" (2019, p.105).

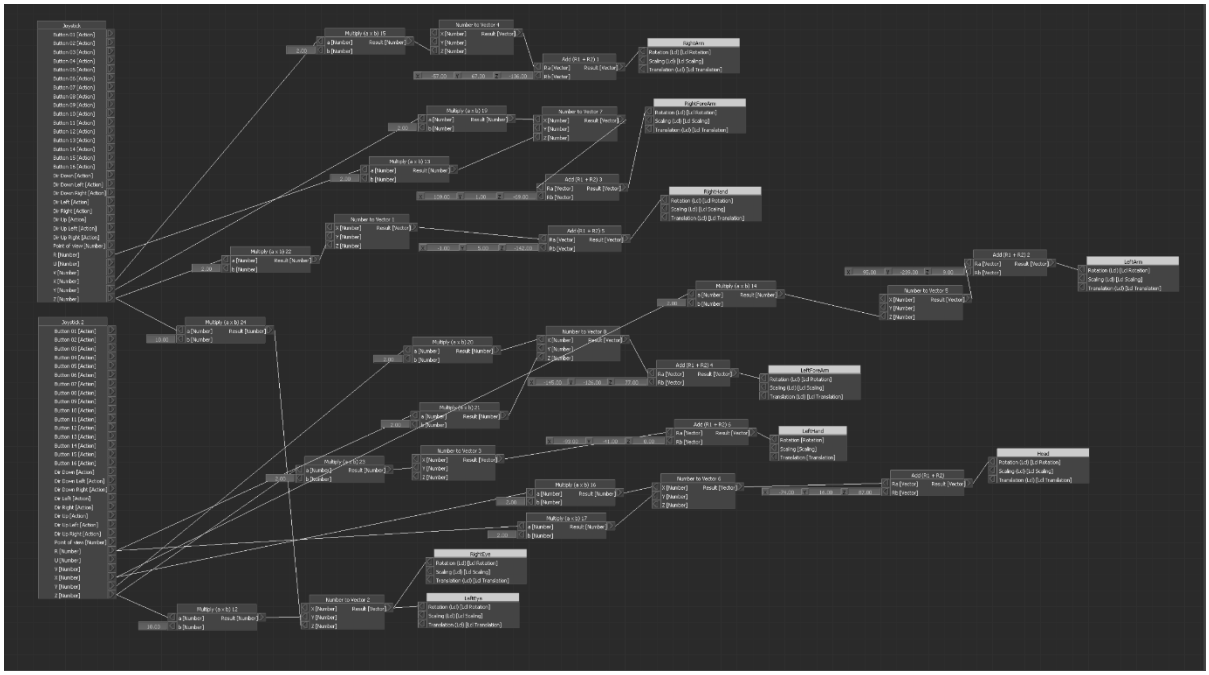

Figure 19. Screenshot showing part of the network of nodes connecting the mathematical operators used to determine the motion and its qualities in a digital puppet character (Screenshot: Lucy Childs 2019).

In CG animation software, it is possible to make connections using a digital node network. It is here that connections between movemes, visimes and phonemes – articulation points – and DIDs are made: this is a choice-point. It is important to note that in GLOPPID, not all possible articulations are used – that is, they are not linked to DID controllers. The act of rigging the puppet is the point at which it comes into being, and the network of nodes defines the way the body will respond to the controllers; the node network is therefore a place of reflection-in-action and reflection-on-action (See Figure 19).

3.7 Design: Improvisation

Improvisation is at the core of the GLOPPID method, and each of its three definitions are applicable to the making of the pieces. Much of the terminology has to do with music, but is transferable to other media. The definitions of improvisation are to invent, compose, or perform, with little or no preparation, to play or sing [music] extemporaneously – especially by inventing variations on a melody, or by creating new melodies in accordance with a set progression of chords – and to make do with whatever materials are at hand. This is also true of the four ways in which improvisation can be used, as identified by Tufnell and Crickmay

(1993, p.45): as a final performance, as a creative tool to generate new material, as a creative tool to develop a piece and as a creative tool to aid a performer's development process, meaning that it acts as training in perception. The GLOPPID method uses a "cut and paste" methodology, as described by Burrows:

> "The use of improvisation as a tool to find material is intimately linked to that kind of choreographic process, which finds things first and then decides the order to put them in. Let's call this process 'cut and paste'. It's a very good way to work for many people. Cut and paste is perhaps the most effective way to deal with fragments found by improvising. We improvise to find the strongest movements and then use cut and paste to put them together" (Burrows, 2010, p.26).

The fragments could be motifs, phrases, or possibly sequences, which can be arranged to create sections and compositions. Identification of fragments takes place in the familiarisation phase shown in Figure 15, and the choice-points in Table 2.

> "If choreography is about making decisions – or about objects placed in relation to each other so that the whole exceeds the sum of the parts – or about a continuity of connection between materials - then improvised performance is as much of a choreographic act as any other approach, the decisions are just made faster" (Burrows 2010, p.24).

These decisions are part of the reflection-in-action component of the GLOPPID method. Principles of improvisation have been identified in relation to various performance disciplines. For example, one set of 'guidelines' applicable to theatre games has been proposed, and another set for contact improvisation, but a universal principle emerges: to *stay in the moment.* Strategies are used to help remind the improvisers to remain open to internal and external, physical and sensory stimuli that are *of the moment*, not preoccupied with time past or future, but simply in the present. Astles cites Meschke (2009, p.54), who says that this is one of the constituent parts of the dead point he identifies as "the state of concentration necessary in order to initiate clearly defined action, achieved through four clear steps: emptying the mind, abstracting the thought, focusing on the immediate task and initiating the task with passion". According to Tufnell and Crickmay, this is the most important skill required for improvisation:

> "As a strategy for discovering and developing images it both demands and creates a whole range of skills, the most important of which is an ability to be still and open one's attention to the present moment" (Tufnell and Crickmay 1993, p.46).

In contrast to commercially-produced work – where predictability is a pre-requisite – knowing exactly what is going to happen is the antithesis of extemporising, and so in the GLOPPID method an element of surprise is prioritised.

> "We improvise the moment we cease to know what is going to happen" (Tufnell and Crickmay 1993, p.46).

A set of principles of improvisation distilled from theatre-clowning workshops I attended between 2015-2018 contribute to the GLOPPID method (Flanagan 2018; Davison 2013, 2015):

- *do* stay in the moment
- *do* listen
- *do* say 'Yes, and ...'
- there are no mistakes, or mistakes can be re-defined as gifts or invitations
- make collaborators look good
- be honest/truthful – the truth is funny, and honest discovery, observation, and reaction are better than contrived invention
- be aware that action beats inaction – keep the energy going; if in doubt, move

The GLOPPID method involves improvisation within pre-determined frameworks, where there is constant reflection-in-action. Schön's account of the processes involved in jazz gives an accurate description of those also at play in collaborative digital puppetry scenarios:

> "When good jazz musicians improvise together, they also manifest a "feel for" their material and they make on-the-spot adjustments to the sounds they hear. Listening to one another and to themselves, they feel where the music is going and adjust their playing accordingly. They can do this, first of all, because their collective effort at musical invention makes use of a schema—a metric, melodic, and harmonic schema familiar to all the participants—which gives a predictable order to the piece. In addition, each of the musicians has at the ready a repertoire of musical figures which he can deliver at appropriate moments. Improvisation consists in varying, combining, and recombining a set of figures within the schema which bounds and gives coherence to the performance. As the musicians feel the direction of the music that is developing out of their interwoven contributions, they make new sense of it and adjust their performance to the new sense they have made. They are reflecting-in-action on the music they are collectively making and on their individual contributions to it." (Schön 1983, p.55).

In the GLOPPID method, I see the "ready repertoire" to which Schön refers as the moveme palette, while the "schema" is to be found in the stage where familiarization with the puppet takes place. The process involves collaboration with the digital puppets themselves and with

other digital puppeteers – this is a phase in which it is possible to gain insights into what the digital is good at and what humans are good at.

> "Much reflection-in-action hinges on the experience of surprise. When intuitive, spontaneous performance yields nothing more than the results expected for it, then we tend not to think about it. But when intuitive performance leads to surprises, pleasing and promising or unwanted, we may respond by reflecting-in-action." (Schön 2017, p.56).

The process has been designed to facilitate spontaneity.

> "As a practitioner experiences many variations of a small number of types of cases, he is able to "practice" his practice. He develops a repertoire of expectations, images, and techniques. He learns what to look for and how to respond to what he finds. As long as his practice is stable, in the sense that it brings him the same types of cases, he becomes less and less subject to surprise. His knowing-in-practice tends to become increasingly tacit, spontaneous, and automatic, thereby conferring upon him and his clients the benefits of specialization" (Schön 1983, p.60).

The process incorporates strategies for dealing with 'overlearning':

> "A practitioner's reflection can serve as a corrective to overlearning. Through reflection, he can surface and criticize the tacit understandings that have grown up around the repetitive experiences of a specialized practice and can make new sense of the situations of uncertainty or uniqueness which he may allow himself to experience" (Schön 1983, p.61).

While the GLOPPID method leads to knowing-in-practice, reflection both *in* and *on* action are fuelled by the improvisational aspect of the practice. In scientific research, predictions are made, the experiment takes place and actual outcomes are observed and evaluated; in my artistic research, an element of surprise is required within a framework of predictable elements, typically comprising theme, models, and sounds. This sets the scene within which improvisation can then take place. An unpredictability factor is built into the method by the approaches I use to procuring, rigging, and manipulating digital puppets. Firstly, each puppet's controls are different, meaning their controls are not rigged in the same places; secondly, the puppets are not rigged for bipedal humanoid anatomical accuracy. These factors give rise to opportunities for surprise.

An important factor in my use of digital puppetry is its instant nature; once a model has been sourced, prepared, and loaded, it takes minutes to make an initial rig, thus transforming the CG model into a puppet. This is not an automated process, but a choice-point, where

connections between controllers on the gamepads and joysticks and the various parts of the puppets' anatomy are made manually using the node network. Several phases of reflection-in-action and reflection-on-action take place, during which controls are added, modified, or removed and tested. This is where a sense of the puppet as a collaborator becomes clearer.

3.8 Summary

This chapter gives an outline of the approach to be followed and underpinning theories informing the creation of the pieces. The process as a whole can be summarised as the previously mentioned control of puppetry and the letting-go of improvisation, where the freedom to extemporise is based in a limited movement palette that defines the vocabulary, and on a rigging design that defines the grammar of the digital puppetry language to be used.

4 Chapter Four: Am I a Puppet?

4.1 Chapter Outline

Chapter Four looks at the questions surrounding the what, where and why of digital puppets and puppetry, beginning with a discussion of the definition of a puppet, and the connected concepts of imagined life and thought. By exploring the answers to the questions '*What* is a puppet?', '*Where* is a puppet?', and '*Why* is a puppet?', the challenges and solutions of digital practice and the factors that inform their quest for life and intelligence will become clearer. This chapter continues the process of extending and expanding tangible puppetry theory to digital puppetry practice, using ideas typically associated with tangible puppetry to suggest themes contributing to an emerging dramaturgy of digital puppetry.

4.2 Imagined Life, Imagined Thought

There is a paradox concerning the appearance of puppets both on a stage and within the frame of a film. A puppet is a combination of seemingly contradictory properties: on one hand it is a dead object or assembly of materials; on the other hand, it has the appearance of a living being – the watcher is aware that what they are seeing is not alive, but is simultaneously able to suspend their disbelief. Jurkowski describes this phenomenon thus:

> "Our awareness that the puppets are not alive recedes, and we get the feeling of something inexplicable, enigmatic, and astounding. In this case, the puppets seem to act mysteriously" (1988, p.58).

That these two perceptions can exist simultaneously is the phenomenon which gives rise to an effect peculiar to puppets, referred to by Jurkowski as opalescence, by Green and Pepicello as oscillation, and by Tillis as double-vision, as mentioned in Chapter Three (Jurkowski 1988, p.41; Green and Pepicello 1983, p.148; Tillis 1992, p.64). Citing Tillis' concept of double vision (1992, p.64), Westecott highlights this object/life-form dichotomy, and extends the metaphysical nature of puppets in general to computer gameplay protagonists:

> "…the metaphor of the puppet offers a useful frame for the central figure of our game-play focus by allowing for a kind of 'double-vision' that enables a player character to be seen in two ways at once, as a perceived object and as an imagined life" (Westecott 2009, p.1).

Professional and institutional definitions show considerable variation in both approach and philosophy about what may be called a puppet. Certain parameters are often used by scholars of tangible puppetry who are seeking a general definition of the term 'puppet', including the materials deployed in its construction, the method of its manipulation, and the means of its display (Philpott 1966, p.19). The Latin term *anima* is used to describe ideas such as breath, soul, spirit or vital force, and to animate means 'to breathe life into'. In fact, many definitions of the term 'puppet' have the notion of animation in common, resulting in a definition that can be reduced to *the creation of the illusion of life in a performance object by means of human effort*. Baker puts it simply: "It is now understood that any object can be considered a puppet if it appears to be alive" (Baker 2011). The key notions of imagined life and human manipulation are central to the definition proposed by Penny Francis, scholar, author, and former director of the Puppet Centre Trust in London:

> "For me, the puppet is a representation and distillation of a character, the repository of a persona perceived by both creator and spectator within its outward form. It can be anything, any object, if brought to imagined life through the agency of a human player who inspires it and controls it directly. The control may be through corporeal contact (hands-on, hands-in) or via strings, wires, wooden or metal rods. The figure animated electronically or even remotely is still a puppet if the performer is present at the other end of the cable or the machinery, controlling the movements, just as at the end of a simple string or rod" (Francis 2012, p.13).

Francis's use of the term 'inspires' also highlights the relationship between the manipulator and the manipulated, but – although her definition includes animatronics figures – it is confined to the tangible. As a result of the study of many definitions given by a mix of theorists and practitioners (including Michael Malkin, Paul McPharlin, Bill Baird, Marjorie Batchelder and Henryk Jurkowski), Tillis arrives at his own general definition, which also contains the key idea of imagined life:

> "When people talk about puppets, they are talking about figures perceived by an audience that are given design, movement, and frequently speech, in such a way that the audience imagines them to have life" (Tillis 1992, p28).

Tillis mentions three elements: design, movement and – often – speech. All of these contribute to the illusion that the puppet is alive; for example, a puppet can move in a convincing manner, mimicking – by means of trickery – the act of breathing.

Clearly, a digital character brought to imagined life by a manipulator in real time *can* be defined as a puppet. The mechanisms by which this occurs are discovered by asking two

questions concerning professional puppetry practice. Firstly, in the words of Baker (2011): "By what means does the puppet convey the illusion of life to the spectator?" The answer lies in energy transference; puppeteers project energy from their bodies and minds into ~~objects~~ the object and beyond. Poulton (2014, p. 280) observes that human creative energy animates lifeless objects in puppetry, while "transferring energy to the object" is one of the basic puppeteering skills taught by Baker (2011). As Astles states:

> "Puppeteers are required to generate and transmit huge amounts of energy towards the inanimate figure, material or thing" (Astles 2009, p.54).

The second question pertains to the development of a puppeteer's ability to generate expressivity in puppet movement, and asks: "When does movement become animation?" (Baker 2011). Baker describes using "tools such as touch, breath, impulse, rhythm, seeing, listening etc., that can be applied to any puppet, object or material ……to develop its potential for theatrical communication". Francis places the manipulation skills of the puppeteer above complicity and form:

> "Good professional live puppetry, solemn or comic, is predicated first on the spectator's complicity and engagement with the animated characters, so that acceptance and credulity overcome scepticism; and second, on the skills of the puppet-maker and above all the puppet operator who must be capable of sustaining the spectator's attention" (Francis 2012, p.9).

Thus, believability is key in puppetry and animation, and, as Poulton (2014, p. 280) also points out, puppeteers use not only the design of the puppet to convey the illusion of life, but also the fact that it moves in certain ways:

> "…because humans appear to be hard-wired to recognize movement, even more than physical resemblance, as the prime indicator of life – hence, animation's etymological link to anima (spirit). Current theory posits a neurological basis for our privileging movement over appearance in detecting sentience in others" (Poulton 2014, p. 288).

Figure 20. *Giacomo* 'imagines' that an animated digital puppet has life (Childs 2008).

This recognition of 'spirit' can occur in animals as well as humans as is evident in the example shown in Figure 20, where Giacomo the cat finds the qualities in the movement of a gesturing CG puppet convincing; this is an example of spurious life. But there is still more to investigate. According to Baker (2011), a puppeteer needs to develop an understanding of "when an object appears to have a will, thoughts, ideas and feelings of its own", while Fredricksson says that it is through intentionality that an observer imagines a puppet is thinking:

> "The structure and material of the puppet give it its character and allow me to listen to what it does. Of course, I want to give it a precise movement, or a precise intention rather, because we don't believe in a puppet because we see it moving, but because we see it thinking" (Fredricksson 2015, p.244).

It turns out that there is a third question to be answered: how do puppets achieve the illusion of *thought*? The quest for life and intelligence in digital puppets involves transferring energy to digital material in such a way as to convey intentionality and emotions. There is a connection between the puppet taking on a life of its own, and API, or imagined thought; a puppet could be said to have a 'soul' because it displays awareness through thought.

Yet another way to look at the question 'What is a puppet?' is to ask '*Where* is the puppet?' Unpacked by Kaplin and Tillis, the distance between the puppet and puppeteer is critical to the thinking behind how puppetry works, and involves the question 'Where is a *digital* puppet?' According to Tillis' definition of a puppet:

> "...if the signification of life can be created by people, then the site of that signification is to be considered a puppet" (Tillis 2001, p.175).

In digital puppetry, the distance between the source of the manipulation energy and the digital puppet is variable in that "the site of [that] signification" of a digital puppet may be on a laptop screen or a mobile phone, or projected onto a surface.

4.3 Imagined Thought: *Am I a Puppet?*

Am I a Puppet? is a short improvisation that grew out of my thinking about the definition of puppets and the energy that animates them (See figure 21). My original intention was to give

the impression that the character is thinking, and I had anticipated that, by not looking directly into the camera and by simple movements of his head and eyes, he would appear to be in a world of his own. However, as I began the improvisation, a software/hardware glitch caused some jitter in the puppet, which had the effect of making him appear nervous. I reacted to this by amplifying an anxiety that was already there, with the result that he actually appears to be in a state of existential angst. This is an example of how the improvisation feedback loop and reflection-in-action can influence the performance.

Figure 21. *Am I a Puppet?* (Childs 2020).

According to Kaplin's and Tillis' definitions of a puppet, the Drone Pilot character in *Am I a Puppet*? *is* a puppet; he is an intangible object that is tangibly moved, and he has a signification of life that is created by me, so his site of signification can also be considered a puppet. That site is located at the point of projection, but I propose that it also lies in the ones and zeros of the code, and in his polygons and algorithms, which I have connected. However, it is when the audience sees his facial expressions and his movements, and gives credence to the proposition that he is alive, that he actually *becomes* a puppet. Furthermore, he has a relationship with the audience because, even though he is a two-dimensional projection, a transaction takes place between them: complicity. In asking the question, the man in *Am I a*

Puppet? demonstrates that, if he is seen as a place where the signs of life created in real time by human agency are located, he must be a puppet. If he is seen as a lifeless virtual image, then he is not a puppet: it is up to the viewer to decide.

4.4 The Drummer

The Drummer is made using the same character as *Am I a Puppet?*, rigged in the same way, but featuring drum-activated facial expressions instead of voice-activated speech. A specially commissioned drum track (Stocking, 2020) is used to activate the visimes, and additional movemes are manipulated live using joysticks. The piece is, therefore, quite literally a talking drum, and is seventy-percent automated, with the connections determined by my choices during the setup. *The Drummer* is a response to the pandemic situation in the UK on April 1st, 2020, when many people – including myself – were feeling overwhelmed by circumstances. The result is a different language that uses a vocabulary of drum sounds.

4.5 The Über-marionette and the Actor-as-marionette

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4.6 The Actor-as-puppet

Brachear places Maeterlinck at the forefront of the rebellion which began in the late nineteenth century against conventional dramatic forms in western theatre, and identifies him as one of the first to "… outline a theory of acting which may be called that of the actor as marionette" (Brachear 1966, p.347). Influenced in part by movement codification systems found in performance art forms from Asia, this revisionary phase in Western theatre – sometimes seriously, sometimes mischievously – proposed puppets as alternatives to human actors. Conventional forms of delivery consisting of orations accompanied by gestures –

which restricted the performance to the hands, face and voice of the actor – were redirected towards more expressive modes, where movement takes place in a performer's entire body. Proponents of this approach include Meyerhold, Decroux, Lecoq, and Grotowski.[7] The pro-puppetry thesis is, in part, symptomatic of this late nineteenth-century reaction against formalised, codified approaches to performance, which resulted in a period of experimentation surrounding expressive human movement. New approaches propose re-imagined motivational transactions as alternatives to the highly-structured exercise regimes of classical systems. Reductivist, abstract and open theatrical timing and spatial biomechanical approaches emerged, rooted in psycho-physical connections, proprioception, anatomical geometry, the musculature, improvisation, patterns, cadence and rhythm inspired by sport, manual labour, and the geometry of gymnastics. Kley describes Meyerhold's theatrical biomechanical system as "value neutral mechanics" (2007, p.33). According to Braun, the latter re-developed theatrical vocabularies:

> "His [Meyerhold's] approach was to sharpen the senses of his ensemble of actors by mixing opposites through an eclectic use of forms such as Commedia dell'arte, Kathakali, Chinese Circus, and Kabuki Theatre. He achieved this in his training by exploring the emotional, muscular and intellectual capacities of his actors, enabling them and himself to discover new rhythms in the theatrical language of the 1920s and 1930s" (1995).

Although the hardware used to control the artificial human figures in *Control Freak* is made for gaming, it is *puppetry* that is used to produce their live facial animation, speech and body movements, and the act of simulation opens new possibilities that Schlemmer somehow foresees:

"As far as the stage is concerned, such paradoxical exclusiveness is less significant than the enrichment of modes of expression which is brought about by it. Possibilities are extraordinary in light of today's technological advancements: precision machinery, scientific apparatus of glass and metal, the artificial limbs developed by surgery, the fantastic costumes of the deep-sea diver and the modern soldier, and so forth…" (Schlemmer 1925, p.29).

The endeavour identified by Schlemmer continues within the digital world, and an HDPI is a good example of the potential use of technology as a tool for freeing people from their

[7] Meyerhold (1874-1940), Laban (1879-1958), Decroux (1898-1991) Lecoq (1921-1999) Grotowski (1933-1999).

physical and mental constraints. However, on occasion, it is in the imposition of a new set of constraints that "enrichment of modes of expression" can be found, as is the case in this study, where all the pieces created have limited movement palettes. These pieces are made using two types of movement: one is triggered, meaning that it is always of the same size and duration, determined by mathematical operators whose parameters are pre-set at the rigging stage; the other uses real-time actuation, meaning that it is proportionate to the puppeteers' hand motions. For example, in *Control Freak* (see appendix 1), which is performed by four players – two artificial human figures and two actor-puppeteers – La G lip-synchs the lyrics in real time, using a set of phonemes (mouth shapes) mapped to buttons on a computer gaming steering wheel. La G is operated by two performer-puppeteers simultaneously; puppeteer A controls the head and face, and puppeteer B the arms, torso, and legs. Figure 26 shows puppeteer A observing La G on a monitor screen as she operates her face.

Figure 22. La G's mouth and head are controlled using a steering wheel and pedals (usually used for computer gaming).

The left and right triggers on the steering wheel control eye-blink and mouth-opening, and buttons two to seven control the phonemes (see Table 3). Puppeteer B, who uses both hands and feet to perform joystick-controlled limb and torso/neck translations, animates La G's body via two Xbox gamepads.

Puppet: La G (operated by two puppeteers using four controllers between them)	**Device**	**Control**	**Action**
Puppeteer A	**Steering wheel (hand-operated)**		**Facial movemes**
		L trigger	**Eye blink**
		R trigger	**mouth**
		1	**Eye blink**
		2	**Mouth a /ɑ:/**
		3	**Mouth ooh /u:/**
		4	**Mouth EEE /i:/**
		5	**Mouth D,T.**

		6	Mouth UH /ʌ/
		7	Mouth very wide open
		8	R. Half snarl
	Pedals x 2 (foot-operated)		**Head rotation - nod**
Puppeteer B	**X box controller A**	**Mini Joystick**	**Torso rotation (CORE)**
		Mini Joystick	**R Arm**
	X box controller B	**Mini Joystick**	**L Arm**
		signature moveme	**HIGH KICK**
		signature moveme	**TORSO TWIST (CORE)**

Table 3. The Moveme, Visime and Phoneme Palette and Puppetry Controls for La G (*Control Freak* Childs 2019).

Computer gaming and digital puppetry have much in common, but the outcome is very different. Many of Westecott's observations on gaming are applicable to digital puppetry: "The main mechanism for [computer] gameplay is through direct control of a player character through a game controller" (Westecott 2009, p.2). The two actor-puppeteers operate La G as in computer gaming, but there is an important difference in that La G herself is not engaged in gameplay, but in a *theatrical performance*; instead of being seen or experienced as she explores her own world, La G looks backs out at the puppeteers and audience as if she is part of *their* world:

> "Closely connected, play becomes performance via the game screen. Digital gaming always involves a screen, producing a doubling in which actions on a controller are represented back on screen. Thus, the player is always audience to her own play act. She progresses through a given game always watching the results of her actions on a screen that shows an ever-changing theatrical performance built by code and run by numbers" (Westecott 2009, p.2).

As in digital gaming, and in common with all the pieces made during this study, the *Control Freak* performance requires a projection surface. The intention is to implement elements found in the so-called "poor theatre" advocated by, among others, Grotowski, which has no elaborate sets, lighting rigs, props, costumes, make-up, soundtracks, or music; instead, the actor uses "only his own body and craft" (Schechner & Wolford 1997, p.34). While *Control Freak* does use a soundscape with music, there are no CG environments or scenery; instead, La G is seen in the the raw software environment, projected onto any available wall, and Halogen Hobbs is projected onto the skin of the naked body of performer-puppeteer B, while

performer-puppeteer A operates his facial expressions and head movements: B's body *is* the scene (See Figure 23).

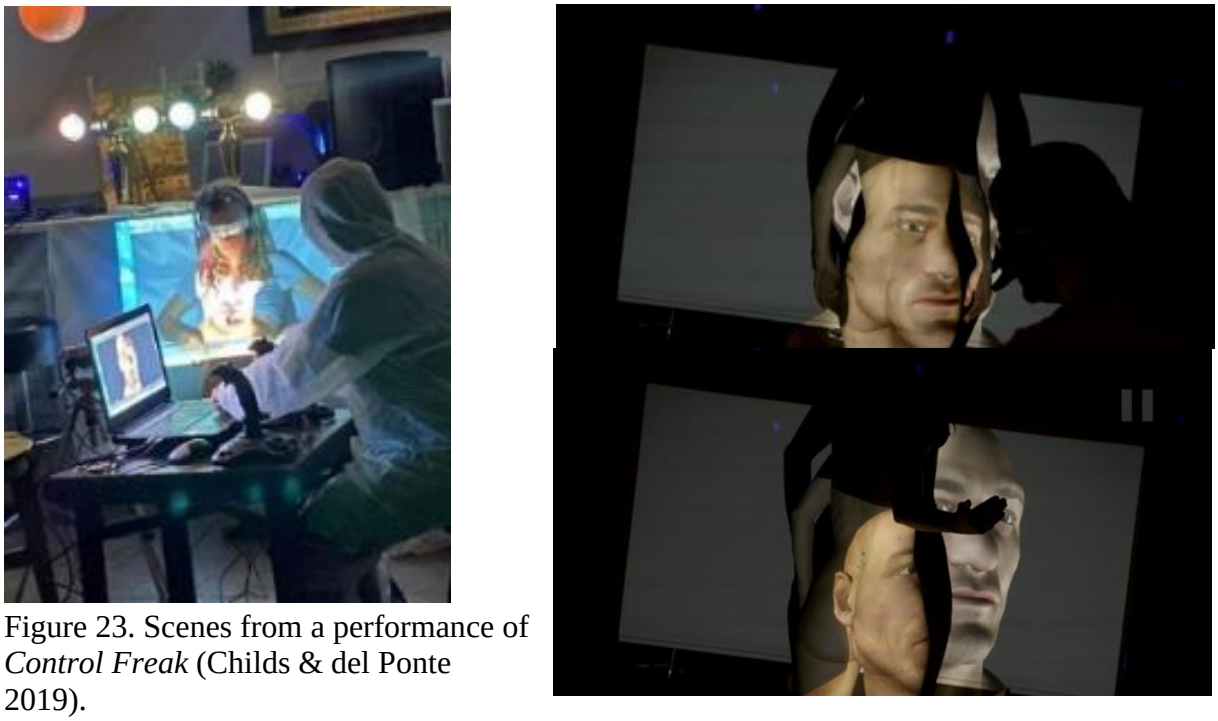


Figure 23. Scenes from a performance of *Control Freak* (Childs & del Ponte 2019).

Maeterlinck was a supporter of the concept of "pure theatre", in which the human actor was seen as a kind of puppet, subservient to the playwright's directorial and dramaturgical intentions which drive the dramatic artefact:

> "The revolt of the idealist theatre in the 1890s against the dramatic conventions of the day found its most extreme expression in the theory of a 'pure theatre' wherein even the actor himself, that 'sacred monster' of the nineteenth-century stage might be replaced by symbolic forms" (Brachear 1966, p.347).

The support of symbolic forms as a reaction to the literal approach of human-as-human legitimises the use of puppets as agents of drama. Maeterlinck believed that the essence of a piece is lost if the representation is too literal, and that mere imitation of life is a distraction and obstacle to truth in theatre. Jurkowski quotes Maeterlinck's work, *Menus Propos*, in which he suggests that the living actor be taken away from the theatre stage:

> "It is possible that we have to remove the living being from the stage…perhaps the human being will be replaced by a shadow, a reflection thrown on the screen, by symbolic forms or by some being that has the appearance of life, but which is lifeless.

> I do not know; but the absence of the human seems to be essential. When a man enters into a poem, the great poem of his presence dims everything around. A man can speak in his own name only; he has no right to speak in the name of the whole world of the dead" (Jurkowski 1988, p.12).

Halogen Hobbs is hollow inside (See Figure 24), and he has no history and no off-stage life to distract from the essence of that which he portrays; he does *not* "dim[s] everything around", in Maeterlink's words.

Figure 24. The empty head of the digital puppet Halogen Hobbs (Childs, 2018).

Maeterlinck is not alone in his view that the core creative ideas underpinning many works of drama would be better expressed if human actors were to be replaced by "symbolic forms" that could take the form of puppets. While human actors have no need to prove their liveness, their egos and physicality can be distractions for the audience, and – arguably – by using puppets as the emoting agents, the focus is placed firmly on the ideas expressed instead of upon the actors:

> "Like Pirandello, Ghelderode believes that flesh and blood actors, popular opinion to the contrary, are the ones who destroy a playwright's creation through their inept, stumbling attempts to recreate the dramatist's conception of his characters. The problem is that the actors' own personalities, gestures, faces, voices, and histories are glaring reminders to the audience that what they are seeing is not an embodiment of the playwright's character, but only an imperfect look-alike, a feeble attempt by a man to be someone he is not" (Levitt 1975, p.974).

Perhaps puppets are also attempting to be someone they are not, but their quest for life is overt, obvious and even heroic, whereas actors do not have to work at being human, and – no matter how much they attempt to control their bodies – they cannot escape from their very humanness. Kerner also approves of puppets' absence of a private life and consequent total commitment to their roles:

> "It may be strange, but for me the marionettes are more free, more natural than live actors. They give me a stronger sense of illusion...Marionettes have no life backstage:

> one cannot listen to them nor make acquaintance with them except in the roles they play" (Jurkowski 1988, p.12).

In his discussion of the concept of the über-marionette, Jurkowski describes the puppet as a virtual actor without the ego and backstage life of the actual actor:

> "When they spoke of the aesthetic value of the puppet the Romantics clearly thought of it as a virtual actor: they were not always satisfied with 'live' actors whom they frequently found motivated by personal ambitions, unfaithful to the author's intentions and over-influenced by traditional, outmoded methods of staging" (Jurkowski 1988, p.7).

As Schlemmer observes, admiration for the advantages brought about by the dramatic deployment of puppets is seen in the apparently pro-synthespian argument expressed by the concept of the über-marionette, or super-puppet:

> "The actor must go and, in his place, come the inanimate figure - we may call him the über-marionette, until he has won for himself a better name… many people have come to regard him as rather a superior doll - and to think he has developed from a doll. This is incorrect. He is a descendant of the stone images of the old temples - he is today a rather degenerate form of a god" (Craig 1957, p.81).

Craig moderates this point of view by saying that he wants the actor to "get a little of his [the marionette's] fire and come back cured", by which he means that the idea behind the über-marionette is the actor, plus fire and minus egotism (Craig 1957, pp.ix-x). But Craig's point still stands: the actor of his time had, and arguably still has, something to learn from puppets. Puppets enjoy a certain freedom, the origin of which lies in their independence from the physics of autonomous motion. In other words, puppets are not governed by the actuation of muscles, meaning that they can move in a variety of ways, examples of which include jerky, loose, pendulum-like, staccato or fluid movements, and they can exhibit dynamic variations in rhythm which endows them with a property of puppetness. Their movement gives them away – a betrayal which acts as both provocation and subversion, and which contributes to their appeal; it can be beguiling to witness puppets attempting to mimic humans and animals. It is the unselfconscious grace admired by Kleist (1972), the versatility admired by Schlemmer (1925) and the exclusivity of the roles they play that contribute to the pro-puppetry thesis (Levitt 1975 p.974).

4.7 Digital Puppetry Dramaturgy

The development of digital media during the late twentieth and early twenty-first centuries, specifically film and computer graphics technologies, resulted in the breaking-down of boundaries between the formerly distinct disciplines of animation, puppetry, acting, live-action film-making and special effects. Viewed through the prism of location, intangible performed objects can now be termed puppets. Searls identifies an evolution in the hybridized figures and forms invoked by this morphing and merging of technologies:

> "As CGI grows ever-more capable and pliant, it is not only changing the way in which actors and puppets appear in various media, it is enabling animated characters to perform like puppets and vice versa. Actors are controlling cartoon characters, while visual-effects teams are seamlessly mingling objects with images, blurring the lines between acting, animation, puppetry, and special effects" (Searls 2008, p.294).

Digital puppetry artefacts share attributes with computer animation, computer gaming, and tangible puppetry, and contribute to the discourse on NMD, defined by Eckersall, Grehan and Scheer as "a concept linking dramaturgical innovations in the globally distributed field of contemporary theatre with theories and practices in media/visual arts" (2015, p.375). Table 5 shows various levels in puppetry performance identified by Jones and Posner.

Jones		Posner	
Macro level	Script	Narrative	words, images, sounds and characters
	Choreography	Meta narrative	the artist's grammar = performance style and aesthetics
Micro level	Ur-narrative/performance of life	Ur-narrative	non- plot/spoken text visual elements of life

Table 4. The levels in puppet performance according to Jones and Posner (Childs 2020).

According to Jones there are two levels in puppetry performance:

> "…one is the macrolevel, which engages with the script and the choreography, the other is the microlevel, and is a performance of the ur-narrative: the performance of life" (Jones 2009, p.257).

Posner proposes a model of the "theatrical event" in puppetry, comprising three interconnecting threads that incorporates Jones' concept of two levels:

> "…three unique narrative strands support distinct, interweaving, simultaneous systems of theatrical meaning that together produce a polyphonic rather than simple melodic theatrical experience for an audience" (2014, p.335).

Posner calls these three components the 'narrative', 'meta narrative' and 'ur-narrative':

> "…the narrative itself – the words, images, sounds and characters used, the artist's grammar – meaning the artist's dialogue with the audience regarding performance style and aesthetics, and the ur-narrative meaning the visual elements used independent of plot/spoken text of life (2014 p.335).

Posner extends her description of the mechanism and components of puppet theatre to include the complicity between audience and puppeteer, which she terms "the fragile thread of belief that is birthed and nurtured by audience and artist over the course of a production, something that, in the puppet theatre in particular, is woven out of things like breath, gaze, surprise, and expectation" (2014, p.335). It is this complicity, inspired by unity of look and movement, that feeds imagined life. Jones argues that a puppet's job is to trick the audience into thinking it's alive; something human actors do not need to do:

> "…the primary work of the puppet is the performance of life, whilst for the actor this fundamental battle is already won. The life – the viability – of the puppet is always provisional. So, a puppet is by its very nature dead, whereas an actor is by her very nature alive. The puppet's work, then – more fundamental than the interpretation of written text or directorial vision – is to strive towards life" (Jones 2009, p.254).

According to Jones, "The puppet's ur-narrative is something quite different to, and more fundamental, than storytelling. It is the quest for life itself." This then is the critical differentiating factor governing performance in an actor and a puppet:

> "The actor is a living person and therefore automatically possesses life. Both the actor and the audience take for granted this fact. His or her living ness is obvious and certainly doesn't need to be 'performed'. The actor is in no danger, at any stage in the performance, of giving away the fact that he is not alive. However, by its very nature, a puppet is an object and therefore by definition, lifeless. The object which we call a puppet lives and breathes only because the puppeteer takes great care, for however long the performance lasts and at every moment during that performance, to make the puppet appear to be alive" (Jones 2009, p.254).

In digital puppetry, the quest for life implies an understanding of the ur-narrative, and how this can be expressed in digital formats. According to Westecott (2009, p.3), a puppet is a choice of signs, regardless of the materials from which it is made: "all the components of a puppet, whether material or virtual are intentional signs, chosen according to dramatic

necessity". Posner (P2015, p.336) says a puppet is **"**a repository of visual dramaturgy; the puppet is character and contains story even before it is set in motion". Jones remarks that "Puppet designers must think of the puppet as a kind of semiotic system", and goes on to say:

> "…the puppeteer becomes a significant collaborator in the semiotics—the generation of the meaning—of the object... a performing puppet is always a part of a *gesamtkunstwerk*—a moving synthesis of a number of sign systems, brought about through the work of a number of artists: scriptwriter, designer, maker, and manipulator(s)". So "story" and "life" have to be part of the very nature of any puppet. It helps therefore if this *ür*-story is somehow crafted or built into the puppet" (Jones, Kohler 2009, p. 346).

For me, this gives rise to the following question: how can ür-story be built into a *digital* puppet?

4.8 A Life of its Own: Manipulation Energy and the Animating Impulse

Adrian Kohler observes that for the glove puppeteer Sergei Obraztsov, the puppet's soul is located in the palm of the hand, and he uses the term "manipulation energy" to denote the animating force:

> "Literally, when you are talking about a glove puppet the puppet itself is nothing without the hand inside. And he believed that the further you got away from the hand, as with string controls, the further the manipulation energy got from the actual puppet the less it was able to perform well. He believed that the palm is the soul of the puppet" Kohler 2011, p.10).

Gross observes how the *animating impulse* and soul of a puppet are linked to the human ability to compartmentalise:

> "The madness of the puppet. It lies along a line or spectrum of things. …The madness lies in the hidden movements of the hand, the curious impulse and skill by which a person's hand can make itself into the animating impulse, the intelligence or soul, of an inanimate object – it is an extension of that more basic wonder by which we can let this one part of our body become a separate, articulate whole capable of surprising its owner with its movements, the stories it tells" (Gross 2011, p.1).

This separation of the animating impulse from the puppeteer enables tangible and intangible puppets alike to surprise their manipulators. The tangible puppeteer Obraztsov describes experiencing the phenomenon of a puppet taking on a life of its own while performing with the puppet baby Tyapa in his piece *Lullaby*:

> "My right hand, on which I wear the puppet, lives apart from me with a rhythm and a character of its own…[It] conducts a silent dialogue with me or, ignoring me altogether, lives its' independent life" (Obratzov 1950, p.155).

During the making of *Ugly*, Diakur experiences a similar phenomenon:

> "There is an interaction between the animator and the animated objects or characters. It is like the characters really have a say in the outcome and the animator has to work with it" (Diakur, 2016).

Although intangible, the puppeteer must also become intimately acquainted with a digital puppet's workings – the tactility is focused on the DIDs used. In the case of a digital puppet operated by means of buttons and levers, the puppeteer learns how far to push or rotate those levers, and at exactly what point in time to press the button to achieve the desired effect. I have rigged the puppet, and I have come to terms with it. I am reduced to the status of doppelganger during its operation, as all my attention is upon both the puppet itself and its performance. However, the control that comes with the familiarisation process must be balanced with the concept of a puppet's own independent life force as an energy that emerges when some control is relinquished.

5 Chapter Five. Movement and the GLOPPID Method

5.1 Chapter Outline

This chapter gives an account of the philosophy of movement underpinning the approach used in the pieces. It begins with a general overview of the factors determining psycho-physical technique, the idea of the actor as a puppet – and vice versa – and how digital puppetry motion vocabulary is defined to identify the interior and exterior mechanisms at work in digital puppetry, extrapolated from my own digital puppetry practice.

5.2 Mechanisms

Using the GLOPPID method I seek to identify the mechanisms in digital puppetry that correspond to those used for releasing the emotional and expressive potential in an actor. By investigating the parallels between onstage presence in tangible puppetry and human acting in that also evident in this digital puppetry work I try to answer the following questions. What part does performance technique play in digital puppetry practice? If performance is just a question of technique, then is a digital puppet like a robot that emotes as a result of a formula?

In digital puppetry practice, the two principal components of psycho-physical actor training – physical body memory and mental association – have practical implications regarding their implementation in a situation where there is an offset between the impulse and the site of its manifestation or signification. The physical and the psychological are interlinked, but how does this work in digital puppetry? I argue that the answer lies in a combination of the use of pure actions based in simple rotations (movemes), not necessarily associated with motivational mental processes, but endowed with intentionality generated by precision and conscious energy transference. I posit that a digital puppeteer acts as a conduit between different forms of matter, in which the performative centre of the puppeteer from whence manipulating energy is transmitted is extended or duplicated, so that it operates with these variations: It is split or shared between the puppeteer's and the puppet's body, or it is split or

shared in a quantum sense – in two places at once, and in neither. Furthermore, I would argue that although manipulation energy is shared, its quantity is not diminished in that sharing.

5.3 Movement Background

To achieve proficient and credible movement technique, puppeteers, physical theatre practitioners, and animators study and analyse the physical forces exerted upon living bodies at rest and in motion, reconstructing and re-interpreting them to create the illusion of life – and physical or psychological states of being – in the inanimate according to the technical and stylistic requirements of their work. Energy, momentum, inertia, velocity, acceleration, mass, and resistance are all components of the performance mechanisms used by these practitioners.

Movement in living creatures is generated by intentional muscle movement, but it is also the involuntary muscles associated with life-signs – such as breathing and heartbeat – that reveal mood and emotional states, and can be over-ridden or counterfeited. Mottram observes that states of mind are indicated by properties in the body such as openness and closedness, tightness and relaxedness, forward and backward, and can be activated by means of dramatic technique involving tension and intention (Mottram 2016). An actor's body and voice are the physical apparatus enabling them to express a dramatic sequence, and, as Bugeja observes, must be trained:

> "…performers need to know and train their bodies well in order to achieve a wide range of movement combinations, which would extend one's performative possibilities" (Bugeja 2015, p 6).

The human brain and nervous system oversee the mechanics of its physique, in much the same way as a puppeteer manipulates each part of its own puppet body.

In systems used for the training of the human body for highly codified physical disciplines such as ballet, where the associated motion is stylised, the body and mind are subject to a process of conditioning, and decades of training result in the distinctive ballet dancer's physique, used to deliver a vocabulary of gestures identified by Morina (2000). According to Barba this is a process where "the utilisation of specific body techniques is separate from

those used in daily life, known as “acculturation” (Barba & Savarese 1991, p.220). The acculturated anatomy has honed muscles and neurological pathways set for non-natural or artificial behaviours “with ways of standing, walking, stopping, looking and sitting that are different from the daily ones” (Barba & Savarese 1991, p.220).

The illusion of life in tangible and intangible inanimate objects is dependent upon unity of design in form and movement, rather than realism coming from a sense of credibility originating in the logic of the movement (Searls 2008, p.298). In his puppet manipulation workshop called ‘The Logic of Movement’, Mottram points out some of the motivating factors:

> “The elements which lie behind our vocabulary of movement are quite easy to identify – responses to gravity, the need to move from place to place, tension patterns and changes in movement tempo linked to emotions like fear or pleasure” (Mottram, 2016).

The quest for life and intelligence in digital puppets is also an investigation of psycho-physical technique. The challenges involved in creating ur-narrative in digital puppets relate to interior processes and exterior appearances, and require a different sort of tension and *in-tension* to that found in human actors.

5.4 Inside Outside: Psycho-physical Technique

The late nineteenth-century shift in approach to the dramatic arts identified in Chapter One was partly demonstrated in the belief that the emotional and expressive potential of actors can be released either through movement itself, or by tapping their inner emotional experience. This can take place either from the outside-in, or from the inside-out, meaning that both a physical action and a mental process or association can have a psychological effect on an actor, as is shown in Kemp’s argument that “the mind is inherently embodied, not just in the sense that the brain operates the body, but because physical experience shapes conceptual and physical action (Kemp 2012, p.xvi). Meyerhold and Stanislavski held differing views on this, which evolved over time (2013).

5.4.1 The Physical

There is the notion that physical performance work should be linked with personal associations that colour its generation and delivery. Grotowski believed that what he called conventional gestures could be avoided by working with personal memories or associations, in order to give an action distinctive, personalised qualities:

> "Grotowski emphasised that if a physical action is not imbued with a performer's relation to personal memories or associations, it turns into a 'conventional gesture', i.e., often belonging to an already established vocabulary. Such a distinction becomes pertinent when comparing, for instance, foxtrot dancing to a physical structure within Grotowski's laboratory theatre; the latter is based on physical action connected to an image or association (in Kemp's terms, a mental process), whilst the former is based on the technical particularities of style conventions. In this context, the performer seeks to work in association with some kind of image, whilst the foxtrot dancer is not necessarily called to do so" (Bugeja 2015, p.8).

Lindh proposes that, whether called 'movement' or 'action', a performer's work needs to be motivated by one's personal input (memories, thoughts, images, and other mental processes), rather than executed as a dictated, and often estranged, vocabulary of movement – a premise that was largely a result of two major influential figures in Lindh's career: Laban and Decroux (Bugeja 2015, p. 3). However, in digital puppetry, the simulation of artificial general puppet intelligence cannot come from interior motivation; a digital puppet has no interior life, memories, or emotional triggers upon which to draw. Without an inner life to tap into for 'motivation', how can a performance composed of empty gestures be avoided? As could be the case in a purely movement-driven digital puppetry performance, where the puppeteer cannot actually feel and be changed by the movement? Actors embody these tensions, but how does this work in puppetry? And what are the implications for digital puppeteers?

> "Although puppet and material performers cannot engage in embodied techniques in the sense that they do not have self-awareness, they do have bodies – material with mass, weight, sound, and texture – as well as limitations of movement resulting from their constructed joints, the means of manipulation that propels them (from hands on to remote controlled) and the distance between puppet or material and the actor-puppeteer. The limitations of these bodies inform how the embodied practices transferred by the live bodies manifest" (Mello 2016, p. 51).

The solution is a strategy of movement that demonstrates intentionality through a certain kind of precision, and through geometry, asymmetry, atypical combinations, and concepts of dynamic immobility, such as disequilibrium. My argument is that in the GLOPPID method

precision is already present in the movemes, and the undesirable exactitude of which Lindh speaks is avoided. Bugeja observes that Lindh:

> "[Lindh] argued that laboratory theatre practitioners like Stanislavsky, Copeau, and Decroux undertook an assiduous search for precision (Bugeja 2015, p.5).

In GLOPPID, the rotations are inherently exact, giving a result that resists excessive precision in their execution.

Audiences are highly sensitive to the nuances of movements and facial expressions in puppetry and animation, necessitating precision in the performance, but while the framework of actions in the GLOPPID method is pre-determined, the exact timings and placement of actions are flexible. Emphasis is placed on variations in the timing and spacing of movemes – rhythm, cadence, and tempo – and attention to the contrast between stillness and motion. As Fredricksson (2015, p.239) observes: "In puppetry and mask, immobility is the punctuation that enables meaning". The challenge in improvisation work is to achieve a balance between precision and freedom. Decroux's approach to acting reproduces the concept of key-poses in animation, giving clear, readable signals:

> "One must be capable of going from one point to another on a route that is a succession of simple designs" (Leabhart 2007, p.63)

But although his work was influenced by Descroux, Lindh rejects the locking-down effect of the former's exactitude:

> "He [Lindh] called Decroux's a '"perfect" technique, accurately thought out on the practical and theoretical level [and] equipped with a poetic power that is overwhelming. What is already perfect cannot be subsequently developed' (Lindh 2010, p. 22). With this belief, Lindh resisted fixed training and performance structures (such as choreography and directorial montage) that sought to acquire precision on an external (technically codified and aesthetic) level" (Bugeja 2015, p.5).

While an awareness of 'readable' poses may be useful, it is important to be aware of stillness, motion, and pure actions as drivers.

5.4.2 The Psychological

In her discussion of embodied practice in puppetry, Mello looks at direct and indirect trans-embodiment techniques, arguing that "both are in fact embodied kinaesthetic practices that emerge within the body/bodies of the actor(s)-puppeteer(s)" (2016, p. 49). Her work addresses the practice, theories and performance techniques that "activate puppet and material performers" (Mello 2016, p.49). The crossover between human-movement practitioner theory and puppetry is present in the training work of the three puppeteers: Genty, Underwood and Tranter. Mello uses experience of this training to try to discover "…what is being produced by the actor-puppeteer and how does it get from the producer to the site of signification?" According to Mello:

> "Trans-embodiment is a process of transference of direct and indirect embodied techniques between live (animate) and puppet or material (inanimate) performers" (2016, p.50).

She defines direct and indirect technique in terms of the overt body language and covert mental processes that inform or influence performance:

> … "those techniques that are visible and directly knowable are direct, whereas techniques not necessarily visible – such as memory, use of an item with personal meaning unknown to the audience, drawing on personal emotion and imagination – are indirect" (2016, p.50).

Mello differentiates between direct and indirect motivational impulses. Indirect are those which are not visible from the outside; memories and emotions used 'as elements of manufacturing a puppet or material performer's anima – its soul or vital force – or liveness. Indirectly knowable embodied experiences affect qualities of movement, tempo and duration of physical movement and gesture (among other aspects) in subtle yet tangible ways, thus affecting meaning. Simple actions and gestures that live actors take for granted must be broken down into bites or beats (Mello 2016, p54). For Mello, direct trans-embodiment is a straightforward and observable phenomenon:

> "Direct trans-embodiment involves the transfer of body language in the form of gesture or physical action between live performers and puppets or material performing objects in a manner that is intended to be read and convey meaning" (Mello 2016, p.51).

whereas indirect trans-embodiment is more mysterious:

> "Tranter actively works with what he refers to as coded physical action – meaning the precise use of body language and physical movement premised on the embodied experience and memory of the actor to construct visual narrative" (Mello 2016, p.53).

I am transferring my own version of body language to the digital puppet, and it will be based on what I know.

> "The assumption, then, is that the performers will 'know' what gesture(s), physical action(s) or rhythm/pacing(s) are needed to convey any given meaning within any given moment. What we 'know' as performers, of course, are those gesture(s), action(s) and rhythm(s) that reside within our own bodies. These constitute what Noland argues are the felt experience of the body moving" (Mello 2016, p.52).

By freeing my own body, I am widening the scope of this felt experience, but I can never extend my abilities to the same extent as a digital puppet. I will always be *imagining* the movement, not actually *feeling* it.

Bugeja describes how Descroux believes that by linking images with physical work "appropriate tension in the body" would be created, which means that it is not actually necessary to use thoughts or emotions in order to do this:

> "Embodying one's mental processes, then, does not necessarily mean one's intimate thoughts or emotions, but also a given image. The point is for performers to be highly aware of (and not alienated from) their inner processes" (Bugeja 2015, p.7).

For digital puppeteers, this picturing creates the appropriate tension in the intangible puppet body, causing the puppet to embody an image the puppeteer pictures in their mind's eye. This mechanism is, therefore, a combination of parts of the puppeteers' approaches described by Mello:

> "Where Underwood uses the immediate experience of the manipulators and Genty assumes that body language will be transferred to a puppet, Tranter actively works with what he refers to as coded physical action – meaning the precise use of body language and physical movement premised on the embodied experience and memory of the actor to construct visual narrative" (Mello 2016, p.53).

Camillieri's exploration of Lindh's differentiation between motivation and intention identifies the meaningful physical act that sends a readable signal:

> "Motivation is distinct from intention. For Lindh an intention to do something (e.g., the mental act that precedes throwing a pebble) can be corporally manifested in diverse ways (e.g., a movement of the head). This kind of work does not require a

> motive in answer to the questions: why am I throwing a pebble? or why do I want to throw a pebble in the first place?" (Camillieri 2008, p.93).

The important element is the idea of the action itself: the concept of *being* the action.

5.4.3 The Combination of the Physical and the Psychological

According to Lindh, empty gestures can be avoided by means of the use of improvisational techniques:

> "Lindh asserts that in the context of a social situation where experienced actors improvise on the basis of reference points, empty gestures do not exist" (Lindh 1998, pp.61–62).

For Lindh, if an action is precise, takes place within a social situation or context where the improvisor is vigilant, and has intentionality – not to be confused with motivation – then it will be meaningful.

> "A gesture could initially seem 'empty' but this is not so. Emptiness does not exist. The gesture can be more or less clear and eloquent, and one can be more or less aware of it, but behind it there is always a sense that can be rediscovered. [. . .] The situation is in a continuous state of flux, and it can happen that one unexpectedly accomplishes a gesture or an action that one had already accomplished countless times before but now has a resonance [. . .] for the actor and those around her. This is the moment when a sense is found, and the actor's actions merge with mental themes" (Lindh 1998, pp. 61–62).

Digital puppetry performance originates in an intentionality derived from purposeful actions established by precision in the movemes and visimes. These then leave space for playfulness. It is the "hand crafted intermediate features" of real-time puppetry that give the puppets personality (Vougioukas, Petridis, & Pantic 2019, p.1398). Intentionality and precise movements prevent the occurrence of empty gestures. Intention in animation is typically indicated by the anticipation principle, examples of which include a backward step before a jump, or the retraction of the arm before a throw, an example of corporal manifestation:

> "Intention in our work terminology indicates this small movement of mind that is at the beginning of every act and indicates an act's mental direction. In life we are always acting out of intention. Intention can be conscious or not, and it does not need

> to be manifested through the movement of the body in space. Intention is prior to impulse (which is physical, involving directly nervous and muscular systems) and can be concretized both through stillness (non-movement) and movement" (Pietruska 2007).

Counterfeiting the "small movement of mind" that shows "mental direction" is evident in Jones' notion of a type of thinking he calls "weak force" (2009, p.266). Jones proposes that the audience of a puppetry performance perceives two forms of thinking: weak, in the sense "that in the puppet's stillness the audience can read its thoughts", and strong, which "refers to the totality of movement the puppet makes". For Jones, the puppet's movement itself is thought in motion – *the physical evolution of ideas*:

> "The assertion is that the movement is the thought. Here we are talking about an embodied form of thinking, of thinking incarnate…. During an improvisation therefore, we would assert that the puppeteer is using the puppet to physically evolve ideas that are incommensurate with script and scriptwriting. This is thought given expression through gesture, timing, rhythm (Jones 2009, p.266).

In my improvised digital puppetry pieces, this is a constantly occurring phenomenon; the puppeteer is using the puppet to evolve ideas by means of psycho-physical mechanisms. For example, Halogen Hobbs' mischievous, friendly, 'cheeky chappy' personality is broadcast in the way he moves. During the *TeknoKolor* (del Ponte) performances, Hobbs' character is at times readable as an intelligent techno aficionado, at times as a mischief-maker and at times as a satirist; his apparent 'appreciation' of the music makes him looks like he is both experiencing pleasure and thinking (DJWhatDuck 2014).

In the GLOPPID method, the approach to psycho-physical technique is inspired by techniques found in physical puppetry, and human dramatic movement systems and improvisation. It is influenced by ideas from human dramatic movement practitioners such as Descroux, Lecoq, Laban, and Grotowski. Their approach uses physical training exercises based in geometry and patterns, which are designed to expand an actor's flexibility and psycho-physical range, without stylistic constraints. This idea is expressed in Lecoq's account of his own practice:

> "I discovered the geometry of movement by exercising on the parallel and horizontal bars…" and "The movement of the body through space demanded by gymnastic exercise is of a purely abstract order" (Lecoq 2002, p.3).

The simplicity of form in the movements found in gymnastics, free of the embellishments of stylisation, were inspirational for Decroux's work on Corporeal Mime. Leabhart describes how Decroux divides the actor's body and "the space around it arguing for geometrical exactness" (Leabhart 2007, p.63) in a process that shares characteristics with puppet motion. He quotes Decroux's account of seeing the human body as segmented in the same way as is a puppet's body; and states that it:

> "…becomes countries and I carve out frontiers. I am reinforced by the vocabulary, and I say: head, neck, chest, etc. The body is viewed in the same way by a craftsman making a string marionette, or a sculptor making an articulated model" (Leabhart 2007, p.63).

These exercises are not rooted in any classical movement codification system; instead, they are exercises in corporeal composition that involve opposites, asymmetry and atypical combinations, the independent control of muscle systems, and the idea of relocated emotional impulses. The digital puppets' motion vocabulary is inspired by Decroux' concept of corporeal mime, unembellished and without the expressive gestures of dance. The movement language is applied in a way that exploits the ease with which controllers used to amplify a given movement – such as, for example, a signature move – can be activated. In these style-neutral approaches, the core is the origin of movement, and the musculature is trained for maximum flexibility. The performer's mind is trained in awareness and independent control of the physical systems of the musculature, so that they can be operated either synchronously or contrapuntally, individually and in combination. Theatrical biomechanical technique seen in physical theatre – for example, the Corporeal Mime of Descroux – is used to create an illusion of weight and force by the strategic use of timing and tension, the isolation of muscles and muscle groups, and sequential movements in various parts of the human body (Kipnis 1976, p.11; Leabhart 2007, p.66). The art of illusion, therefore, is a kind of fakery in which the performer counterfeits states of being. My work is concerned with movement of puppet bodies through and in space, determined by movemes that can easily cross and re-cross human anatomical and psychological boundaries.

> "…while a classical dancer deals with symmetrical models, exact repetitions, and regular rhythms as demanded by the music, the mime works with asymmetry, variation, rhythmic models of language, and natural movements of the body. The freedom from the dominance of music, as well as the priority given to the natural dynamics and rhythms of the body are thus common to both Laban and Decroux. Furthermore, like Laban and other modern dance pioneers, Decroux did not appreciate the air-bound and light nature of ballet, preferring the weightier and grounded corporeal mime with its resemblance to the heavier effort of manual work. For him, dance is 'serene' while mime is unhappy' and 'anxious' (Bugeja 2015, p. 6).

The GLOPPID method takes the idea that movement itself is the driver – that expressivity can be realised from the outside in, thus fuelling the creative feedback loop. A superhuman spectrum of articulations is available to La G, but her vocabulary of motion can be limited to only part of the spectrum of possible movement ~~only~~. This is the approach taken in all the work in this study, where each of the puppets has a movement palette similar to the constrained gesture sets used in computer gaming. It is through the use of such palettes that a kind of expressivity is embedded in each puppet. There can be no tension at a muscular level in a puppet, but movement and timing techniques can be used to create the illusion that there *is*. Richards gives an account of Grotowski's perspective on the "right" tension:

> "According to Grotowski, impulses are linked to the right tension. An impulse appears in tension. When we in-tend to do something, there is a right tension inside, directed outside… 'In/tension – intention. There is no intention if there is not a proper muscular mobilisation. This is also part of the intention. The intention exists even at a muscular level in the body. Usually, when the actor thinks of intentions, he thinks that it means to pump an emotional state. It is not this. Intentions are related to physical memories, to associations, to wishes, to contact with the others, but also to muscular in/tensions" (Richards 1995, p. 96).

One such technique is onstage presence, designated as "dynamic immobility" by Decroux, which is the concept that even in stillness, the tensions in the actor's body set up a sense of energy, an 'energetic design based on opposition' (Leabhart 2007, p87). This idea is repeated in Barba and Savarese's identification of positions which make a performer interesting to watch, by placing the body in difficult balance (1991 p.32). According to Bugeja:

> "Decroux's corporeal mime and Laban's modern dance practice had much in common – primarily the drive to discover a new and wider range of body movement possibilities. They both worked extensively on the body in an analytical and methodical way, trying to free movement from rigid techniques. Through this reaction to conventional vocabularies such as classical ballet, they both worked on disequilibrium, counter-tensions in the performer, and focused on the torso rather than on the peripheral limbs" (De Marinis 1993, p. 115 cited by Bugeja 2015, p. 5).

Tension in digital puppets must come from places other than deep in the muscle tissue. Fortunately, impossible balancing and contortions present no problem for intangible puppets (See Figure 25).

Figure 25. La G in disequilibrium (Screenshot: Childs 2018).

Lecoq was a proponent of a style-neutral approach influenced both by gymnastics and by an admiration for the economy of motion found in the simple, unembellished, repetitive movement phrases of manual labourers. Lecoq's "action mime" system is heavily influenced by his own athletic practice and by the "natural method" proposed by Hébert, based around eleven activities composed of specific sets of motion primitives: pulling, pushing, climbing, walking, running, jumping, lifting, carrying, attacking, defending, and swimming (Murray 2003, p.165). These actions relate to the libraries of movement generated by human actors

using suit-based motion capture systems. Typical stock moves, including idling, combat and locomotion sequences, are captured and stored, ready to be triggered for use by characters during game play (for example the gesture library created by Keanu Reeves for *CyberPunk 2077)*. Lecoq's approach advocates economy of motion, attention to the lines of force and the centre of gravity (C.O.G.), freedom from gravity, lightness, strength, balance, and the independent control of individual muscles. Muscular "isolations" are an aspect of technique upon which illusionary mime is predicated (Kipnis 1976, p.11). Although all these properties require fitness, the technique is not purely athletic; an actor must be able to perform in the sense of being able to create an illusion requiring awareness of tension and timing (Lecoq 2002, p.72).

Many simple actions which are difficult for human actors to achieve – because a high level of coordination, precision, flexibility and control is required in order to execute certain combinations of movemes but – are easy to implement in digital puppets. This can be seen in Bugeja's explanation of Descroux's description of the "anxious" nature of mime:

> "…refers, rather, to the physical effort (suffering) entailed by the centrality of the trunk in corporeal movement" (2015, p. 6).

Further examples of these kinds of actions can be seen in Fredricksson's analysis of Heggen's work in the context of the Feldenkrais Method (FM) and Awareness Through Movement (ATM). According to Fredricksson:

> "A constraint in ATM [Awareness Through Movement] might be to frame the head with the arm, preventing the neck from moving and encouraging movement in the ribs. In Heggen's work it might be to keep one hand fixed on an upright pole whilst seeing where it is possible to move the rest of one's body. An auxiliary movement in ATM might be to move one's eyes in the opposite direction to the way one is turning one's head; with Heggen it might be using only the head during a moment of immobility, followed by a return to global movement, thus opening up a moment dramatically. A distal–proximal reversal of the initiation of a movement in ATM might involve a focus on movement in the shoulder blade, rather than in the arm. With Heggen it might be to follow a partner's finger first with the eyes, followed by the head, then with the head, followed by the eyes, developing focus and precision" (Fredricksson 2015, p.236).

Limited movement palettes are a feature of digital puppetry which are not so easy to achieve in actors. Digital puppets are capable of the independent control of their imagined

musculature, a property which, in the human actor (including the vocal musculature), is an essential part of the approach put forward by Meyerhold, Lecoq, Descroux, and Grotowski. According to Braun, Meyerhold advocated a separation between the "vocal and physical rhythms so that each one can be controlled independently of the other in the service of the theatrical performance and the manipulation of the viewer's sensibilities (1995)". Complete control of the musculature allowed for contrasts in rhythm and groupings, as demonstrated by Grotowski's exercises for independent control of the facial muscles:

> "It is very important to be able to set in motion simultaneously, but at different rhythms, the various muscles of the face. For example, make the eyebrows quiver very fast while the cheek muscles tremble slowly, or the left side of the face react vivaciously while the right side is sluggish" (Grotowski 1969, p.114).

Grotowski referred to the "Theatre Laboratory" method he deployed as "a via negativa – not a collection of skills but an eradication of blocks", saying it results in "freedom from the time-lapse between inner impulse and outer reaction":

> "Years of work and specially composed exercises (which, by means of physical, plastic and vocal training, attempt to guide the actor towards the right kind of concentration) sometime permit the discovery of the beginning of this road" (Grotowski 1969, p.17).

These effects can be achieved in digital puppetry by deliberately rigging the puppet in such a way as to facilitate the operation of atypical combinations that are difficult to achieve in human actors, as is true of the following Grotowski exercise:

> "…choose an emotional impulse (such as crying) and transfer it to a particular part of the body – a foot, for example – which then has to give it expression. Express two contrasting impulses with two different parts of the body: the hands laugh while the feet cry…Moulding of the muscles: the shoulder cries like a face; the abdomen exults; a knee is greedy" (Grotowski 1969, p.112).

For me, this is a feature of puppetry in that a motivational force causes a non-autonomous subject to move and emote in a certain way. The simplicity of movement based in rotations creates qualities of *puppetness*. It combines the geometry of movement found in the work of Lecoq and Decroux with puppetry, resulting in the properties so desirable to those proposing the concept of the actor as marionette.

The adoption of the core – a group of muscles around the pelvis and the solar plexus where a cluster of nerves is located – as a centre of impetus in non-formal (non-classical) techniques of movement is a feature of revisionist approaches to dramatic biomechanics. Grotowski believed that "All true reaction begins inside the body" and said that the source-location of that reaction is "the sacrum-pelvis complex" (Slowiak 2018, p.124). According to Slowiak, this core area is “that part of the body comprising the lower part of the spinal column (the coccyx) as well as the whole base of the trunk up to and including the abdomen” (Slowiak 2018, p.124).

In addition to connecting with the idea of an actor as a puppet, Decroux’s work contributes to the rebellion against pantomime’s emphasis on face and arms:

> “Descroux distrusted the hands almost as much as he did the face since they were co-partners in the deceit of nineteenth-century pantomime” (Leabhart 2007, p.57).

Decroux favoured the use of the trunk, to the point where he and his student-collaborators would sometimes veil their faces when performing:

> “For Decroux, the head, neck, chest, waist and pelvis – the trunk constituted the core of essence of a person… no other technique requires the trunk to become, as Barrault said, a face” (Leabhart 2007, p.58).

According to this philosophy, if this core body mass, or trunk, can act, then the actor is successful:

> “Corporeal Mime covers the face to reveal what the trunk can say without it” (Leabhart 2007, p.57)

Therefore, all digital puppets can be successful actors. Grotowski gives an example of use of the whole body in a performance by the Italian actress Eleanora Duse “who, without using her face or arms ‘kissed’ with her entire body” (Grotowski 1969, p.112). This is the kind of acting that cartoon characters do so well.

5.5 When Does Movement Become Animation?

According to Fredricksson, tangible puppetry involves a knowledge of the relationship between three categories of movement:

> "...awareness of one's own movement, awareness of the movement between oneself and an object, and awareness of the movement created in the object" (2015, p.238).

Puppeteers develop a sense of the space around them, and an awareness of the locations and movement of the objects they control remotely. "Developing this proprioceptive awareness is indispensable for the puppeteer." (Fredricksson 2015, p.241). In digital puppetry, this means both the movement required to control the object, and the motion in the object that results from that movement. The movement *between* the digital puppeteer and the object takes place in two spaces: physical space and virtual space. Fundamental puppeteering skills include concentration, perception, spontaneity, imagination, peripheral vision, internal and external kinesthetics, transferring energy to the object, and focusing the audience's attention on the object. Fredricksson's approach to movement (2015, p.238-9) points to the desirability of a freedom of flow between puppeteer and puppet, a dialogue where the puppeteer's impulse transforms into energy and translates into puppet impulse, creating a two-way energy exchange. A parallel mechanism exists in the energy flow between digital puppet and puppeteer, one which is based in peri-personal space, proprioception, and floating attention.

Therefore, understanding a digital puppet's "tree of life", or skeleton, is key to inhabiting him/her/it, to the point where it is possible to sense the joints using proprioception. Gousseff describes this mechanism in humans:

> "It was troubling and took me a long time to integrate the skeleton as the tree of life and not an image of death. The idea that even though we don't feel our bones there is something in the quality of proprioceptive action that allows us to understand the skeleton, or at least allows us to understand the different segments of the body in relation to gravity; this constant puzzle which is always moving" (Fredricksson 2015, p.242).

In puppetry this sense of "proprioceptive action" is expanded to include the puppet's bones. In the psycho-physical digital puppetry technique that I developed during this research study, my own and the puppet's skeletons are combined, and originate at the core (pelvis). I visualise the two skeletons as trees that are connected in a process that uses mind's eye mapping and *mirror neuron* activity, in which I picture the proximal and distal relationships between the joints and articulations. This happens either consciously, or at the level of the

subconscious. Whereas in human anatomy, proximal means closer to the core, and distal further from the core, in puppetry the approach must be re-imagined to reflect two cores: those of both the puppeteer *and* the puppet. Although the puppeteer's hand is distal to the puppeteer's shoulder, the puppeteer's knee-joint is proximal to the puppeteer's ankle-joint, and the most proximal joint is at the core – the hips and the lowest spine joint. The relationship between the hands of the *puppeteer* and those of the *puppet* requires beyond-the-body awareness. Fredricksson describes how a tangible puppeteer's actions create movement beyond their body in the tangible puppet body, and that, by means of what can be understood as force feedback, the puppet can then become the initiator of further movement:

> "In puppetry the movement must start proximally [closer to the core] in the puppeteer in a very clear manner in order to produce a precise distal [further from the core] movement in the puppet, beyond the body of the puppeteer. Precise does not mean overly controlled in this context, but a clear expression of the intention of the puppeteer. However, the puppet can also lead the dance; the sweet spot is in the ability to flow between proximal/puppeteer-initiated movement and distal/puppet-initiated movement, so that the puppet does what it wants, but within the constraints provided by the puppeteer in the form of a context or situation" (Fredricksson 2015, p.236-237).

In the GLOPPID method, the puppeteer's proximal movements produce precise distal movements in the puppet, due to the inherent precision of the movemes that contribute to intentionality. The aim here is to open a direct link between mind and puppet by using a *virtual awareness*. I have found that the offset and the discrepancies between the morphology of the puppeteer's body and that of the puppet enable a puppeteer to inhabit the puppet body in a way that is not possible where there is direct telemetric translation. Fredricksson reports the performer Gouseff's recognition of this kind of awareness:

> "If you work the whole body, every joint specifically, towards an inner understanding to the point you can construct them; what an incredible lesson in corporeal mechanics for a puppet-maker or puppeteer. Visualising and sensing the shoulder joint, or the ensemble of bones that make up the ribcage, the suppleness that it allows, the way it can bend . . . these are mechanical lessons but also completely linked to emotions and to how we look or observe. (2015, p.241).

Having no muscle-memory and no psycho-physical technique of their own, digital puppets are not subject to the kind of conditioning involved in acculturation, although this could be externally imposed. Digital puppets never run out of energy; it is the puppeteers who, through sharing their energy with the puppets, eventually become fatigued. McClure says of the early

digital character, Kyoko Date, that she "never gets sick, she doesn't complain, you don't have to pay her, she doesn't get old" (Malone 2000, p.61).

6 Chapter Six. Puppet Intelligence: *Control Freak* and Face Jazz

6.1 Chapter Outline

This chapter gives an account of the theories and themes underpinning the creation, production and performance of *Control Freak* as an example of the application of the GLOPPID method. It includes the decision-making processes behind La G's whole-body rigging, the moveme palette selection of La G and Halogen Hobbs, and the ways Grotowski's ideas on movement are applied in the piece. This chapter also introduces face jazz as a performance art-form. It looks at the way the pieces developed with reference to the aim, namely, to find out if it is possible to create the illusion of life and intelligence in CG models using algorithm-assisted digital puppetry, and to test the hypothesis that the ability to use improvisation performance techniques enhances spontaneity in CG characters.

6.2 Timeline.

Artwork Title	**Performance Location**	**Performance Date**
Control Freak	Lerici Castle, Lerici, Italy	24 June 2022
Control Freak	Thessaloniki, Greece	3rd April 2022
Control Freak	Spetses, Greece	1st April 2022
Is there anybody there?	*Museum of Dark Matter*, West Ham, London.	2021
Museum of Dark Matter – Drone Pilot	Online	2021
The Drummer – Drone Pilot	Online	2020
Am I a Puppet? – Drone Pilot	Online	2020
Prefix Ur – Oskar & Bruno	Online via Synergy Arts	17th September 2020
Control Freak	Community Bass Extravaganza, Café Cairo, Brixton	6th December 2019
Control Freak	Women in Tottenham Bluecoats	29th October 2019

Control Freak	Hundred Years Gallery	25th January 2019
Control Freak	Teknokolor, Flying Dutchman, South London	17th February 2019
History of the Theatre (Oskar & Bruno)	[Online]	2018
House Watch 01/02	My House in North London	Various dates, 2018-2019
Boot Stompers (Childs 2018)	Rosemary Branch Theatre, Islington	5th August 2018
Flowering Pools (Childs 2018)	Online	2018
Nuke Your Clothes (Childs 2018)	Online	2018
DJ_01 (Childs 2018)	My House in North London	Various dates, 2018-2019
Teknokolor (2018-19)	Flying Dutchman, South London	December 2018
MoDm – Drone Pilot	Online	2021
My Friend	Friday Flop, Rosemary Branch Theatre, Islington	2018

Figure 26. List of Performances

Development has occurred through working concurrently with different characters, rather than on specific pieces, one at a time. My first publicly-performed experiments with a face were made with *My Friend* (April 2018). They were limited by difficulties with head-movements, but were successful in that they did create the illusion of life – there was audience complicity, and I realised that I could be spontaneous. The early experiments involving Halogen Hobbs' facial expressions were carried out at *Teknokolor*, an indoor dance venue, and also in the pieces *DJ 01* and *House Watch 01* and *02*, projected at my house and visible from the street. Overall development has been non-linear, in the sense that by trying the same character out in different situations, I have learnt more about how a face behaves when operated while using a limited moveme palette, and what works in terms of the aim. *Flowering Pools*, *Nuke Your Clothes* and *Boot Stompers* are pieces associated with music, and by using the structure of the songs to govern the movement and the character mood, as opposed to using a script, I was able to understand what works – particularly in terms of timing. My work with Halogen Hobbs fed into my idea for *Control Freak*, which has been very successful. Over the course of the eight performances of *Control Freak* (2019-2022), we have played with the placement of his projected face, making jokes about his superimposition

onto Elisabetta del Ponte's body, and we have been able to exploit and enjoy the spontaneity the technique affords.

6.3 *Control Freak*: Movement Style and Rigging Rationale

Control Freak (see figure 24) is a twelve-minute-long combined digital puppetry and human physical performance piece in three acts. There are four main protagonists: two digital puppet characters, who are named La G and Halogen Hobbs, and two overt (visible to the audience) human performer-puppeteers. La G is a whole-body and Halogen Hobbs a head-only puppet. The three-act framework is linked to a pre-recorded soundscape made by Elisabetta del Ponte, consisting of two music tracks bridged by a section comprising sounds chosen to denote life – namely, breathing and throat-clearing. The music tracks were chosen to reflect the core creative ideas of control and letting go: *I need a Freak* (Tolliver 1983) and *Virtual Boyfriend* (Poly Styrene 2011). *Control Freak* has also been performed with the Menopause Army Band's tracks *Flowering Pools* and *Nuke Your Clothes* (Childs 2018), which both reflect the ideas of creativity and rebellion.

The CG models were chosen both/firstly/primarily for their technical suitability for conversion to digital puppets, and also for their aesthetics, in a way akin to casting actors for a film. Choosing the model for his contemporary Londoner look, I see Halogen Hobbs as everyone's virtual boyfriend, in a way similar to that in which Mr. Punch is seen as an 'everyman' figure. La G's goth-punk visual design-style (see figure 25) is inspired by Nina Courson, lead-singer of the band the *Healthy Junkies.* The puppet's movement style is based on Courson's air of defiant vulnerability, transmitted by her melodramatic and extreme-but-slack movements, and is also influenced by the dramatic movement theorists and practitioners Lecoq, Laban and Decroux. La G's rigging design incorporates and exaggerates identifiable movemes while creating combinations that show her essence in a puppetised format. Many of these movements originate at her core, identified as the centre of impetus by many movement practitioners, including Grotowski (1989, p.297). As previously explained, Grotowski developed exercises for students of acting which are designed to "work on engagement of the sacrum-pelvis complex and flexibility of the spinal column", described by Slowiak thus:

> "Engagement and unblocking of this area is essential for a body to live and react truthfully. Our entire body is one big memory and, in our body-memory originate various points of departure. But because this organic base of body reaction is, in a certain sense, objective, if it is blocked during exercises, it will be blocked during performance, and it will also block all of the body-memory's other departure points." (2018, p.124).

Puppets are not subject to blocking in the same way as a human actor; the rigging (defined in the node-network) determines the freedom of movement in the joints, without the same need for psycho-physical training in the puppet and puppeteer, who must share the responsibility between them. Every person has their own unique patterns of movement, and factors that define movement characteristics, such as constraints, can be designed into a CG model via the rigging. These elements, combined with phrasing patterns derived from the way she is manipulated, define La G's "Movement Signature", as identified by Bishko in the LMA system:

> "The unique Phrasing patterns of movement elements constitute one's Movement Signature" (2014, p. 202).

La G. has two signature moves, originating at her core, that form part of her Movement Signature: a straight-legged kick and a forward torso-bend, where she breaks at the waist, and collapses as if she were folding up (See Figures 30 and 31). La G also has a signature visime: an asymmetrical snarl controlled by button number eight.

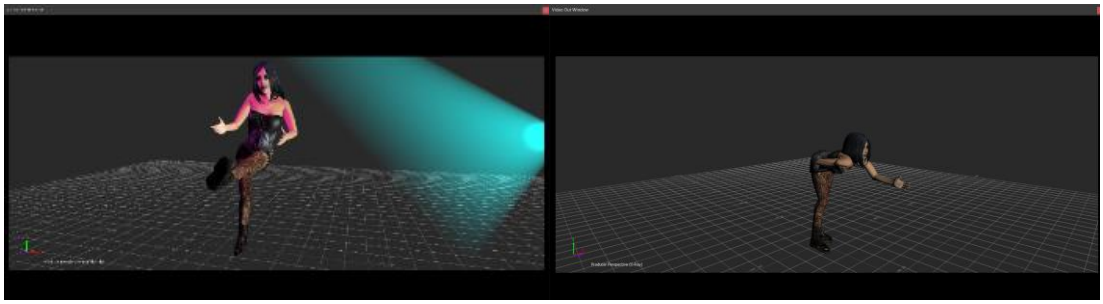


Figure 27. La G's two signature movements. Left: straight-legged kick. Right: forward torso-bend (Screenshot: Lucy Childs).

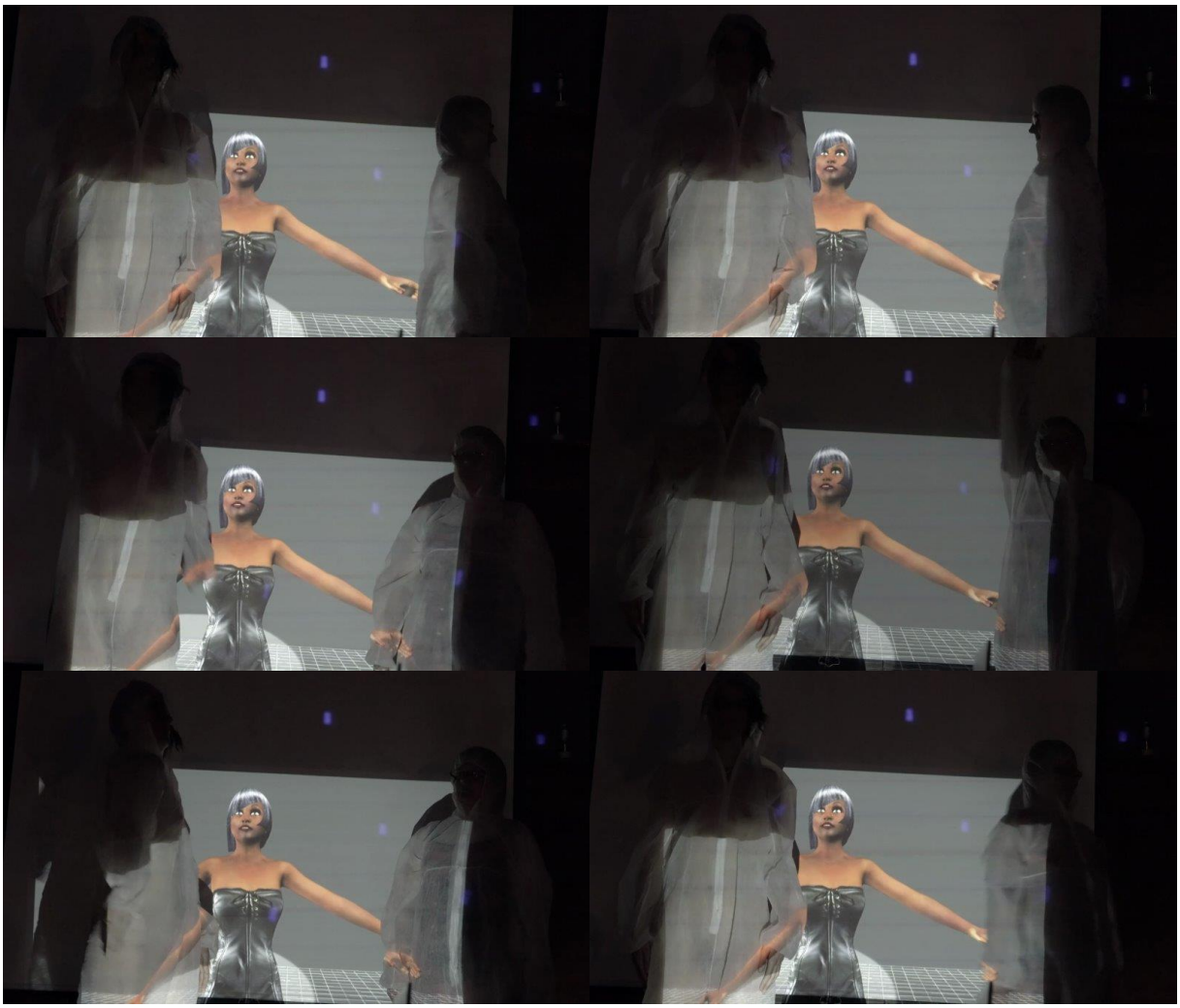
In LMA, the systematic analysis of "human movement and effort" is organised in terms of space, time, energy, and the parts of the body involved (Hutchinson 1974, p.19). Much of the Laban Movement Family Tree (Hutchinson 1974, p.19) is applicable to GLOPPID digital puppetry work, the critical divergence from it occurring with reference to dynamics, where the category of "inner attitude" is supplanted by 'puppeteer-transmitted' attitude.

6.4 The Actor-puppeteer: Signalling La G's Movemes

There is the notion that a puppeteer or animator's ability to perform an action themselves is a necessary prerequisite for successful performance in a character. Underwood's puppetry training method includes allusions to the Feldenkrais and Alexander movement techniques. These techniques are used to develop an actor's physical flexibility, balance, efficiency and economy of movement – properties which can then be applied to puppets. According to Mello (2016, p.52), this process "gives us the basic information we need to begin to understand and translate any action with a puppet". This approach is built into the *Control Freak* performance, which begins with an attempt by the actor-puppeteers to execute the same set of movemes that La G uses in the piece. This is intended to indicate that the human performers share La G's vocabulary of movement – they speak the same language. Like all digital puppets, and unlike a human actor or dancer, La G has no issues of fitness or flexibility; her movement is not constrained by her physiology. Her moveme palette comprises straight-arm rotations, core twists, head-nods and head-shakes, in addition to her Signature Movements (see figure 27). La G's arc-based rotations in themselves are possible for a human to execute, but the timing of the movements, as copied from the digital puppet, is speedy, vehement, and staccato, and their velocity and reach require a high level of fitness that is difficult – if not impossible – for the performers to achieve. When the performer-puppeteers mimic the puppets, the movements appear awkward and absurd.

Figure 28a. Elisabetta del Ponte and Lucy Childs operate La G at the Women in Tottenham Bluecoats event 29th October 2019. (Photo courtesy of Women in Tottenham.)

Figure 28. The puppeteers Signal La G*'s* Movemes. (Screenshot: Lucy Childs 2019.)



In *my* digital puppetry practice, the ability to perform the exact movements the puppet makes is not necessary: instead, I need to link them to images in my mind. This approach is similar to that espoused by Decroux (2009, p. 143), who declares that an actor's work is to imagine what does not exist.

6.5 Grotowski's Body Mapping Exercise

Throughout his career, Grotowski explored the idea of the aforementioned "via negativa". For Grotowski, once the body and the mind have been trained using the "via negativa", which he describes as "not a collection of skills but an eradication of blocks", then even the body

disappears, and only the energy of the actor in the purest sense remains: “The body vanishes, burns and the spectator sees only a series of visible impulses” (1969, p.16).

Slowiak describes Grotowski’s view on psychophysical blocks in actors as a division that is both divisive, and a hindrance to their practice:

> “Grotowski understood that actors have many blocks, not only physical blocks, but also in terms of their attitude toward their own bodies. Being ashamed of your body or narcissistic toward it both indicate a lack of acceptance of your body. You divide yourself into "me" and "my body" and this attitude creates a feeling of insecurity, a lack of trust in the body, and, therefore, a lack of trust in oneself. By spending time mapping the body and awaking an active attention, the actor begins to know her body and accept herself.” (Slowiak 2018, p. 123).

Grotowski believed that a discrepancy between an actor’s idea of themselves and the reality is detrimental to their performance:

> “Very often the imagination we have of our bodies has little to do with the reality of our anatomy. These misconceptions can create physical habits that prevent us from maintaining "a state of idle readiness, a passive availability, which makes possible an active acting score" (2002, p. 37).

Digital puppets are immune to this kind of physical block, and, as digital puppeteers, we need not feel ashamed or narcissistic about our puppet-bodies; we did not build them, and therefore don’t suffer the same insecurities. A digital puppet is in a state of “passive availability”. However, trust does need to be developed between puppet and puppeteer, and it takes the form of confidence in the performance:

> "Not trusting your body means not having confidence in yourself: to be divided. Not to be divided: is not just the actor's seed of creativity, but is also the seed of life, of the possible whole" (Slowiak 2018, p.124).

In Grotowski’s approach, an actor becomes a laboratory tool with which to carry out experiments; the actor’s exaggerated persona becomes subordinate to the core creative idea. In digital puppetry, the puppeteer’s body disappears, while the puppet’s body is fully present when it is animated by manipulation energy; when, to paraphrase Grotowski, *only the energy of the puppeteer in the purest sense remains*.

As part of the familiarisation process with La G, del Ponte and I undertook exercises based on Grotowski's Body Mapping Exercise, as described by Slowiak (2018, p.123). Slowiak explains the theory that underpins the exercises thus:

> "To overcome the resistances, the so-called psychophysical blocks, present in our bodies today requires a different strategy. The individual's relationship with the body has changed; the predominance of machines, computers, and an image-saturated media in twenty-first century lives creates its own plethora of psychophysical blocks. Therefore, in our workshops we begin "to get to know the body" and awake an active attention with exercises in Body Mapping and yoga stretches" (Slowiak 2018, p.122).

The questions the puppeteers ask themselves, and the La G puppet herself, are a digital puppetry version of Grotowski's questions: "Begin by asking participants some basic questions about their bodies" (Slowiak 2018, p. 123). The original questions relating to a human performer, and the reinterpreted versions used by the digital puppeteers, are shown in Figure 29.

"Where is the middle of your body? If all your flesh were stripped away and all that remained was the skeleton and we folded the skeleton in half, where would the bend occur? The answer is at the hip joint, but many people think the halfway point is the waist or navel area, or the sternum, or the pelvic bones. A wrong answer clearly indicates how separated the person is from the reality of her body. It can also demonstrate the seat of excess tensions in the body or other chronic physiological problems. Further questions can be developed to continue the mapping session":	Where is the middle of La G's body? If all her flesh were stripped away and all that remained was the skeleton and we folded the skeleton in half, where would the bend occur?
"Where is the top of your spine? Where is the bottom of your spine? Where is the hip joint, the knee joint, the ankle joint? Not in general, but precisely where does the articulation occur? If the fingers are one end of the arm structure, where is the other end? (Hint: the answer here is not the shoulder.) Where are the lungs located? How high up or how low do they go?"	Where is the top of your spine? Where is the bottom of your spine? Where is the hip joint, the knee joint, the ankle joint? Not in general, but precisely where does the articulation occur? If the fingers are one end of the arm structure, where is the other end? (Hint: the answer here is not the shoulder.) Where are the lungs located? How high up or how low do they go?

“How much does your head weigh?”	How much does La G’s head weigh?

Figure 29. La G’s warm-up exercises based on Grotowski/Slowiak’s Body Mapping Exercise (2018, p.123).

When del Ponte and I systematically go through La G’s moveme palette, we are unblocking our bodies. La G’s body is easier to unblock for two reasons: ~~because of~~ the actuation mechanisms and the amplification of the movemes. Digital puppets are not dramatically trained; they do not undergo an extended period of acculturation, nor do they require any fitness training. Having no personal psychology, a digital puppet – in the same way as a physical puppet – has no psychological blocks to overcome; the “via negativa” is not applicable to them in the same way as it is to a human actor. However, it *is* applicable to the combination of puppeteer and rigging that constitutes La G. As we prepare to perform with La G, del Ponte and I test the motion of the limbs. The vocabulary, originating in the limitations of the number of controls that can be operated by our four hands and two voices, means that the performable limb-motion consists of four movemes. This preparatory period is a negotiation surrounding the our psycho-physical blocks, which clog the mechanism of impetus and response; we become at one with the puppet and each other (See Figure 30).

Live lip-synching works well for pre-recorded songs, as the puppeteer can rehearse and become familiar with the performance, as is the case with La G. While not exact, the phoneme vocabulary gives an overall impression of synchronised speech patterns.

In my practice I place my focus within the puppet, but I also see her looking at me. I see La G, and she sees me. I let her see me and she returns my gaze. We pay attention to one another. I see La G as part of me, and I am part of her. She can do things I can’t do, and vice versa, meaning that we have a mutual admiration for one another. Staying in the moment, listening, watching, saying “yes” to whatever happens, not stopping, simply continuing to react to her movements, *is* the performance.

Figure 30. An account of the beginning of the performance from the perspective of the first puppeteer: myself. This is my preparation and mind's eye view:

1. Embodiment. La G's psycho-physical technique originates in her puppeteers, who start the performance by executing the movemes that the digital puppet will use. As one of the puppeteers, I am putting myself in the puppet's shoes: I am La G. and she is me. We simultaneously inhabit the same bodies, my physical body and the software body, a state of being that Astles describes thus: "…this sense of the puppet as part of the puppeteer and not as a separate element. The process of energy-transfer is at the heart of puppet theatre. The union of breath and movement is the factor linking the source and expression of the energy. Training the puppeteer is thus to train a bodily awareness of the breath as impulse to the movement, which in turn suggests life" (2009, p.58).
2. Dead point. We walk to the stools that we sit on to operate La G, and sit down; we are entering a state of mind of puppetry-improvisation-readiness (Meschke 1988, p.54).
3. Life-signs. The soundscape starts with audio signs of life: breathing, throat-clearing, heartbeat.
4. Movement. We start to manipulate La G by eye-blinking; movements in her neck and torso change the angles in her stance. (La G is not rigged to locomote; she stands on the spot.)
5. La G starts to sing and move to the music.

6.6 Improvisation: Devising the Movement Sequences for *Control Freak*

No storyboard was used for the *Control Freak* devising process. The soundscape was decided on and assembled first, and then experimental rehearsals took place, which entailed a process of familiarisation with the soundscape elements and the moveme palette. This process allowed the puppeteers to choose the speed and frequency of the use of the movemes, the rhythms set up by that use and, where applicable, the extent of the actuation; it is at this point that signature movements emerged. Basic principles of improvisation were used to devise choreographed sequences for the *Control Freak* piece. RIA and ROA throughout repeated takes enable both the identification of movement sequences which are to be retained, and those in which movements could be improvised. The timings of sections of action are defined by the soundscape, and certain milestones must therefore be hit, but within this framework, movement sequences are extemporised, and no two performances are exactly alike. Different versions of each digital puppet performance demonstrate a variety of RIA responses, resulting in slightly different action sequences. During these processes, movemes can be

added, removed, and adjusted:

> "Practitioners do reflect on their knowing-in-practice. Sometimes, in the relative tranquillity of a post-mortem, they think back on a project they have undertaken" (Schön 1983, p.61).

According to Smith and Dean, the technique of referent improvisation:

> "…is one which is based on a pre-arranged structure, procedure, theme or objective which dictates some features of the work…It might be a pre-arranged succession of events … thematic referent [for instance] would take a particular subject as its starting point… The referent rarely suggests more than the simplest outline of the macro-level of the improvisation, and the improviser has virtually complete control of the micro-level, which then permits control of the macro level" (1997, pp. 29–3).

While in Lindh's approach:

> "'Variation and development' refer to the actor's ability to approach actions with a different dynamic every time they are performed. Lindh explains that when performers work on an action, they can leave it and shift to completely different performance material. In a context of mental precision, performers can then return to that action, approaching it from a completely different dynamic. The dynamic could be, among other options, a change in rhythm, a reduction in size of that action, or a different spatial configuration…Alternation means that one is able to enter at any moment in any part of one's material, interrupt the planned development, and invert its order" (Bugeja 2015, pp.13-14).

A palette or keyboard used in combination with "…referent improvisation", as described by Smith and Dean (1997, pp. 29–30), and a "flexible dynamics" approach such as Lindh's improvisation concept (Bugeja 2015, pp.13-14) of "variation and development" – also known as "alternation" – results in a creatively conducive improvisation environment. This is how the GLOPPID method works, with the HDPI facilitating an iterative feedback loop in which modifications and variations are made, according to feedback from – and interaction with – puppet and puppeteer collaborators, who are in a state of "mental precision", described by Bugeja as:

> "a kind of mindfulness meditation process in which the performers nurture a heightened awareness of what is arising within them (i.e., their mental processes and the resultant physicality) and outside of them" (Bugeja 2015, p.10).

Rather than directionless, so-called “dolly-waggling” (Myhrum 2015, p.16j), there is intentionality and precision in the actions, occurring in the same way that Lindh describes in his human-based work:

> “It can be a musical phrase, a physical phrase – a series of physical movements – or a dynamo-rhythmical, literary, melodic, or vocal phrase. It is always an action that has a beginning, a development with a precise direction, and an end. A precise action is always a vehicle of sense” (Lindh 1998, pp. 99–100).

My approach to each improvisation is marked by reference points. My own body is not trained for flexibility, athleticism, or endurance; it is trained for vigilance, and I rely on the precision found within the movemes to enable to act as the “vehicles of sense” (Lindh 1998, pp. 99–100). According to Burrows, “Improvisation is a negotiation with the patterns your body is thinking” (Burrows 2010, p.27). This is paralleled in the GLOPPID method in that the patterns which both the puppets’ *and* the performers’ bodies are thinking are generated as a result of a collaboration between the puppet, the puppeteer *and* the performer herself. This is a three-way feedback mechanism, within which the puppeteer channels a portion of the patterns into the body of the puppet. The puppeteer re-positions their core in relation to that of the puppet. Yet another level, in the form of an asymmetrical component, is enabled by weighting the visimes differently on either side.

Figure 30. The digital puppet Halogen Hobbs projected onto a performing human body, from the live performance piece *Control Freak* (Childs & del Ponte 2019).

6.7 Face Jazz: The Mimetics of The Face and Improvising with Visimes

Much of my work in *Teknokolor, Housewatch, DJ 01*, and parts of *Control Freak* are sonically-inspired experiments with a digital puppet's facial features. These experiments explore the micro level in order to construct the puppet's ur-narrative. The pieces use music and sound, but not speech, to drive and inform the facial puppetry. Extemporising around a theme and a soundtrack, combined with the use of a limited moveme vocabulary, provides a framework within which there is a freedom to make patterns and rhythms. These limited moveme vocabularies are composed of movements associated with both the micro and macro narratives, and at any given instant the micro – in the form of the ur-narrative identified by Jones and Posner – can be prioritised over the macro, and vice versa.

> "Jones suggests that it is the interweaving of a puppet's macro movement and micromovement that produces what I call visual narrative and visual ur-narrative. For him, macro-movement "engages with the script and the choreography," while micromovement – moments of stillness or breathing – is "a performance of the ur-narrative" (Posner 2014, p.339).

The exact details of the performance depend on the feedback loop between the performer, the performed-object and the audience, in which RIA takes place. This part of the process corresponds to Bugeja's understanding of Lindh's improvisational practice, in which she understands "…mental processes as embodied phenomena in a process where they are both triggering a performer's work and also being informed by it" (Bugeja 2015, p.4). Halogen Hobbs's set of facial controls is a restricted moveme and visime palette, with which I extemporise and riff in a similar way to, for example, a jazz or flamenco musician (*Control Freak*, 2019). In these performances I am both operating and watching the puppet, and I am, as Westecott (2009, p.1) observes – speaking with regard to computer gameplay – simultaneously an audience member and a performer.

Housewatch 01 & 02 and *DJ 01* are rear-projected onto a first-floor window of my house in North London, and also onto my white van outside the house; as night falls, the projection becomes more visible. This work could be performed after dark anywhere with windows and/or a parking space.

Figure 31. *Housewatch* (Childs 2018).

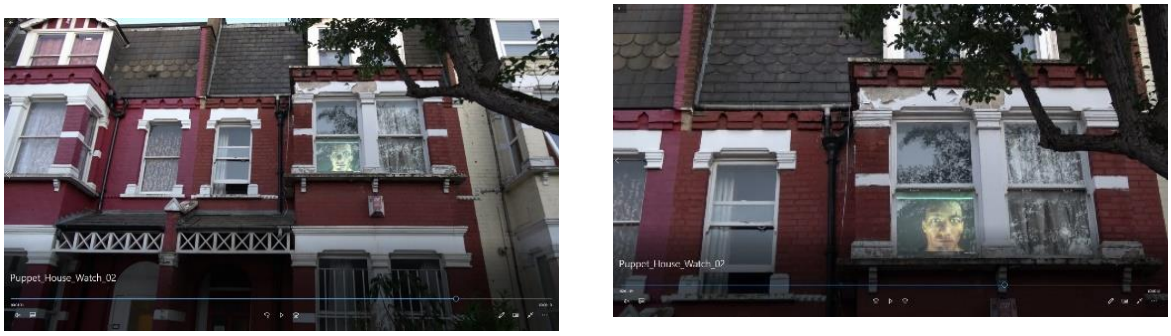


Figure 32. Housewatch 02. Expression puppeteering of the Halogen Hobbs character (Childs 2018).

Nuke Your Clothes and *Flowering Pools* are pieces performed to their eponymous songs by the Menopause Army Band. The core creative idea behind these pieces is that Hobbs is a groupie and fan of the band, and the motivation for his movements comes from his appreciation of the music. Hobbs is used in performances with and for the band; either operated in real time or in a pre-recorded format.

6.7.1 The Rigging Set-up

As shown in Table 6, Halogen Hobbs has an alphabet of twenty-six facial movemes and visimes – he does not speak. His visime palette includes controls for blinking, smiling, opening and closing the mouth, eyebrow-raising, and assorted asymmetrical facial feature morphs. His moveme palette includes controls for head rotation and tilting, while the nodding movement of his head is controlled by a gaming accelerator foot-pedal, and the shaking movement by a joystick. Most of his visimes, including the eye-rolls and mouth open/closed morphs, are keyboard-operated. My aim is to make operations with just two hands as simple as possible, and several phases of try-out and revision take place at this point in the process, where I arrange and re-arrange controls. Because of their accessibility, joystick buttons one and two are designated as prioritised movement controllers, and in the case of Halogen Hobbs, these are used for controlling the actions I choose to use most frequently, which are the blink and smile functions. For the same reason, the keyboard arrow keys are mapped to the eye movements in both eyes. The system is not polyphonic, meaning that it is only capable of the simultaneous operation of up to three movemes and visimes, but this is enough to achieve a variety of expressions if required (see Figure 33). Visimes such as the widening of the eyes, the snarl, pout, and upper/lower left/right mouth controls facilitate such expression-making. Controller operation is highly responsive, making fast changes of expression possible.

Puppet: Halogen Hobbs	
Controller:	**Moveme/visime:**
Foot pedals x2	**Head-nod**
Joystick:	
twist	**Head-shake**
1	**Blink**
2	**Smile**
3	**Nostrils in**
4	**Bottom lip down, show teeth**
5	**Eyes wide**
6	**Pucker**
7	**Upper lip area down**
8	**Snarl**
Keyboard:	
1	**Mouth left (upper)**
2	**Mouth right (upper)**
3	**Mouth left (lower)**
4	**Mouth right (lower)**

5	**Mouth pout**
6	**Mouth lips tighten**
7	**Phoneme D, T**
8	**Mouth open**
9	**Mouth wide open**
HOME	**Brows sad**
PgUp	**Brows up**
PgDn	**Mouth corners down**
Arrow L	**Eyes left**
Arrow R	**Eyes right**
Arrow U	**Eyes up**
Arrow D	**Eyes down**

Table 5. The puppetry controls for Halogen Hobbs in *Control Freak* (Childs 2019).

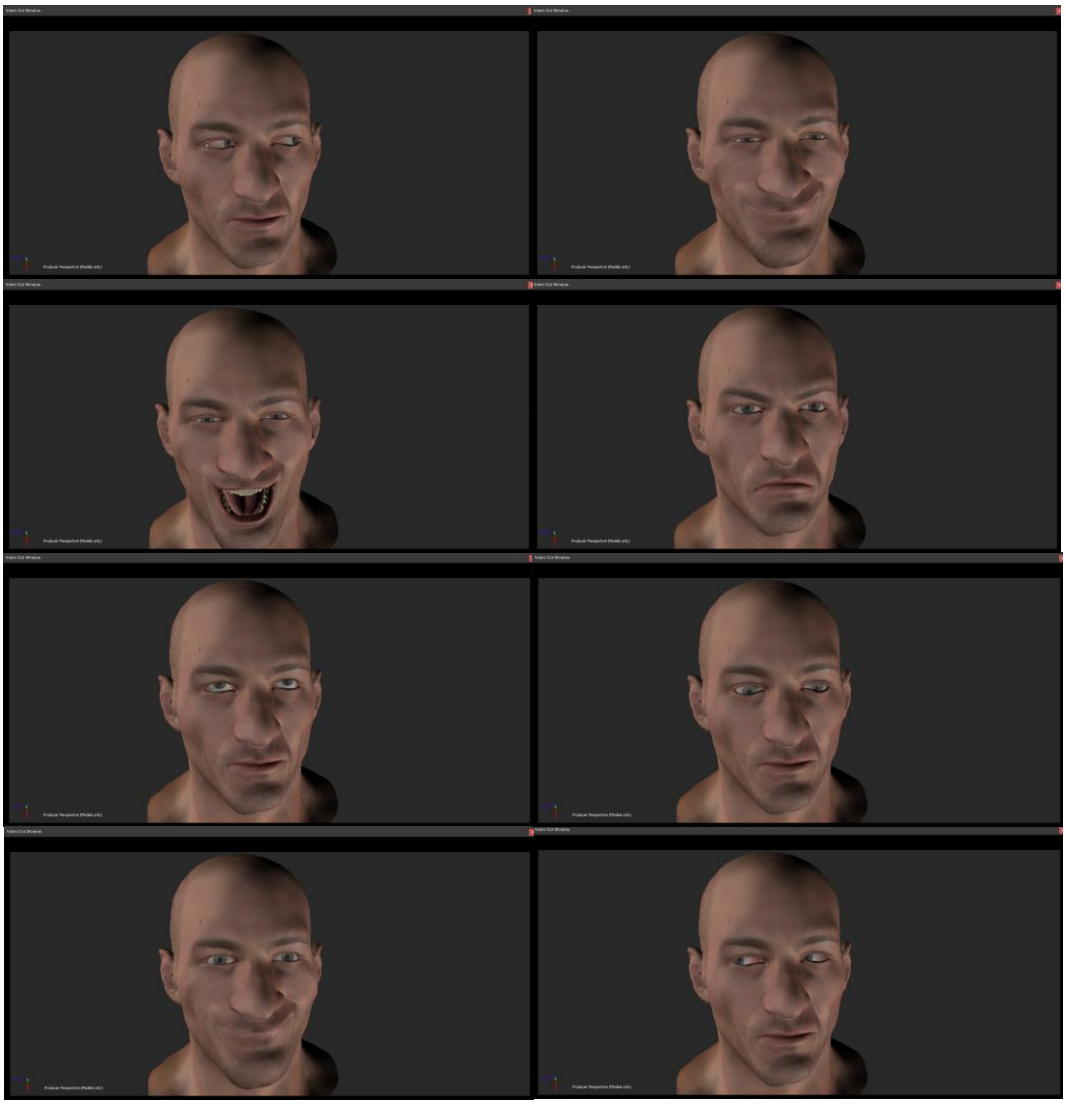


Figure 33. A selection of Halogen Hobbs's facial movemes and visimes ('Victor' CG model by Faceware Tech.; screenshots by Childs 2018).

6.8 Diderot And the Actor's Face

In all the musically-stimulated pieces, including *Teknokolor* and *Control Freak,* Halogen Hobbs' performances are influenced by Diderot's late nineteenth-century evaluation of technique in the actor David Garrick:

> "Garrick will put his head between two folding- doors, and in the courfe of five or fix feconds his expreffion will change fucceflively from wild delight to temperate pleafure, from this to tranquillity, from tranquillity to furprife, from furprife to blank aftonifh- ment, from that to forrow, from forrow to the air of one overwhelmed, from that to fright, from fright to horror, from horror to defpair, and thence he will go up again to the point from which he ftarted. Can his foul have experienced all thefe feelings, and played this kind of fcale in concert with his face? I don't believe it; nor do you" (Diderot 1883, p.67).

From his account, it is evident that Diderot does not believe that Garrick actually *feels* the emotions his facial expressions demonstrate, and need not himself be moved in order to move an audience. As Kemp points out in his analysis of Diderot's reaction to the Garrick phenomenon, human actors use physical technique to create the illusion of emotion:

> "Puzzling over the issue of whether the actor has to be moved in order to move an audience, Diderot described seeing the famous English actor David Garrick do a party trick in which he rapidly altered his facial expression to convey a wide range of emotions: 'Can his soul have experienced all these feelings, and played this kind of scale in concert with his face? I don't believe it, nor do you.' Diderot defined the two possible approaches available to an actor as 'sensibility' (the capacity to feel 'genuine' emotion), or the use of technique (the conscious control of the musculature of expression). Although Garrick himself considered that he used a combination of both, Diderot decided that it must be the case that the actor uses physical technique to affect an audience. Although much of Diderot's analysis was prescient when viewed in the context of cognitive science, the conceptual division of 'internal' and 'external' approaches to actor" (Diderot 1883, p.67; Kemp 2012, p.2).

Diderot's account identifies a disjunct between Garrick's soul and face which shows how an actor in full command of his facial muscles can create the illusion that he experiences a whole spectrum of emotional states within five or six seconds, ranging from wild delight, temperate pleasure, tranquillity, surprise, blank astonishment, sorrow, and fright, through to horror and despair. In describing Garrick's performance in these terms: "… played this kind of scale in concert with his face", Diderot's description suggests that he sees the range of expressions as

a visime palette, and that Garrick plays his face like a musical instrument. Decroux (Leabhart and Chamberlain 2009, p.5) views the body as a keyboard, while Laban (Bradley 2009, p.30) sees the body as an artist's palette, and both these perspectives give an insight into how improvisation works with moveme and visime palettes. In an improvisational framework something is fixed; in music, this may be the key or the rhythm or both. In the GLOPPID method, the movemes and visimes are the notes, and in the same way that a musician extemporises by using notes in a certain key, I can improvise using the movemes in the selective palette. The mechanism by which Halogen Hobbs emotes is predicated upon simple changes in his visimes and movemes, in a process that can be likened to the application of physical technique by an actor puppeteering herself (a human-actor-as-puppet), in accordance with Bloch's analysis that in an actor:

> "… each basic emotion can be evoked by a particular configuration composed of: (1) a breathing pattern, characterized by amplitude and frequency modulation; (2) a muscular activation characterized by a set of contracting and/or relaxing groups of muscles, defined in a particular posture; (3) a facial expression or mimicry characterized by the activation of different facial muscle patterns" (Kemp 2012, p.184).

If an emotion is conveyed using a combination of breath, posture or pose, and a facial expression, this can be used to create a formula for achieving the desired result in digital puppetry, animation, human dramatic activity, and robotics. Hirata's work simulates agency in robots by attention to the micro-narrative, using pacing, rhythm, cadence in speech, and movement:

> "His unique directorial method is not based on any notion of interiority or quest for a character's motivation. Instead, his hyper-realistic style is created out of a multitude of formal elements of closely observed human behaviour: gestures and speeches modulated by precise calibrations of movement and timbre, volume, and pause of speech. Hirata has said that by carefully calibrating the pacing of dialogue he could create the eerie sensation of consciousness and agency in his automata" (Poulton 2014, p.283).

This exploits the tendency for audiences to read moods and emotions into faces, regardless of motivational impulse. In other words, technique creates an illusion of mood and emotion because of the suggestibility of humans – there is no need to embark on a quest for a character's motivation, inner thoughts, or mental associations. Poulton (2014, p. 283) quotes Hirata Ishiguro, who states:

> **“**I believe that in theatre there is fundamentally no difference between a human and a robot”.

This has implications for the quest for life and intelligence in digital puppets, and, in fact, physical technique – in the form of activation of the visimes and movemes – is not all that is happening in face jazz; what I refer to as *puppet noise* also forms part of the ur-narrative. Poulton refers to Hirata’s concept of noise and its place in the relationship between order and chaos, where noise is unpredictable and unprogrammable:

> “The fundamental difference between a machine and a human being, he suggests, is the presence in the human of “noise” (yuragi), the term used in electronics to contrast with “signal”– that is, order. Perhaps the element of chaos – what cannot be predicted or programmed – is what makes us human after all” (2014, p.287).

The technique of digital puppetry allows changes to can be made much more quickly than in a tangible medium. For example, I can activate Hobbs’ features in rhythmic patterns by using my fingers with great speed, intensity and precision, making it possible to mimic the altered states of the ecstatic crowd in a techno-music club. This is demonstrated in the site-specific piece *Teknokolor* (del Ponte), where I discovered what I call *face-jazz*. These projection performances take place at regular techno-music events, and involve the live manipulation of virtual puppet heads – and their faces – to music I have not previously heard. Techno music conforms to a formula in which layers of sound are built up and broken down, with features such as the ‘break’ and the ‘kick’ occurring in strict relation to the number of beats per minute. The highly-structured nature of techno music, where the DJ’s performance is concerned with reading and manipulating the energy levels in the dancers, means that it is possible for a digital puppeteer working live to predict the rhythms and phrasing, and contribute to the narrative of the occasion. During these performances I am not hidden, and I zoom in and out of the frame in order to show the heads both as a mesh and in shaded model view, in a deliberate attempt to make the technology visible.

The pieces undertaken at the Teknokolor events use movements of the facial features, not necessarily intended to create specific facial expressions. The features are designed to move more quickly, and in different combinations than they would naturally, with the aim of creating a sense of excitement and exhilaration both disconcerting and extraordinary. This mimicry of the crowd’s faces makes it possible to see the event from a satirical perspective.

The ur-narrative (containing signs denoting life), and its deconstruction, is given primacy by placing the emphasis on the facial features themselves, rather than on expressions. This has the effect of changing the emphasis of the improvisation, moving it away from the actual choice of visimes and movemes, and towards the rhythm and cadence of the sequence as a whole. This shifting of weight is discernible in the test improvisations carried out for Hobbs' part in *Control Freak* (see HHCF 01 and 02). The flamenco guitarist Paco Peña describes a similar phenomenon when he plays, as shifting the weight and direction of a piece:

> "… I don't consider improvisation only to play different notes within a piece. I also consider improvisation to change the weight of a piece from one place to another. Change the direction" (Bailey 1993, p16).

Mario Maya describes dancing flamenco as "a state of mind" dependent on high levels of skill and complete command of timing:

> "If you spoke to a musician, he would know the rhythmic structure so well that he could improvise on it. The rhythm is fixed …I think it means knowing the rhythms perfectly in this case flamenco rhythms and having total control over them being able to improvise. Improvisation is like duende … it's a state of mind. Improvisation is the soul of a person it's simply what you hear and do "at that moment" and for this you need powerful technique" (Bailey 1992).

This improvisational approach is advantageous in that not only can the performance be steered via changes of weight, but also in terms of silence and emptiness, in ways identified by Budde:

> "There are media like a jazz jam session, which McLuhan brings up in distinguishing between hot and cool media, that do leave a space — silences and emptiness — for cocreation and interaction between musicians and audience" (2019, p.109).

There are times when the rhythm and patterns are felt, and I do not need to look at the face. While using this model and watching the audience, I can react to their mood, leaving space for stillness, then suddenly sending the puppet off into paroxysms of motion, without having to monitor the puppet's every move.

6.9 The Results

The question 'Can the ur-narrative be mechanically *counterfeited*?' may remain unanswered.

Is this robot theatre? Is this mindless, in the sense meant by Kleist? Kleist's pro-puppetry argument takes the form of a conversation between the author and a dancer he has seen who is watching marionettes in the street perform "short dramatic burlesques interspersed with song and dance" (Kleist 1972, p.22). The dancer much admires the marionettes' pantomime, and the author endeavours to find out what is so engaging and interesting about their performances. The author asks how much understanding the dancer thinks the puppeteer needs in order to be able to carry out the performance required of a puppet:

> "I asked him whether he thought that the operator who controlled the puppets was himself a dancer, or at least had to have an understanding of what constitutes beauty in dance" (Kleist 1972, p.23).

… to which the dancer replies "when an undertaking, from its mechanical side, was easy, it still did not follow that it could be carried out with a complete absence of feeling". The author replies that "...the operator's work had been presented to me as somewhat rather mindless: similar to the turning of a handle to play a barrel organ" to which the dancer gives an answer which I feel encapsulates the mechanisms at play in algorithm-assisted digital puppetry:

> "Not at all, he answered. The movements of the operator's fingers relate to the movement of the puppets to which they are attached in rather a much more artful way, somewhat as numbers are attached to their logarithms or the asymptote to the hyperbola" (Kleist 1972, p.23).

This seems to suggest that there is skill required in the application of the right amount of power, its angle of application and its rhythm and cadence. However, after consideration, it turns out that the dancer changes his mind:

> "He had since come to believe that even this last fraction of spirit could be removed from the marionettes, that their dance could pass completely into the realm of mechanical forces, and could, by means of a handle, just as I had imagined, be reproduced" (Kleist 1972, p.23).

Halogen Hobbs is a digital model made of mathematically-determined virtual mesh. He feels nothing, and comes into existence as himself only once he has been rigged, named and related to as another being. His performances in these pieces are experiments with the

abstraction of emotions by means of facial features; he does not speak. There is a separation between changes in Hobbs' facial features and expressions, resulting in a performance that may or may not resemble emotion. While at times Hobbs appears to show signs of life indicative of the ur-narrative, at other times technique is uppermost, and his face is simply a rapidly-changing canvas, sometimes showing a gamut of emotions, and sometimes resembling a robot testing its features. Emotions are produced by accident, rather than intentionally, because of the coincidental activation of a set of features corresponding to recognisable facial expression and any associated emotion.

In this chapter I give insights on what is happening when I am operating the digital puppets. This involves determining at what point they come to life, what causes them to *stay* alive, and how this is linked to the ur-narrative – in addition to identifying when they show intelligence. For me, working with digital puppets is akin to working with robots, with tangible puppets and with actors who are viewed as puppets. The quest for life and intelligence in digital puppets is a search for duende, achieved – at least in part – by paying special attention to the ur-narrative and puppet noise.

I have found that there are two main components in the quest for life and intelligence in digital puppets: signal and noise. For me, signal means the signs of life and thought that are deliberately delivered, and noise means the collection of micro movements and indicators. These components combine to create an overall 'atmosphere' of a living, thinking being. Both signal and noise can be found in what Vougioukas, Petridis, & Pantic refer to as, "hand crafted intermediate features" (2019, p.1398), which are not fully automated but *performed*: they bear the mark of human intervention. These interventions give the models patterns and rhythms of movement that are recognisably human in origin. They are composed using asymmetry and non-mathematically-generated randomness that create attributes such as the unpredictable contrasts of rhythm, and the number of eye-blinks not found in exclusively AGI-driven HCIs. This is what I use to build the sense not only of life, but also of emotion, in the puppets, and it contributes to their ur-narrative.

I took the concept of puppet noise further in Oskar and Bruno, exaggerating these properties to produce a twitchiness that signals the presence of nerves, and suggests neuroses and anxieties. A sense of agency is created in Oskar and Bruno by means of multiple asymmetrically-weighted visimes, controlled by real-time automated voice-recognition

devices, linked via mathematical operators to left and right facial movemes. In the piece *History of the Theatre*, Oskar and Bruno converse using text taken from Schlemmer's "Man and Art Figure" (1929) and Preston's "Modernism's Dancing Marionettes" (2014). Prior to the performance, I chose and highlighted segments of text based on their relevance to the pro-puppetry thesis underpinning this research. I briefed del Ponte before the performance that we should take turns to recite segments of text and see what happens. Del Ponte had only a short period of familiarisation with the puppet controls before we began the improvisation.

Bruno
The Body Movemes.
The arms rotate at the shoulder in opposite directions. The head rotates forwards and backwards in the z axis. The eyes move left to right in the x axis. The whole body rotates about the y axis.
The facial feature visimes linked to automated voice recognition.
AE AA - R NECK TENSION 80%, L NECK TENSION 100%, CHEW 20%, R NOSTRIL 60%, L NOSTRIL 100%, R EYE CLOSE 50%
AO – LLOW LID 100% L BROW UP 100% R BROW DOWN 100%
AX - L EYE CLOSE 100%
FV - L SQUINT 100%
G - L EYE CLOSE 100%, R EYE CLOSE 100%
IY – R SMILE OPEN 100%, MOUTH OPEN 50%, L LOWER BROW UP 100%
KG – R LIP DOWN 100%
L - MOUTH OPEN 60%, L EYE CLOSE 100%, R EYE CLOSE 100%.
N - L EYE CLOSE 100%, R EYE CLOSE 100%.
PB - R EYE CLOSE 100%.
UW – KISS 100%, R BLOW 100%, L BLOW 100%, L SAD 100%.

Oskar
The Body Movemes.
The arms rotate at the shoulder in opposite directions. The body moves asymmetrically in a stiff lurch down and to his left. The head rotates about y, asymmetrical nod.
The facial feature visimes linked to automated voice recognition.
AE – R SMILE CLOSE 100%, CHIN 100%, R EYE CLOSE 70%, L EYE CLOSE 100%, L NECK TENSION 100%, R NOSTRIL 100%, L SQUINT 50%, R LOWER LID 80%,
AO - CHIN 10 0%, R NOSTRIL 100%, R EYE CLOSE 70%, L EYE CLOSE 100%, L BROW UP 80%, R BROW DOWN 100%, RR BROW DOWN 100%
AX - RR BROW UP 100%, L BROW UP 100%,
B – CHIN 100%, GLOTIS 100%.

FV - L BROW UP 100%, LL BROW UP 100%,
IY - R SMILE OPEN 100%, L SMILE OPEN 100%,
KG - L SQUINT 100%
OW – GLOTIS 100%, L NOSTRIL 100%, RPITYFUL 100%,
TD – GLOTIS 100%, L NECK TENSION 80%,
UH – L EYE OPEN

Table 6. Oskar and Bruno movemes and visimes (Childs 2019).

Through the application of GLOPPID, I show that ur-narrative is a combination of psycho-physical technique, accidentally produced meaning, manipulation energy, puppet noise, duende and intentionality. I did not build Hobbs; I rigged him, and I manipulate him. Hobbs may be a character, even before he is set in motion, at which point the technique and energy that animates him in performance affect the aesthetics and generation of meaning in his form, but it is predominantly manipulation energy and movement that determine his demeanour. I class Halogen Hobbs as an über-marionette, or as a Kunstfigur; part of Schlemmer's predicted "Mechanical, Automatic and Electric Theatre" (1932, p.29) and part of the post-humanist continuum. In *Control Freak* he is projected onto del Ponte's naked body, as shown in Figure 34, where he interacts with her moves by continually emoting; he constructs his own ur-narrative, in addition to a narrative about the physical and the digital. The effect of Halogen Hobbs having a persona may be achieved by the timing of his facial expressions alone, but as the performance progresses he also *takes on a life of his own*.

Figure 34. *Halogen* interacts with del Ponte's naked body (Photo: RedandBlackRose).

6.10 The HITL in Face Jazz

In face jazz, instead of precision, analysis, and highly-choreographed use of movemes, I flood the puppet with micro-movements, refining the results through rhythm, holds, moveme motifs, and patterning, in the way an improvising musician uses rhythm, silences, and repeated phrases in jazz, flamenco or freestyling. This is a way of mimicking the "noise" that is present in the human; the aforementioned "element of chaos" identified by Poulton (2014, p.287) that makes the human, human, and which is paralleled by the ur-narrative of the puppet. The Stimulation-Impulse-Action-Contact process is not random or automated, but is a response that bears the impression of the hand of a puppeteer; it has intentionality. This is the puppet noise, which shows not only signs of life, but also of intelligence. What humans do best is more expressive, because of the variety in terms of changes of rhythm. This is *putting the human back in the loop*; it is adding the chaotic element that even a random algorithm cannot achieve, but which supplies credibility.

6.11 Three Techniques

Evidence in support of the pro-digital-puppetry thesis in live facial-animation production can be seen through a comparison between the properties of three different techniques, applied to the same CG model face. If the Halogen Hobbs character is driven by real-time human-markerless motion capture using a camera, the movements of the puppet correspond to the movements of the face (Faceware Live 2.0 2014, 4'). In the animated version of the same head model, as seen in the *Kellogg Happiness Speech*, the lip-synch is more precise (Burns 2016). In the puppeteered version of the same head model, as seen in *House Watch 01 & 02* (Childs 2020), the face appears more alive and dynamic because the movemes – the segments of movement trajectory – travel further and show greater change, thus making the expressions more extreme**.** This is the effect I am aiming for in my work: puppetness. The puppets' expressivity is, in part, determined by the constraints imposed by the number and extent of operations that can be carried out by the hands of one person who is interfaced with the software/hardware. The mediating effect arises from the choices and speed occurring at the intersection between puppeteer and puppet. It is not possible to perform face jazz with human actors in the same way as with a digital puppet. Direct mapping of a human face to a puppet face, as in facial motion capture, cannot be classed as puppetry; were I to use my own face to drive the motion of Hobbs' face, the motion would be humanlike instead of puppetlike,

because motion capture removes the mediating element supplied by channelling via DIDs. Likewise, the performance in automated speech-driven facial animation lacks the exaggeration and extreme poses produced by hand-rigged and operated DIDs.

The relationship between digital puppeteer and puppet is a combination of mechanics, psycho-physical technique, ur-narrative, and the belief that the puppet is alive. La G and Halogen Hobbs are symbolic forms – reflections thrown onto the screen – that have the appearance of life, but are something else; they are not literal reproductions and interpretations, but metaphors and mirrors. It could be said that there is a mismatch between La G's CG appearance and her puppet-like moves and inaccurate lip-synch, but, for me, her movement is the dominant part of her persona; it 'changes' her, and contributes to the sense of playfulness and mischief that makes her an engaging collaborator. The visime improvisations made using the GLOPPID method are an attempt to subvert the typical, literal approach of CG-animated performance.

In digital puppetry, the tension intention manifests differently to that of the actor, because psycho-physical digital puppetry technique links directly with the puppet's code. For example, the rigging choices determining the way La G moves are simple, and her actuations are amplified so that small motions activate large movements.

No matter how much they train, human performers can never escape the limitations of their anatomies; their movement can only be stylised within the constraints of their physiques. Meanwhile, La G, who suffers no psychological block of self-consciousness, ego or past, is free to express herself. Digital puppets have no physical constraints, need neither oxygen nor nutrition, and have limitless energy. Puppet and cartoon anatomies, digital or not, share a scope for expressivity not available in the human body. This expressivity is an ideal attribute where the aim is to perform dramatically unrealistic, but credible, actions. In motion capture, the limbs are constrained to their realistic maximum rotations; in my work, the limbs can go much further, and so can my performances.

7 Chapter Seven. Dialogues with Digital Puppetry Matter

> "The good moral work of art should have all the qualities that a good amoral work of art should have, such as formal unity, balance, contrast, and a sensitivity to the material out of which it is made" Norman McLaren.

7.1 Chapter Outline

This chapter looks at the materiality of digital puppetry, by means of a discussion of the connections between digital animism, manipulation energy, digital alchemy and the "resonance theory of consciousness" (Hunt and Schooler, 2019). It examines the relationship between the puppeteer and the puppet as one of demiurge to digital prima materia, using parallels found in stop-frame animation practice and theory to inform my digital puppetry practice. The aim is to investigate how digital animism and the inner life of code contribute to the ur-narrative in this quest.

7.2 Digital Matter, Animism, and Prima Materia

McLaren's observation – quoted at the beginning of this chapter – encapsulates ideas central to my digital puppetry practice. The relationship between actor-puppeteers and the digital puppets they operate involves a dialogue between the puppeteers and the material from which the puppets are made: the code. The ur-narrative of a digital puppet derives, in part, from the puppeteer's belief in the inherent liveness of the material from which the puppet is made. As a puppeteer, I believe in the life of the puppet and also in the life present in its raw materials – its prima materia (a formless primeval substance regarded as the original material of the universe). These co-beliefs result both in and from the idea that a puppet has a life of its own. Digital puppetry work requires a rethinking of the meaning of the matter that deals with digital data and energy, while maintaining a sense of the formal unity, balance, and contrast to which Mclaren refers.

Animism is a belief in the inner life of objects – a concept that is on the one hand, comforting and on the other, frightening. As a puppeteer, my dialogue with digital material involves digital animism – a belief in the autonomy and even consciousness of the puppets' *digitalia*; this is closely related to the techno-animism present in Japanese culture. For me, digital puppetry provides a link between digital animism, alchemy, prima materia, and the resonance

theory of consciousness. Astles' account of the belief in the "life qualities" of matter in tangible puppetry can be extrapolated to included digital prima materia:

> "It can be seen as a more profound process of giving life not only through physical action but through the belief in the intrinsic life qualities held in matter and the transmission of this belief" (Astles 2009, p.58).

I need to have a belief in the life qualities within digital matter in order to work convincingly. In their review of the materiality of the digital, Bishop, Gansing and Parikka put forward the notion that a conventionally binary approach to analogue/digital and material/immaterial categorisations is outmoded, preferring the perspective that digital matter is so pervasive that it goes far beyond our perceived reality:

> "…we tend to stick to a traditional division between analogue and digital that usually boils down to the material and immaterial, tactile and impalpable, real-life object and projection. But … the materiality of the digital is not reducible to the screen, not to software, and not even to hardware. It is a massively distributed reality that in turn conditions our perceptual realities" (Bishop, Gansing and Parikka 2016).

Their implication is that matter is actually non-binary and fluid, and that there are no direct correlations between these seemingly opposite categories. In her proposed revision of the conventions regarding matter, Kozub identifies prima materia as the metaphysical medium connecting all matter, and identifies a tendency among artists to move freely between all categories of material:

> "The alchemic term **"prima materia"** refers to the metaphysical substance, which was said to connect everything in the cosmos. Pre-17th Century scientists looked for it to understand what the essential element of all things in the world is. Nowadays, having the digital along with physical, artists create works that play with our perception and senses. Moving back and forth from virtual to real, it's time to rethink the meaning of "matter" all over again" (Kozub 2017).

Dixon observes that digital artists are engaged in rethinking matter because their work requires them to move back and forth across conventional frontiers:

> "What fascinates digital artists is the ways in which their embodied existence is redefined in cyberspace. So, they use digital technology to examine the interaction between the physical and the virtual.... Digital design oscillates between the physical and the virtual, just as it oscillates between the reflective and the transparent" (Dixon 2007, p.216).

According to Franz, prima materia is: “the basic substance of the world in which lies God's secret of life and death” (Franz 1915, p.75). For me, digital prima materia is connective tissue or dark matter, and is affected by the energy waves that pass unimpeded through all matter. My own perspective is that digital puppets are made out of digital prima materia, and that therefore energy can pass through them as well. I see the physical and digital versions of the Boot-on-Stick stompers I use for Menopause Army music-band performances as an example of the ways my digital design work also oscillates between the physical and the virtual. The two versions of these boots are renditions of the same idea, shown in different mediums and used, in a literal sense, to reconcile the physical with the virtual. Physical versions of these boots are stomped either by members of the band or of the audience, and the digital versions are projected as they are stomped in real time during live events.

Figure 35. Physical and digital Boot-on-Stick stompers used for performances with and for the music band ‘Menopause Army’ stand at the porous boundaries between the digital and the physical (Childs 2019).

These stompers operate at the porous boundaries between the digital and the physical, and embody my own interest in the membrane between the physical-real and digital-virtual. The visual aesthetic of the two versions differs, but the unity of design remains intact, because the dominant aesthetic property – their motion – is the same; the characterisation is in the

stomping. As can be seen in Table 7, the virtual stompers are rigged for movement in three planes, using two joysticks per boot, thus enabling a similar kind of motion as is possible with the physical ones.

	Left Boot
Joystick One	
Twist (R)	Rotation in X
Forward/Back	Rotation in Y
Z	Translation in Y
Joystick Two	
Twist (R)	Translation in Z
	Translation in X

Table 7. Boot-on-Stick stomper controllers for the left boot (Childs 2019).

7.3 The Museum of Dark Matter (MoDM)

The *Museum of Dark Matter* (Childs, del Ponte, 2021) is a promotional piece made for Elisabetta del Ponte's original idea for a roaming gallery which exhibits work by the unseen, unshown artists who form ninety-nine percent of the art world (del Ponte 2021 p.1). Del Ponte was inspired by Gregory Sholette, whose work uses the concept of Dark Matter in that it "… borrows the metaphor of an unknown but ubiquitous stellar mass and applies it to the world of art and culture". In our digital puppetry piece, the Drone Pilot character – who consists of a head, torso, and arms, rigged for operation by two puppeteers – delivers a script written by del Ponte, which introduces the concept of the MoDM and invites participation in its inaugural exhibition. The core creative idea for the piece is that the message shown in the promotional film comes from somewhere within the dark matter itself. The awkwardness of the delivery is intentional. Although the character is highly illuminated, the sound is out of synch, and the footage is damaged and aged, making the message itself appear distant and difficult to decipher. This artwork demonstrates the advantages of digital puppetry in the sense that it was very quick to produce, taking del Ponte only twenty minutes to perform two takes of the script, add the effects and render the piece.

7.4 The Spirit Guide

Is there anybody there? (Childs 2021) is an interactive, part-scripted and part-improvised entertainment séance, in the tradition of the phantasmagoria shows which formed part of the illusion industry in the nineteenth century. This piece is a twenty-first century take on Johann Schröpfer's Leipzig coffee-shop shows; it replaces the magic lantern projections used by Schröpfer to "summon ghosts" (Camilletti 2017) with digital puppet projections. The performers include a medium, her assistant, and between two and four participants, all seated around a table. The medium summons the spirit guide, which is a digital puppet projected onto gauze above the table, secretly operated by one of the participants at the séance. This participant puppeteer has fake arms and hands, which lie on the tabletop while she operates the puppet via DIDs that are hidden under the table. The live operation of the spirit guide allows the medium to extemporise, according to the participants' questions and responses. The medium asks a participant with whom they would like to make contact, and sends the spirit guide to fetch the desired person. The spirit guide nods, shake his head, smiles, makes faces, utters groans and wails, but seldom – if ever – speaks intelligible words.

This piece uses technology that only became available to independent puppetry artists in the early twenty-first century. *Is there anybody there?* exploits the performative possibilities of live digital puppetry, and would not have the same effect if it were made entirely with tangible puppets or actors. It also offers opportunities for reflections on matter, digital matter, animating spirit and manipulation energy. It is an example of a contextually appropriate use of digital puppets in that it takes advantage of their ghostly, insubstantial strangeness by using them as representatives of the etheric body. Warner (2006, p.376) notes that "the virtual reality of the internet has forged a new narrative of spirits and spectres". This is a narrative to which – as ghostlike entities in 'the cloud', and, therefore, part of a massively distributed reality – discorporate digital puppets can make a valuable contribution. The casting of a digital puppet in the role of the spirit guide, an intermediary between the human medium and the human dead, acts as a metaphorical device that connects the physical-digital divide to that of the dead-yet-alive. The medium herself acts both literally and metaphorically as a conduit between the two worlds: those of the living and the dead and those of the animate and the inanimate. According to Mello's analysis (p.50) of trans-embodiment as a process of transference between live (animate) performers and puppet or material (inanimate) performers, each affect the other. My operation of the spirit guide is both an example of how my "embodied existence is redefined in cyberspace" (Dixon 2007, p.216), and also of how the process of transference affects both the puppet and me. In *Is there anybody there?* the

focus moves back and forth from virtual to real, in an oscillation that demonstrates my ability to occupy two worlds: I too am part of this theatre of spectres. The literal enlightenment of projection, where light is a medium for revealing beings, creates an interactive connection between the analogue DIDs and the digital character, in which the spirit guide becomes visible as photons, thus illuminating the relationship between matter and spirit.

O'Pray connects what he sees as a sense of soullessness in marionettes to the uncanny, which he paradoxically links to "residual animism":

> "The marionette, in theatre and animation, is an appropriately morbid and menacing figuration of the alienated being, at odds with the world and somehow soul-less, that one also finds in the writings of Kafka and Schulz or the films of the Quay Brothers This is partly due, no doubt, to the residual animism that Freud sees as one source of the uncanny - the projection of mental properties onto the world and its objects." (O'Pray 1989, p.260)

The soullessness of which O'Pray speaks reflects the dead-yet-alive quality projected by puppets causing the puppet to be seen to be alive.

> "Generally speaking, what we refer to as 'spirit' or 'soul' is a very vague concept, including things programmed into, or closely related to, the physical body, such as memory, the results of chemical reactions, etc" (Poulton 2014, p. 290).

Alchemy is a pseudoscience, regarded as the precursor to modern science, that combines chemical, magical and philosophical experimentation. It is a useful tool with which to explore themes such as the conscious and the unconscious, the physical body and the etheric body. Benayoun's observation, cited by Hammond, that "Anyone dealing with puppets in fact must be an alchemist" can, in my view, be expanded to include digital puppets, which share properties with the work of the Alchemists of the Surreal [8] (1987, p.63).

There is the notion that analogue film animation requires a knowledge of the basic process of frame-by-frame photography. Similarly, the life-giving urge, or the power of resurrection, necessitates a knowledge of the building-blocks of matter. Modified instances of a duplicated

[8] The term Alchemists of the Surreal was coined by Michael O'Pray and Archie Tait. The group's members are listed by O'Pray as: - Georges Melies, Joseph Cornell, Zbigniew Rybcznski, Walerian Borowczyk, Luis Bunuel, Jeff Keen, the Brothers Quay, Jean Painleve, David Lynch, Georges Franju, David Cronenberg, Peter Greenaway, Roger Corman, Roman Polanski, Harry Smith and Jan Svankmajer (1989, p.254).

CG model, known as blend shape deformations, are the building-blocks of digital puppetry, in the same way that frames are the building-blocks of analogue animated film. For me, there is a pleasing symmetry in the way that the spirit guide is brought to life by means of visimes that are made from blend shape deformations:

> "…a blend shape deformer blends or interpolates between variations of a geometric form, duplicates of the original model that have been modified using a variety of modelling techniques typically used for animating facial expressions and speech in characters" (Palamar, Keller 2011, p.293).

These "variations of a geometric form" are the prima materia of digital puppetry. An Alchemist of the Surreal is someone seeking to bring about a transformation *similar to* that sought in alchemy, in that they give the material world a sense of the fantastic. In my view, if applied to digital matter, O'Pray's description of the properties that define the Alchemists of the Surreal produces a parallel sense of the fantastic:

> "They are alchemists in the sense that they blend disparate materials in the service of fantasy; they endow the real, the very materiality of the world, its objects, surfaces and textures with an aura of strangeness and the fantastic" (O'Pray 1989, p.254)

It is my contention that, as animators in the broadest sense, digital puppeteers also blend disparate materials in the service of fantasy, in the same way that film animators do. Cardinal's perspective on the capacity of animated film to question accepted views of reality (echoing Kozub and North) could also apply to digital puppetry:

> "The animated film renders in irrefutable terms the implausible proposition that the realm of materiality is less static than is generally thought" (O'Pray 1987 p.4).

Boundaries blur; opposites attract, mingle, and merge. This confusion between realities takes the discussion back to the idea of rethinking matter; it breaks down preconceptions, and calls into question the viewer's sense of what is rational, challenging them to change their way of thinking. By ignoring the rules, and enabling substances and objects to either *do* or *be* the impossible, these animators challenge the viewer into believing the fantastic, to the point where, according to Field, matter is transformed:

> "Animation here becomes not simply a particular technique but a metaphysical process of transformation and creation" (1987, p.3).

Field's viewpoint correlates with the law of conservation of energy – that the total amount of energy in a system stays the same, even when matter is re-ordered, energy cannot be created or destroyed, it can only be transformed or transferred, nothing is annihilated, energy simply flows and relocates.

7.5 Demiurge

Digital puppetry practice (like animated film-making) begins with the demiurge – in Platonic philosophy, the Maker or Creator of the world, a subordinate deity who fashions the sensible world in the light of eternal ideas (Plato 1888, p.41) – and is a powerful human compulsion:

> "The fascination with puppets reaches far back into history, revealing our yearning to play god, to exert domination over our human experience" (Westecott 2009, p.1).

The bringing-to-life of inanimate objects implies knowledge of the secret of life and of alternative realities, suggesting power over life and death, and causing us to question our perception of reality. In saying that "most animators are, unconsciously probably, surrealists, or anyway people looking for the secrets of being and un-being", Benayoun (cited by Hammond 1987, p.63) corroborates the argument that animation – and, I would add, digital puppetry – is a way of altering our perception of reality in terms of matter, consciousness, and the concept of soul, or animating spirit. Stop-motion puppets and digital puppets present a different reality to the apparent everyday one, allowing them to convey eternal truths, or simply to pass metaphysical comment. As dead things deriving vitality from their puppeteers and viewers, puppets offer a different perspective on immortality; one that satisfies a human need. They bring the mystery of death closer to our comprehension – an idea echoed by Cardinal:

> "The animation of the lifeless is no absurdist caprice but a philosophical demonstration that what lies beyond our immediate reach can still acquire qualities of intimacy. We are not cut off: the natural sign is a communication, an act of contact" (1987, p.9).

There is reassurance in a belief in imagined life that makes spectators feel less alone, and less anxious at their ignorance concerning the mystery of death. Cardinal uses the example of a toy skeleton made for the Mexican festival 'Day of the Dead' to express this idea of proximity:

> "...the remote abstraction of dying is embodied and brought close to. The wire-spring arms on a grinning plaster skeleton wiggle when disturbed, improvising a jig which is a kind of droll oxymoron; the toy is dead-alive, its effect is fearful-joyful, macabre-jolly" (1987, p.9).

Animism is seen by Jones, among others, as a precursor to formalised religion. It is a system that endows all things with a spirit or a sense of soul that is related to what Jurkowski (1996, p.21) sees as the hieratic origins of puppets:

> "That was the first form of religion, and animism is still underneath all of the religions that grew on top of the ancient religions" (Kohler & Jones 2011, p.12).

Jones states that animism remains a vital force in humans, despite what he calls "scientific materialism", and I would argue, is a demystification of phenomena caused by the imposition of technical rationality:

> "This belief in agency is deeply engrained in our psyches...We are still animists at heart, even though science and scientific materialism have usurped earlier ways of explaining to us the world and the way things work and function" (2009, p.255).

Jones believes that the puppet theatre has a particular part to play in animism:

> "So, when we go into a theatre and the lights go down, and we once again are shown objects – i.e., puppets –that are brought to life, I think it ignites a smouldering coal of ancient belief in us – that there is life in stones, in rivers, in objects, in wood. I feel it's almost part of our DNA that we all left Africa believing in the life of things, as animists" (Kohler & Jones 2011, p.12).

This is the reason why puppets have the ability to either appeal or appal:

> "I think that deep in all of us we have a belief in the life of objects and the life of things around us. We suspect that objects may have life, and that dead people might have an afterlife (Kohler & Jones 2011, p.12).

It is no accident that the Alchemists of the Surreal choose subject matter that stands at the boundaries between the dead and the alive, between being and unbeing. The act of animation itself reinforces the content. Johnson (2017, p.1) refers to work made by the animated object film-maker Jan Svankmajer as "animist cinema". Svankmajer's pieces *Faust* (1994) and *Alice* (1988) play with perceptions on life and death, and altered realities. The Quays' film *Street of Crocodiles* (1986) is based on the eponymous short story by Bruno Schulz, whose

main protagonist repeatedly expresses beliefs that demonstrate the porosity of this alive-dead boundary:

> "There is no dead matter, lifelessness is only a disguise behind which hide unknown forms of life" (Schulz 1988, p.40).

Schulz even describes the distress to which matter is subjected when it becomes trapped as a particular form:

> "Who knows how many suffering, crippled, fragmentary forms of life there are, such as the artificially created life of chests and tables quickly nailed together… crucified timbers, silent martyrs to cruel inventiveness? The terrible transplantation of incompatible and hostile races of wood, their merging into one misbegotten personality" (1988, p.46).

In my view, such anxiety about matter – rooted in animistic belief and linked to the idea of the consciousness of matter – can be extended to *digital* matter.

7.6 My Friend

My Friend (Childs 2018) explores my relationship with digital entities, and was conceived as part of a clown show staged by the graduates of clowning classes run by Davison at the London School of Clowning. Every month a new show, directed by Davison and entitled *Friday Flop*, was assembled, composed of gags loosely attached to a framework and theme. The idea of the flop refers to failure derived from the perceived stupidity and foolishness of a clown, and characterised by the audience believing they can see the clown thinking (Davison 2015, p.49). The show presented in April 2018 was devised to celebrate a quarter millennium of circus that features an often-faked sense of danger, where audiences typically hope to witness an accident. Crucially, the audience witnesses the clown's understanding of the failure as it happens, but about which the latter can do nothing.

My Friend deliberately plays with computer animation paraphernalia (see figure 38). Powered by electricity, and made of plastics and elements including copper, magnesium, lead, mercury, silicon and aluminium, computers are the machines that stand at the interface between the tangible (analogue) and the intangible (digital).

The piece explores my relationship with My Friend, framed within a clowning scenario composed of gags that use equipment associated with computers to set the scene. The core creative idea is to deliberately mix the analogue, the digital and the elemental. The starting premise is that it is wrong to mix electricity with water, and the high-risk factor involved elevates this to the level of a taboo. *My Friend* is intended to fulfil the audience's often-denied need to witness the dangerous mixing of water and electricity (Davison 2015, p.99). People are accustomed to being careful with their electronic gadgets, but the cracked screens and dead pixels on their personal communication devices are testament to the mishaps that occur.

Computer-related gags occurring in *My Friend* include a keyboard whose keys fall off, and a water-squirting mouse. The piece evolved over several rehearsals and performances. A tried-and-tested method for the devising of clown acts is the concept of 'wrongness', which could mean any or all of the following: the wrong time, the wrong place, the wrong person, or the wrong action for any given situation. If clowns are truthful to the predicament in which they are placed by whatever is wrong, the act is likely to have clown integrity (Davison 2013, pp. 195-233).

My Friend is a script-based piece with one digital puppet and one performer-puppeteer. The piece was devised through improvisations, which resulted in a finalised script and some fixed choreographed sequences. The digital puppet protagonist in *My Friend* is a head-only character, projected onto a screen held by two other performers who are onstage with me. My Friend is green, with eyes that are black holes, resulting from a happy accident and giving her the appearance of an alien, but her facial structure is humanoid, and her facial expressions human-like and recognisable; she is not meant to be an example of perfect human mimesis.

In clowning there is no fourth wall, and I am facing the audience while My Friend is projected behind me, so I that cannot see her face unless I turn to look at her. I do no not hide the fact that I am operating My Friend; the audience can see that I am. Whenever I turn towards her, she smiles, but while I am looking away, she is making faces and other mischief. The audience sees that I talk to her, but I comfort them by saying 'don't worry, she's not real'. Despite my reassurance, a double layer of complicity is evident in the audience reaction, in terms of when and how laughter occurs. My Friend responds to what I'm saying as if she and the audience are sharing a secret that is being kept from me, even though I am

operating her, and they know I am operating her, and I know that they know. We are playing a game together: a game of complicity.

Figure 36. A sequence taken from a performance of *My Friend*. Rosemary Branch Theatre London. 2018.

By introducing her as My Friend, and by addressing her as if she is real, even while saying that she's not, then following on by saying 'I'm so glad I've got you to talk to', I am deliberately giving her power over me by expressing my need. This energy transference simultaneously endows her with superiority and strength, and shows my vulnerability. The judicious implementation of her facial expressions over time causes her character – a character I had not known existed before we started to work together – to be revealed. By careful fine-tuning of the timing I allow her to show attitude, and she takes on a life of her own. Staging her facial expressions as if I don't know what she's doing reinforces the idea of autonomy. The fact that the performance is live means that accidents occur, which adds to the sense of my not being completely in control. In accordance with the rules of improvisation, these are treated as *offers* to be incorporated into the improvisation.

Figure 37. *My Friend* (Screenshot by Childs, 2018).

7.7 The Magic of Life

Digital puppets can be reduced to a series of technical specifications. A digital puppet is made from a virtual material – a code-based mesh covered in mathematically-calculated textures. Tangible puppets are real-life objects made of matter and energy: the matter of their materiality and the energy of their puppeteers. Digital puppets are projections, screen-based life-forms, located in hard drives, servers, and code; ethereal beings that are in contrast to the pragmatism of computer technology. The materiality of a digital puppet can be a "massively distributed reality" (Bishop, Gansing, Parikka 2016), everywhere, yet nowhere. The concept of actors as software assumes greater significance in light of the revised scientific approaches to data and energy taken by physicists (Malone 2000, pp.60-61):

> "In recent years, physicists have shown information is more that the bits and bytes that course through computers. It can be converted into energy, for example" (Sample 2019)

A digital puppet is composed of bits and bytes, and – following on from this analysis – it can become energy. There is also the notion that all matter has, at some level, consciousness; or, as Hunt and Schooler put it, "mind":

> "…our preferred approach, accepts that all matter has some associated mind. This position is often described as panpsychism or pan-experientialism (Hunt, 2011, 2014; Schooler et al., 2011; Schooler, 2015; Goff, 2017). In the vast majority of matter this associated mind is very rudimentary – perhaps just a rudimentary humming of simple awareness in, for example, an electron or an atom…" (Hunt and Schooler, 2019).

Hunt and Schooler (2019) expand on the idea that simple awareness is present in the basic building-blocks of matter, proposing that small amounts build up:

> "An electron or an atom, for example, enjoy just a tiny amount of consciousness. But as matter "complexifies," so mind complexifies, and vice versa…".

According to Hunt and Schooler, complexification of awareness leads to biological life:

> "Boulders and piles of sand are "mere aggregates" or just collections of more rudimentary conscious entities (probably at the atomic or molecular level only), rather than combinations of micro-conscious entities that combine into a higher level macro-conscious entity, which is the hallmark of biological life".

Hunt and Schooler's "resonance theory of consciousness" posits that all matter – even objects that appear to be static – is actually vibrating, and that there is a tendency for adjacent oscillating or vibrating objects to synch up with each other, resulting in what they term "shared resonance". This "shared resonance, or synchronisation of vibrations leads to more and faster information flows" between objects. In the same way that the viewer of an illusion is oscillating between two states, as in double-vision, so are other collections of matter:

> "All things in our universe are constantly in motion, in process...Resonance is a specific type of motion, characterized by synchronized oscillation between two states" (Hunt and Schooler 2019).

For me, animism is connected to Hunt and Schooler's "resonance theory of consciousness". I believe digital puppets are a manifestation of the mind in digital matter, and, in my capacity as puppeteer, both the puppets and I form, as Chatfield puts it, "the crowd in the cloud becoming a stream of shared consciousness" (Chatfield, 2016).

A puppeteer working with digital matter needs to demonstrate understanding in the same way as one working with tangible matter, a challenge for which Fredricksson advocates the use of the Feldenkrais Method, which, she says:

> "…can help facilitate the compassion towards matter and towards oneself needed to accomplish this, through encouraging listening to what's happening without judgement and without necessarily wanting to change it" (Fredricksson 2015, p.238).

Although I don't use the Feldenkrais Method, I *do* feel compassion towards both myself and the digital matter of the puppets, and am aware of their meshes and mechanisms through various senses while in a state of RIA. Dixon posits an argument in support of the materiality of the digital, and the tangibility of the visual:

> "Digital artists in particular insist on the materiality of their work. They will never abandon or disparage the ways of knowing that the senses give us. For them, even the

> experience of seeing is not disembodied; it is visceral. Seeing is feeling" (Dixon 2007, p. 216).

Manipulation of Hobbs and La G is visual improvisation, and sight is the the main interactive sense – being the channel through which feedback from the puppet is received – but the rhythms of the interaction are felt through the joystick, the pedal, and the keyboard, and sometimes (as in the dance-club performances) it becomes unnecessary to look at the puppet. It is possible to imagine a scenario where haptic devices with force-feedback capabilities are deployed. The Quays describe the relationship between puppet-animator and puppet as one in which the puppeteer is a wraith, the double of the puppet (Hammond 1987, p.55):

> "Whoever builds the puppet animates it," say the Quays, "he's come to terms with it. With its drives and resistances, you might say, because the requisite stiffness of ball-and-socket joint or pipe-cleaner physique gives the puppet a character: armour that will bend to the musculature of the puppeteer only by reducing the latter to the status of doppelganger" (1987, p.55).

The implication is that a life-exchange takes place between the puppet and its animator, paradoxically elevating the puppet to a higher level of vitality than its manipulator; the puppet is even more real than the puppeteer. This sense of understanding the nature of the puppet is a contributory factor to the belief in its life; there must be a dialogue with digital material. Puppeteers are aware that their energy extends beyond their own bodies, and is an expression of interpenetration with their environment. Rokeby speaks of an "enlarged sense of self" that is not confined to the physical boundaries of the body:

> "Within ourselves, we are all systems. But when I was initially thinking about interactivity in art, I was also exploring the relationship between the self we imagine as contained within the membrane of our skin and an enlarged sense of self that takes into account the complex bidirectional flows across this boundary as we interpenetrate with our environment" (2019, p.107).

This enlargement is enhanced in a digital puppeteer, and also in robotics. The roboticist Ishiguro says that "operating an android often gives one an eerie sense of extending one's perceptual field, such that one becomes, as it were, embodied by the android and can feel when the android is touched, for example" (Poulton 2014, p. 287). This phenomenon is related to the experiment in which a fake hand is substituted for a person's own hand, and the illusion that it is theirs is created. Proprioception plays its part in the delusion experienced by the participant, as highlighted in the example conducted by Krishna-Pillay:

> "…bit by bit he's starting to believe that this hand he's seeing is also the hand he's feeling even though it's not so his body re-adjusts its understanding of where his body parts are and begins to believe that this fake hand is actually part of his body" (Krishna-Pillay 2015).

This experiment proves that the mind can be fooled, which also means that it can be trained. For me, the act of digital puppetry requires a way of imagining movement, a virtual awareness, as if mirror-neurons are firing somewhere between my mind and the intangible puppet. The complex operations I carry out as a puppeteer rely on my proprioceptive and kinaesthetic senses, but this requires a virtual imagination, because the puppets can execute far more extreme movements than I can with my own body, in addition to non-realistic movements. By Using both my virtual imagination and RIA, I can break out of my physical body and change my patterns of moving.

> "Imagining movement is a way to forestall moving in one's habitual way as it produces the almost same neuronal activity as doing the movement without involving the habituated musculature" (Fredricksson 2015, p.237).

Furthermore, although my body's potential is not in accord with that of La G, I can move *through* her – I have the freedom to become something else, and to become aware of possibilities I would not have imagined without her, a phenomenon described by Fredricksson:

> "I think that if the actor has no movement awareness for his own body, he will have problems imagining movement in the puppet's body. But my puppet can also bring me awareness of things I wouldn't necessarily have incorporated to begin with" (Fredricksson 2015, p.239).

In order to be at one with the technology, I have identified a digital puppetry skill-set that involves developing a virtual sense related to proprioception and peri personal space, similar to that developed by contact improvisers like the dancer Lisa May Thomas:

> "I think I've been able to sense more synaesthetically… a sense of touch beyond the body…the sense of touch is expanded beyond the skin…the bodily boundaries are broken down more and breath is part of that mixing…sense of corona sphere as this more expanded realm around the body of breath and the reach of the breath".

I have a direct line to the puppet; it is an extension of me, and part of my peri personal space:

> "…The psychology of studying personal space, or 'peri personal space' as it is known, tells us there really is such a thing. The brain computes a buffer zone around the body, which is very flexible. It changes in size, depending on context, computed in a manner that's largely unconscious" (Worrall 2018).

The ambiguity of being simultaneously alive and dead endows puppets with a sense of immortality that gives them credibility when communicating ideas about the secrets of life, of being and un-being. Puppets have a psychological effect, in that they appeal to the viewer's unconscious and can therefore be used to represent the etheric body, the anima, which leaves the physical body and operates on the astral plane. Puppeteers and puppet animators are in a unique position because these properties allow a dimensional shift to take place in the viewer's mind. *Is there anybody there?* exploits puppets' ability to operate on both sides of the boundary between the living and the dead, the animated and the inanimate.

8 Chapter Eight: Findings

> "Not all, he replied. Rather the movement of his fingers has somewhat artificial relationship to those of the attached puppets, somewhat like the relationship of numbers to logarithms or the asymptote to the hyperbola" (Kleist 1972, p.23).

8.1 Chapter Outline

This part of the dissertation looks at what the study set out to do and what it has achieved in terms of questions, method, experiments, and results. The chapter draws together the principle themes running through the research by summarising the findings, and indicating the contribution to knowledge.

8.2 Introduction

This study set out to explore questions and ideas that lie at the intersection of computer technology and humanity. The aim was to find out if it is possible to create the illusion of life and intelligence in CG models using algorithm-assisted digital puppetry, and to test the hypothesis that the ability to use improvisation performance techniques enhances spontaneity in CG characters. The major theme was the quest for life in digital puppets, with particular reference to their ur-narrative. To investigate these areas, I created and employed the GLOPPID method, which I use to devise and perform digital puppetry artefacts, using a practice-as-research methodology in an iterative process cycle, in which critical reflection is incorporated into the pipeline.

The research study is successful in that the GLOPPID method fulfils its aim of devising a way of interfacing with computational machinery, so that CG models can be puppeteered live. Live onstage performance with digital puppets is a rarity, and to the best of my knowledge, there are no other performer-puppeteers using the same approach. For example, although *Earth to Ned* is a live improvised chat-show format featuring a digital puppet, not only is it televised, but the puppet is covertly operated, which and does not have the same effect as my real-time onstage performances, in which the puppeteers are intentionally overt, thus forming part of the performance.

This study presents evidence that supports the pro-puppetry thesis as applied in digital puppetry, by demonstrating that it combines the advantages of the digital medium with the art of puppetry. Although CG animation can be precise and finessed, it is laborious to produce, and lacks the spontaneity of digital puppetry, a technique that facilitates both improvisation and collaboration. It is possible to work with other puppeteers, either by sharing the operation of the same puppet, or by performing together in the same improvisation scenario using separate puppets. Both ways of working foster an element of surprise that sustains creative interest on the part of the puppeteers, and increases the likelihood of happy accidents.

The speed with which a digital puppet can be operated lets the performance run away with itself in ways not possible in CG animation. At the beginning of this study, I saw the aims through the lens of an animator, and the process as an act of creating an *illusion*, but, as I worked with the puppets, I found that they took on a life of their own, reinforcing the ideas of double-vision and opalescence *in the puppeteer* as well as in the audience.

These properties indicate what a successful collaboration between humans and machines might look like, and positions the work in the context of Searl's observation that:

> "The interactive puppet stage as a place of 'spontaneous impulse' where accidents, happy or otherwise, can happen" (2008, p.298).

This spontaneity extends the potential of animated characters, which – until early in the second millennium – were confined to the constraints imposed by animation. Not only can digital puppetry broaden the scope for animation, but it can also do the same for puppetry itself, and the merging of the two into a hybrid art-form leads to what Searls calls "a new species of make-believe", extending both disciplines, and, in the process, creating a new one:

> "Performance-capture creatures … make animation more spontaneous and lend the possibility of naturalism if that is desired for a particular kind of communication with audiences. To puppetry, they bring the possibility of operating photorealistic images and participating in the creation of a new species of make-believe" (Searls 2008, p.305).

Searls points out that the mixing of human movements with animation through motion capture is risky, because it fails to maintain the distance between the performer and the performed object, which is critical to successful characterisation:

> "[Indeed,] both puppets and animations pretend to be alive. They are removed from their creators by this simple fact of nature as well as basic physics. But the gap between performer and performed has actually been obscured in a number of attempts by fantasy film directors to mix human character acting with animation through motion capture. In these cases, the failure to understand this essential rule of distance has resulted in rather flat, uncompelling characters" (2008, p.299).

Digital puppetry is an inappropriate technique for content-creation requiring photorealism and realistic movement, but it is well-suited to expressivity produced by stylised motion behaviours and characterisations. Support for the pro-puppetry thesis in digital puppets depends on qualities of puppetness produced through channelling. It is the puppeteer, the HITL, who provides the crucial ingredient that facilitates extemporising, and who, by the act of channelling, creates the sense of puppetness originating in the distance between the character and its operator.

As a live-performance activity, digital puppetry yields immediate results, and has the advantage that it can be directed. Additionally, the CG models used can be easily scaled and duplicated. In recent years, many more CG models have become available to artists who do not wish to spend time building their own. Although the CG models available for use as 'found materials' tend to be stereotypes, particularly in terms of gender, using them as puppets contributes to the mischief factor in my work.

8.3 Collaboration and Relationship

I claim that my work is an example of a free collaboration between humans and machines, but, paradoxically, Oliver (2015, p.125) describes her process of creating digital performances incorporating gaming technologies as one of both emancipation *and* enslavement. She argues that the appearance of a collaborative relationship with onscreen characters is an illusion:

> "I propose that although these playful technologies have permitted the illusion of interaction with onscreen characters, this sense of relationship with digital characters is still one that resides primarily in the mind of the inter-actor" (Oliver 2015, p.125).

Oliver bases her argument on work she produced with a cartoon digital double, with which she interacts via TV monitors showing triggered pre-recordings, meaning that she must remember the sequence and the content. Therefore the timing is problematic, which may be why Oliver describes the interaction as symbolic only:

> "As a performance maker, my abilities lay in creating the 'appearance' of a collaborative relationship between the stage-based and digital performer, but in truth I had only ever achieved a symbolic interaction" (Oliver 2015, p. 132).

I do not have the same problem as Oliver, because my interaction with my digital collaborators is live and improvised; they wait for me to finish speaking, before they speak or interact with me, and so the "agony" to which Oliver refers (2015, p.127) is absent. Furthermore, *my* digital characters have a life of their own that I cannot always predict, and this enriches our relationship. The question is 'How is it possible to prove that this is not in my mind?' The relationship between my puppets and me may look collaborative from the outside but successful performance – as Francis observes – is marked by complicity between performer and audience, which may only reinforce my delusion. Further evidence in support of Oliver's argument lies in the fact that I cannot judge what the audience really knows, only what I *think* they know, because – by definition – they are complicit in *my* delusion. However, I present the notion of the 'life-of-its-own' mechanism as a phenomenon in which I have enough belief to create the unpredicted.

By using algorithm-assisted digital puppetry, my method counterfeits AGI in CG puppet characters, endowing them with API – a sense of life, intelligence, and personality; they show signs of imagined life and imagined thought. At times, both the viewers and I imagine the characters to be alive, at times, we imagine them to be thinking, and at times, we *believe* they are alive. As a result of interacting with a technically rational CG system in a non-technically rational way, a human element is introduced, and this allows the puppets enough of a life of their own to become collaborators. In a Stimulation-Impetus-Action process I cause the puppet to act, it acts; I react to its action, and a feedback loop driven by my impetus is created, with action and reaction happening so fast that I am no longer conscious of the processes taking place. This is the point at which the puppet takes on a life of its own; it gains

a degree of autonomy and independence, which enhances the performance. As the study progressed and I became more familiar with the workings of the method, live puppetry with the CG models became instinctive and natural, and I developed a greater belief in digital animism. I quickly realised that there might be a shortcut to credibility – as opposed to realism – through the repetitive use of a selection of movemes. It seemed to me that as soon as I started making connections and testing the results, previously 'dead' CG models began to come to life.

The tangible puppet-puppeteer dialogue can be understood through the interconnectedness of objects and energy; energy flows as waves through matter, without regard to physical boundaries. If matter can be virtual, then the theory of shared resonance produces code-based entities with inherent "mind": primitive or basic collaborators that give the HITL something to work with, a sounding board to react with and against.

Imagined life in a digital puppet must overcome preconceptions and prejudice, but perhaps there is advantage in its impossibility:

> "The more obviously dead a puppet looks, based on the materials of which it is constructed, the greater the wonder of its life…Handspring's puppets are made of undisguised, obviously inert materials such as cane or wood, but are designed to be absolutely lifelike in their movement" (Posner 2014, p.338).

It could be argued that code is even more dead than cane and wood, which was – at least in a biological sense – once alive, but the wonder of a digital puppet's life comes from the fact that it is made of at least two kinds of energy: that found in its code, and the manipulation energy generated by its puppeteer(s). Code made into animated imagery has the same properties as any other animation, and can be treated in the same way, as argued by Proschan in the case of analogue imagery:

> "…the creative energy that animates the images is the same - the impulse to create objects to act on our stead, objects through which we can project intensified, artistic and often holy speech and action" (Proschan 1983, p.34).

The focus of my expression as a digital puppeteer is, therefore, a piece of code made of energy and combined with my own energy. I have found that in the same way as a mask worn by different performers has a different effect and flavour, the same digital puppet model

controlled by different puppeteers, using identical controllers, has different characteristics and personality; each person's manipulation energy is visible in the performance. In a paradoxical counterargument to the soullessness of puppets, I would argue that these variations in performance come from the puppet itself, which, in addition to the manipulation energy of the puppeteer, has its own energy – the energy in digital materiality – which means it develops a life of its own and creates a re-energising cycle. Puppets have a ready response to any external stimuli, and can send it out as someone other, or more, than the puppeteer.

Their code-based anatomies mean that digital puppets have cross-platform portability; the ability to travel via the Internet as quantum entities and be present in many places at one time. Digital puppets are everywhere and nowhere, broken up into packets of data, sent down wires and stored on servers. Their presence transcends the constraints of the physical, even onstage, conforming to Astles' concept of "the law of continuum", which:

> "...is that which understands that all movement between puppets, puppeteers and other elements on stage is intrinsically linked, in constant motion and relationality" (2009, pp. 57-58).

For me, this is also true of real and digital space: energy flows beyond the body and into the digital space. These code-based collaborator friends are ubiquitous. Their ethereal, yet eternal presence gives digital puppets an affinity with expressing ideas about being and un-being, as identified in Chapter Seven.

The GLOPPID method is a two-part process in which rigging and puppeteering are distinct phases and skillsets. The artworks produced using the GLOPPID method demonstrate that, by engineering the puppets as expressive actors, they are able to exploit the advantages of segmentation, muscle isolation, and articulation present in an approach to movement based in the concept of an actor as a marionette or puppet. The rigging approach accentuates puppet-like qualities, bringing out a sense of puppetness in the CG models that makes working with them easier, as well as spontaneous. The previously-mentioned tension between the control of puppetry and the letting-go of improvisation is present in the relationship between puppet and puppeteer, software and hardware, and within the rigging and the controllers, which are all locations of manipulating energy. My method means that the puppeteer can concentrate on improvisation, using the moveme palette like a musician improvising within a scale or key.

The processes and pieces developed during the course of this study confirm digital puppetry as an artform in its own right, and as a credible creative choice for independent artists and commercial enterprises alike. For example, when performed in crowded techno clubs among people in varying states of awareness of themselves and their surroundings, face jazz has site-specific significance as a mirror that offers insights into what it is to be human. Digital puppetry emerges as a distinct performative practice.

The GLOPPID method and its outcomes contribute to the discourse surrounding critically reflective artistic research practice, and helps to bridge Budde's (2019, p.102) aforementioned perceived "interdisciplinary abyss of knowledge". This research contributes to discourses surrounding HCI, the computer as a collaborator and algorithm-assisted performance.

Without the need for expensive, waldo-like remote-controllers and complex coding, and by using the most basic of controllers and rigging, combined with the re-purposing of CG models, the GLOPPID method subverts what I see as the conventional CG aesthetic, evident in the work of commercial production houses such as Pixar and Disney. One example of this subversion is that I implement no collision-detection, meaning that an arm can pass through a torso. I see this as an act of rebellion against the tyranny of the commercial imperative. At times, this may jeopardise credibility, in that it might contravene the logic of the performance; however, it can be limited in extent. Such 'unrealistic abilities' are intended to create a sense of excitement and exhilaration, both disconcerting and extraordinary. If used judiciously, this may endow a character with unexpected – perhaps nonsensical – superpowers, and can contribute to its sense of humour. For example, if, at the right moment, La G bends over backwards, thrusts her head through her legs and beams, she is clowning (see Figure 38).

Figure 38. La G has a happy accident that results in clowning.

The 'joke' of the performance in *My Friend* lies in the use of human mimesis, and even though the aesthetics of the puppets in the re-purposed models I use risks invoking the phenomenon known as "uncanny valley" (Mori 1970), I would argue that this does not apply here because of their very puppetness; their behaviour is *too* puppet-like. The GLOPPID-method movement aesthetic is based in precise rotations, where complexity is achieved by means of many simple building-blocks, as opposed to layers of technology. This approach reveals the "via negativa" in what is, typically, perceived as a "via positiva". The additive property identified in Dixon's description of the "via positiva" in digital performance is at odds with the reality of the GLOPPID method, where the technology is pared back to the barest minimum required for the performance:

> "Digital performance is by and large the polar opposite: *via positiva*. Rather than stripping away to reveal essences, like the classical image of Michelangelo hammering and sculpting stone to reveal and bring into being something already there but hidden underneath, digital performance is by definition an additive process. New technology is *added* to performance, a new ingredient that is delicious for some but unpalatable for others. In digital performance, extra technologies are added, extra effects, extra interactions extra prosthesis and extra bodies" (Dixon 2007, p.28).

The notions of the "via negativa" and the "via positiva" are therefore of relevance to my work in two ways. Firstly, the "via positiva" is evident in *Control Freak* in its use of projections and secondly, the GLOPPID method uses the "via negativa" in the sense that it is ablative: the digital intervention is limited to the minimum level of technology needed to create this form of expression. Neither the technique nor the technology is superimposed onto another non-digital performance; they *are* the performance, and using them as improvisation, like jazz, is an artform in itself. The same effect could not be achieved in tangible puppetry which, arguably, requires more technology, in the form of physical equipment. Two principles are at work in the GLOPPID method: the controls are simple, and the puppeteer is at one with the controls.

In *My Friend* there is no scenery and no set, and the props are made from re-purposed obsolete computer technology. The main protagonist is a re-purposed CG model, the performance is devised through improvisation, and there is no technical support. This is not an exercise in techno-exhibitionism, or an example of performance where surface artifice is prioritised over substance and content (O'Dwyer 2015, p.35). I am aware that the use of computers, verbalisation, CG models and projections in my work is a far stretch from the "poor theatre" of those such as Grotowski, whose focus was on the craft, technique and presence of the human body. It is also far from the simplicity of object manipulators who, for example, bring a paper bag to life. For me, *My Friend* is a kind of partly digital "poor theatre", in which the layers and masks obscuring the essence of performance are peeled back.

8.4 The Mirror and The Angst

This research contributes to the discourse surrounding art and technology as mirrors that reflect what it is to be human. Digital puppetry is an interactive process, a collaboration between the puppets and the puppeteers, and a direct result of decisions made by the puppeteers – who are both themselves and the puppets. It is also a vehicle for the performers to discover themselves in the puppets, in the same way that Rokeby describes in *Very Nervous Systems*:

> "A technology is interactive to the degree that it reflects the consequences of our actions or decisions back to us. It follows that an interactive technology is a medium through which we communicate with ourselves... a mirror. The medium not only reflects back, but also refracts what it is given; what is returned is ourselves, transformed and processed" (Rokeby, 1996).

As an interactive technology, digital puppetry is a medium through which I communicate with myself and others. Placed in the context of Rokeby's account of the effects of interactive technology in general, it not only gives me an image of myself, but, because it changes my reflected image, it also gives me a sense of myself in relation to the outside world:

> "To the degree that the technology reflects ourselves back recognizably, it provides us with a self-image, a sense of self. To the degree that the technology transforms our image in the act of reflection, it provides us with a sense of the relation between this self and the experienced world. This is analogous to our relationship with the

> universe. Newton's First Law, stating that "For every action there is an equal and opposite reaction," implies that everything is a mirror. We discover our 'selves' in the mirror of the universe" (Rokeby, 1996).

This study tests the hypothesis that by putting a property of puppetness into CG character models, they become more approachable. It is a timely contribution to the discourse surrounding digital angst, and shines a light on the human condition. Because the puppets' predicaments mirror those of the audience, they have the power to alleviate existential and digital angst. The mechanism by which this occurs is seen in the relationships between the protagonists within the artefacts.

I see *My Friend* as a response to the tropes of puppets that move of their own volition, of rogue robots taking control of themselves, of AGI, AI, and big data. This is my reaction to the sense of apprehension about autonomous computational machinery, within which data is used to make important decisions about – yet without – people, as identified by Krotoski (2020). Calculations may be faster, weapons more lethal and construction stronger when done by machines, and this may frighten people, but, as Rokeby says, they find it thrilling at the same time:

> "We take things that we are not good at and try to make machines that can do them better...and we are terrified when the machine performs better than us, but we're secretly delighted at the same time, because we are attracted to the idea of stepping beyond the human limitations that prevent us from living at the level of our dreams and ideals (2019, p.111).

By transforming code into friendly, and, at times, anxious and vulnerable characters, the GLOPPID method allows me to interface with technology as a puppeteer, alleviating my own anxieties surrounding AI, big data and the digital. This gives me back some of the control I fear losing, thus ameliorating my own angst, and this is demonstrated to the audience in every performance. The quest for life and intelligence in digital puppets is also a quest for emotions such as desire and anxiety, thus demonstrating their imagined ability to think and feel, and endowing them with a sense of vulnerability, weakness, and fallibility. The puppets' ability to reveal the essence of themselves, and what can be seen as their predicaments, offers ways to dissolve suspicions and fears surrounding the digital. For example, my virtual boyfriend, Halogen Hobbs, is cheerful and cheeky, making him fun to be with and to operate. My belief in his life-force is based in the extension of my own life-force, beyond my own body; I am

him and he is me. *My Friend* builds a bridge, via the HDPI, between myself as a human and the otherness of the digital. My Friend and I have a relationship, and by juxtaposing my own body and the disembodied head of My Friend in a theatre clown context, the audience gains understanding of both our predicaments.

Existential angst expressed by a digital puppet, as in *Am I a Puppet?*, has different implications to that voiced by a human actor. Paradoxically, and setting aside instances of digital pupaphobia, the sense that the digital puppets develop a life of their own does not pose a threat in the same way as the autonomy of robots with AI, as long as they are presented as having a sense of humour and being fallible. My own fear is overcome by allowing a code-based collaborator to have a life of its own and then work *with* me; we are seen to be working together in a benign way. The alien in *My Friend* shows pity for her sad human collaborator. Although the effect on observers is not systematically measured, it is evident in their engagement with the puppets themselves; for example, the way the audience laughs along with Halogen Hobbs as he smiles suggestively, while projected onto del Ponte's naked body:

> "Many people would be disposed to say that it was not the machine, but what one did with the machine, that was its meaning or message" (McLuhan 1964, p.9).

Digital puppets themselves, what they do, and how they do it, *are* the message.

8.5 Negatives and Failings

The research is unsuccessful in that it fails to fully explore the scope and capabilities of digital puppets and puppetry. Firstly, all the pieces, with the exception of the Menopause Army Band stomper-boots-on-sticks, are figurative, constrained by their humanoid model design in ways the thesis purports to abhor. Secondly, it exposes the limitations digital puppets have. For example, the iterative workflow of CG film-making models allows greater complexity in the movement of a CG model. in digital puppetry this is only possible if three or four puppeteers work together in unison, because locomotion requires more controllers than is feasible when working alone or with one co-performer. The use of gaming controllers as the HMI relies on the movement of the digits and the feet alone; much more could be achieved with access to technical support and professional equipment. However, on a positive

note, this research can be replicated using domestic equipment and basic technical expertise which is available to puppeteers and artists.

My reliance on found digital objects – although freeing in the sense that it narrowed the choices and decisions to be made – did limit the scope of the scenarios. The way that the rigging is carried out means that the found models must have certain attributes, and these were not as common in the female models as in the male. While I had expected to make both figurative and non-figurative work, the availability of found digital objects suitable for re-purposing as digital puppets curtailed these ambitions. There are many humanoid characters and body parts modelled for use in games and animations, but a lack of other kinds of models suitable for modification and rigging for real-time manipulation as puppets. I became distracted by these humanoid models at the expense of abstract object manipulation. Because the work is focused on humanoid forms, it fails to explore the wider scope and flexibility of puppet movement; there is a vast field of movement experiment still to be explored. In fact, much of the work is partially motivated by either music or speech, as opposed to being purely based in movement. Furthermore, the models did not allow for retro-fitting of breath muscles, making the application of life-signs challenging.

On the one hand, the pieces are mainly experimental fragments, as opposed to the major works I had hoped to make. On the other hand, this research has now given me a cast of code-based collaborators that I can enlarge and use for future digital puppet theatre improvisations.

8.6 A Look to The Future

The GLOPPID method is a work in progress, and I envisage future performances that will exploit its advantages. The artefacts discussed in this practice-based doctoral study are experiments and tests of a method that I will build on in order to make larger works. For example, staged as a round-table theatrical experience, *Is there anybody there?* has potential for audience interaction, with some of the participants as performers and some as audience members, and the puppets able to react in real time to audience input.

Technical limitations regarding the development of HMIs coupled with the cult of celebrity

have restricted the use of puppeteers in CG film-making. But in the twenty-first century, teams of skilled puppeteers will be employed to bring digital creatures, characters, and performance objects to life, instead of famous actors being covered in motion capture sensors in order to achieve this effect. Technical developments in CG, cost reductions, and the potential for engaging in non-human movement styles make digital puppetry an attractive solution in many scenarios. The expressivity of puppets, who move so differently to humans, coupled with the ability to direct them, will make them an increasingly attractive option. A merging of techniques, technologies and disciplines will lead to a better understanding of the tasks that can be achieved efficiently and economically using digital puppetry. New ways of controlling digital puppets will be developed, in which sophisticated and expressive movement will be prioritised. Puppets operated by two or more puppeteers working together will have greater functionality in terms of complex activities such as locomotion. Brain machine interfaces used for controlling the movement of robots and exoskeletons, such as those described by Hramov, Maksimenko & Pisarchik (2021), will be routinely deployed to create character content. The advantages real-time feedback brings to directors for control over a performance make this method an attractive proposition for independent and commercial artists. This calls for gamer-puppeteers, hybrid puppeteers who do not require the materiality and tactility of working with physical materials, but who use their proprioceptive senses and imagination to create fantastical performances by means of neuro-interfaces.

8.7 Conclusion.

This research study demonstrates innovative practice by identifying the specialist skills and describing the decision-making strategies used in the creation of digital puppetry artefacts. I found my own way of working with the technology, and expanded this into a discussion of digital puppetry practice and aesthetics. The GLOPPID method is a novel approach, exploring possible languages of digital puppetry movement through experimental extemporising within limited movement vocabularies. These artworks, devised and performed using improvisation techniques from disciplines including physical puppetry, dance, physical theatre and clowning, show what it is possible to do with digital puppets as opposed to actors in motion capture suits, or conventional physical puppets. It confirms the currently little-used practice of digital puppetry as a distinct artform, and offers a glimpse of its potential for future application.

Improvisational performance using an HDPI keeps the human-in-the-loop of the HMI, and makes a timely contribution to the discussion with regard to the differentiation between the activities to which humans and machines are best suited. Within this HDPI, what humans do best is reading emotions and meaning in actions, appearances and sounds, and reacting to these in a stimulus-impulse-action process; for example, seeing a joke, or recognising an attitude, or a character trait. What machines do best is performing triggered motions and effecting change based on high-speed mathematical calculations and interpolations in CG imagery, which is full of colour and movement. For me, in digital puppetry the whole is greater than the sum of its parts: the artificial life and intelligence of digital puppets emanates from a partnership between a human and something more, either wholly based in that human, or tapping into some external energy.

Performing a digital puppetry piece using the GLOPPID method is a process measured not in days or weeks, but in minutes, as the Futurists demanded. While performing with digital puppets, I *do* experience an oscillation between belief and disbelief in their life and intelligence, but they are always alive enough to work with. Digital puppets are symbolic figures, smirking, smiling, speaking at the human-computer interface, occupying a position that gives them the power to allay, or exacerbate, fears. The ability to extemporise with digital puppets opens the way for spontaneity, experimentation, surprise, and happy accidents, resulting in a creative process fuelled by serendipity. When using improvisation within a framework, every live performance is different, and during the process a feedback loop develops, with unpredicted stimuli originating in the puppet and puppeteer collaborators, and producing a snowball effect that sustains creative interest.

To return to the challenges and questions contained in Russell's and Chatfield's observations and the statement made in Chapter One, I agree with Chatfield's argument that crediting machines with understanding and intelligence that they don't really have is dangerous, and that the human *must* be put back into the loop (Chatfield 2016). As experiments in puppet intelligence, my work with my digital puppet collaborators conforms to my interpretation of Russell's concept of a new model for AI "based on machines that learn about and defer to human preferences". My digital puppet collaborators are not machines, but they do learn about, and defer to, my human preferences while – at times – rebelling against my controlling nature. They experience glitches, and have accidents, and it is these that give them credibility. For me, a "successful collaboration between humans and machines" looks like artificial

digital puppet life and intelligence; it looks like the pieces made during this study: *My Friend*, *Control Freak* and *Is there anybody there?*

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11 Appendix One. Artworks: Supporting Materials.

11.1 My Friend (2018) Script.

Stage technicians place a small table on which is a laptop computer, a stool and a projector on a tripod in the middle of the stage. Lucy enters the auditorium down the aisle, wearing a laptop backpack containing water reservoir and carrying a computer keyboard, mouse and electrical extension cable.

LUCY: Never mind all that traditional stuff, it's time to bring clowning into the twenty-first century. Computers!"
LUCY: *steps onto the stage, and trip myself up, causing the keys fly off the keyboard. I throw down the keyboard.*
LUCY: This (*waves the mouse at the audience)* "is a computer mouse"
water squirts out of the mouse in arcs
LUCY: Electricity! (Lucy *passes the plug end of the mains extension lead to the assistant)*
LUCY: Plug this in. (*ASSISTANT looks at the plug which squirts water in his face***)**
LUCY: Give me that. Take this end and plug in the computer. *LUCY goes to plug the other end in. ASSISTANT stares at the socket; it squirts water in his face again.*
LUCY: get the keyboard,
ASSISTANT picks up the keyboard, drops it, all the keys fall off.
LUCY: plug this mouse in at the back
LUCY: Bring the projector screen. There, no there, no…over there…
(*ASSISTANT picks up a sheet. Lucy aims the projector at the back wall backstage right then to the other side, holding up the projection screen ASSISTANT moves to where she indicates)* backstage left (*Lucy aims the projector at the door in the middle of the wall stage left marked fire escape, the assistant moves to where she indicates)* over there. (*ASSISTANT moves to where she indicates)*
LUCY: No, further, a bit further, a bit more" (*the assistant backs out of the fire door and out of sight of the audience…sound effect of crash….. ASSISTANT makes his way round and back through bar. LUCY sits down at the table, puts the gamepad on the floor, places her feet on its joysticks and looks up distractedly,*
LUCY: where's the screen?
A stage technician goes to the back of the stage with a white square screen, a woman's head is projected onto the screen.
LUCY: Do you want to meet my friend?
CONFEDERATE AUDIENCE MEMBER: Yes.
LUCY: (*to audience*) This is my friend. Don't worry, she's not real.
FRIEND frowns and the corners of her mouth turn down
LUCY: She can't speak.
FRIEND grimaces
LUCY: That's the way I like it. She does anything I want. She's a state-of-the-art piece of kit. A software, hardware, shareware, firmware, menswear, dual core, quad core, apple core solution.
LUCY: Are you alright?
Lucy turns to look at FRIEND, FRIEND smiles.
LUCY: Are you feeling sick? *FRIEND shakes her head.*

LUCY: *I'm* not alright. I've not been feeling very well.
FRIEND rolls her eyes
LUCY: I've been nervous and anxious and anxious and nervous and like I don't really know what to do with my life.
***FRIEND** pout 1 pout 2 pout 1 pout 2 eyes closed, and nods off as if bored by what **LUCY** is saying.* (two different versions of a pout)
LUCY: I'm so glad I've got you to talk to.
LUCY looks at FRIEND, FRIEND opens eyes turns head away
LUCY: I can tell you anything.
LUCY looks at FRIEND, FRIEND eyebrows up
LUCY: Because you accept me as I am.
LUCY looks at FRIEND, FRIEND smiles
LUCY: Thank you.
***FRIEND** looks at **LUCY** gives a very quick smile, a bit late.*
ASSISTANT reappears.

11.2 Is there anybody there? Script.

Interior, night. A dining room. A table, eerie sounds play, candlelight. A diaphanous veil is draped at one end of the room.

MEDIUM: Welcome. Please be seated. Place your hands on the table face down next to but not quite touching those of your neighbours. I know that the ones from the Other Side are not far away, and even if they are distracted by the un-earthly delights that await us all, some will come when we call. You are about to meet *El Duende*, my spirit guide, my intermediary between this world and the next, who will do his best to find them and bring them close, but there are no guarantees. Now, please, close your eyes, empty your minds, feel the strength of the circle, we are all here in this world now, but we will not always be and when we cross, we might hope that our loved ones will do as we do and ask for a fleeting connection, a glimpse past the veil at the place and the ones we have left behind. Now, open your hearts, and think of the one with whom you would like to make contact. Is there anybody there? I ask again. Is there anybody there? If there is anyone there, please, knock twice.

BANG, BANG.
MEDIUM: Ahhhh…who is it? Is that you El Duende?
BANG, BANG.
MEDIUM: Come closer, *El Duende*, it is I, Mme. Berthaud. Reveal yourself in the portal.

THE MAN COMES TO LIFE.
MEDIUM: Ahhh, *El Duende*, I'm so glad you are here! Thank you. You look well, have you been partying? Partying with the dead?

EL DUENDE nods.

MEDIUM: Marvellous!

EL DUENDE grins.

MEDIUM: Now, I have some people here with me who would like you to help us. Is that ok with you?

EL DUENDE nods.

MEDIUM: Thankyo u. Do you have someone there with you already?

EL DUENDE nods

MEDIUM: I'm getting a Greta, is that Greta?

EL DUENDE nods and smiles coyly, as if he is channelling somebody else

MEDIUM: Greta, welcome. Is someone here looking for Greta?

CLAIRE: Yes, that's my Auntie. Wow!

MEDIUM: Greta, Claire is here with me, she's so pleased to hear from you. Do you have a message for Claire?

EL DUENDE nods.

MEDIUM: What is the message?

EL DUENDE delivers a message.

MEDIUM: Is there a Virginia, Victoria, Veronica…I'm getting a Virginia…Victoria…

PARTICIPANT: Yes, Virginia, she was the love of my life!

MEDIUM: Do you have a message Victoria

EL DUENDE nods.

MEDIUM: What is your message?

EL DUENDE Squeaks like a mouse.

PARTICIPANT: Yes, Virginia, my pet, I love you too!

12 Glossary.

3D CGI: Three-dimensional computer-generated imagery.
Animation: refers to incrementally moved frame-by-frame animation of either physical or digital images or objects. Examples include two-dimensional drawn cartoons such as 'Bugs Bunny', three-dimensional model animation such as 'The Clangers' and 'Toy Story, a three-dimensional computer animation.
Algorithm: mathematical rule
AGI: Artificial General Intelligence
API: Artificial Puppet Intelligence
ATM: Awareness Through Movement. (Feldenkreis).
'Bunraku" style puppetry: one puppet operated by several puppeteers,
Japanese in origin.
Computer animation software: computer programs used for two and three-dimensional digital animation. Examples include Autodesk Maya.
Digital puppetry, cyber puppetry, digital puppetry, performance capture puppetry: the real-time manipulation of digital performance objects and figures in three dimensions.
Direct input device: electronic devices, typically hand-held or hand operated, used to control the movement of a digital puppet or artefact; examples include computer mice, keyboards, joysticks or gamepads.
Follow-through, overlapping action and drag: principles of animation applied to achieve credible motion in cartoon characters.
FM: Feldenkrais Method.
Haptics: interaction involving touch.
HCI: Human Computer Interaction.
HDPI: Human Digital Puppet Interface
HMI: Human Machine Interface.
HPPI: Human Physical Puppet Interface.
Key frames and in-betweening: key framing is the setting of principle poses. In-betweening refers to the drawing or filling in by computer of the poses in between the key frames.
LMA: Laban Movement Analysis
ML: Machine Learning.
Motion Capture: digital recording of movement.
Moveme: a segment of movement trajectory**.**
Movement analysis and codification systems: taxonomies of movement in human dramatic arts, animation robotics.
Performance Capture: digital recording of movement.
Phoneme: individual sound from the phonetic alphabet, multiple phonemes form speech.
Pose-to-pose animation: principle of animation where key poses are drawn or keyed first and the in-between poses are added or interpolated afterwards.
Real-time: live. (But this requires further discussion).
Straight ahead animation: method of animation where the frames are drawn or keyed in chronological order.
Puppetry: physical puppetry, the manipulation of inanimate objects. Examples include the techniques of string or rod marionette manipulation and glove puppetry.
Puppeteering: the manipulation of inanimate objects.

Real-time: ‘live’, where there is synchronicity between the manipulation and the manipulated.
Synthespian: a simulated digital human-looking actor.
Visime: the mouth shape used to form a sound from the phonetic alphabet.
Waldo®: ergonomic-gonio-kineti-telemetric device devised by the Jim Henson Studio.