Composing the Instrument:
An Alternative Approach to Musical Relationships between Composer, Instrument, Performer and Audience

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Abstract

This thesis develops a new conception for ‘composed instruments’ and explores how these instruments can serve to challenge the established norms of musical relationships. It investigates the relationships between music and those who listen, make and facilitate it and, by extension, the relationship between the audience, the performer, and the composer. Music need not be bound by the constraints of traditional instruments and performances can be interactive as opposed to didactic.

These notions are investigated through the lens of a series of composed instruments, particularly the Arduinome (and variants), the *Large Flat Panel Speakers* (*LaFPanS*) and the *Augmented Televisions* (*ATVs*). The building of each of these instruments contributed to the refinement of the concept and, in turn, each has proven to offer a range of artistic possibilities as a result of being developed through a compositional process.

The notion of the composed instrument as defined within this text aligns somewhat with the Fluxus group of artists, fostering the transition from audience to performer through universal playability and the levelling of musical hierarchies. Such an approach can re-organise performance hierarchies and have a democratising effect on music-making.

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List of works and excerpts

These are described throughout the text. The first nine items are held as music files on the accompanying CD. The remaining videos are held on the accompanying DVDs as listed.

CD Track	Audio Title
1	Cymbals Study Part 1
2	Cymbals Study Part 2
3	Cymbals Study Part 3
4	Lincolnshire Poacher (example of a numbers station broadcast)
5	Swedish Rhapsody (example of a numbers station broadcast)
6	Backwards Radio Station (example of a numbers station broadcast)
7	Stick Vs Monome (with Ed Perkins)
8	The Jason Dixon Line (with Jason Dixon and Owen Green)
9	3 Minute(ish) Pop Song (with Owen Green and Sean Williams)

DVD 1

Thinking Path
Numbers Station
Code-A
ATV01
ATV02

DVD 2

Anthony Bailey – Contours II
Daniel Mills – Edification
Daniel Mills – Massacre

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1
Introduction

> The ideas discovered through practice have a great influence not only on the sounds heard when we listen to electronic music, but also on the compositional process, the technology and instrument design and on the practice itself. (Williams, 2012: 9)

So is the case with the composed instrument, the concept of which I developed from the creation of musical works and the approaches taken to build instruments with which to realise these works. The Fluxus movement of artists has provided useful inspiration, being rooted in what Jerry Mander (1996) termed ‘deep democracy’ that encourages “attentiveness to all the voices of experience” (Higgins, 2002: 66). Ina Blom (1992) established that the Fluxus group operated under an ‘intermedia dynamic’, where an experiential modality exists through the relationships between “secondary systems of knowledge” (Higgins, 2002:95) (the arts) and “life media (spontaneous decisions, the relationship to the environment, and the physical parameters within which the work occurs)” (ibid). By approaching the creation of instruments with similar goals in mind a democratising process begins to emerge that manifests within those instruments, dismantling the usual musical hierarchies so that audiences may become performers and performers may have tangible input into the compositional process; the composed instrument starts to form.

This thesis explores how composed instruments serve to challenge the established norms of musical relationships. It investigates the relationships between music and those who listen, make and facilitate it and, by extension, the relationship between the audience, the performer, and the facilitator. Music need not be bound by the constraints of

traditional instruments and performances can be interactive as opposed to didactic.

The composed instruments discussed in this document (and detailed in Appendices 1, 2 and 3) are, briefly:

> the **Arduinome**, an open source version of an existing instrument, the Monome, that I have used, adapted and expanded,
> the ***Large Flat Panel Speakers*** (*LaFPanS*), a set of door-sized panels I built for use within my work, which can function as speakers, microphones or percussive surfaces, and
> the ***Augmented Televisions*** (*ATVs*), a set of old black and white televisions, adapted to display graphical representations of audio signals and expanded with microphones.

These instruments are investigated in relation to the different works created with them by myself and other composers in order to demonstrate the compositional possibilities that a composed instrument approach affords, and will provide context and background for the accompanying portfolio of works contained on the CD and DVDs.

The works contained on the accompanying portfolio are in the following forms. DVD 1 presents my own compositions:

> ***Thinking Path***, a sound-art installation that inspired the concept of the composed instrument,
> ***Numbers Station***, a sound-art installation created with my first composed instrument, the *LaFPanS*,
> ***Code-A***, a more traditional performance piece involving the *LaFPanS*, the Arduinome, two cellists and two clarinettists,
> ***ATV01***, a sound-art installation created with the *ATVs*, and
> ***ATV02***, a performance with the *ATVs* presented in orchestral formation.

DVD 2 contains examples of pieces written by other composers using my composed instruments:

> ***Contours II***, a piece by Anthony Bailey for clarinet and *LaFPanS*
> ***Edification***, a piece by Daniel Mills for eight *LaFPanS* using only their acoustic properties, and
> ***Massacre***, a further piece by Daniel Mills for solo male voice and electronics, modified to incorporate the *LaFPanS*.

CD 1 contains further examples of my compositions (either alone or collaboratively):

> ***Studies 1, 2 & 3 for cymbals***, a collection of studies for cymbals that informed my subsequent experimentation for *Thinking Path*,
> ***Stick Vs Monome***, a collaborative work utilising the Arduinome composed with Ed Perkins
> ***The Jason Dixon Line***, a collaborative work utilising the Arduinome, composed with Jason Dixon and Owen Green for the third Laboratory for Laptop and Electronic Audio Practice (LLEAPP) event, and
> ***Three Minute(ish) Pop Song***, a further piece utilising the Arduinome and composed for LLEAPP, this time in collaboration with Owen Green and Sean Williams

LLEAPP[1] is an ongoing series of conference/workshop events, the third of which was held at the University of East Anglia, 2011. The goals of LLEAPP are to "investigate issues around the collaborative composition and performance of live electronic music, and to confront specific issues around practice-led research in this field." [2]

[1] http://lleapp.blogspot.co.uk/

[2] Email correspondence with Sean Williams, one of the founders of LLEAPP, 02/04/14

CD 1 also includes three examples of numbers station broadcasts[3], which were used as part of the source material for *Numbers Station* on DVD 1.

What makes a composed instrument? This question drives the central concerns of this PhD in addressing how the concept became a fundamental compositional tool for me and what opportunities it presents to others. There have been several attempts made to define composed instruments by the likes of Wanderley (1998), Schnell & Battier (2002) and Fiebrick (2010), but their focus has been on computer systems and the idea that they can "carry as much the notion of an instrument as that of a score" (Schnell, Battier, 2002: 01). In this thesis, however, the focus is on: the compositional processes that go into the creation of an instrument; its function as an agent of non-virtuosic music making; the developmental possibilities that enable it to be re-interpreted by different composers; and the relationships between instrument, composer, audience and performer, the last two of which will often be seen to overlap.

At the heart of the composed instruments and the work created with them is my own particular need to build. The instruments themselves and compositions created with them often take on an intrinsic sculptural element that allows investigation and experimentation with the identities of those engaged with them, both in terms of different composers and different audience groups and performers. The relationship between the body and the instrument is explored in works such as *Thinking Path*, *Numbers Station* and *ATV01*, where bodily interaction without physical contact is essential to their realisation. The use of a contactless interface will be shown to be a useful element in the blurring of the boundaries between audience and performer, enabling and encouraging non-expert music making.

[3] Shortwave coded radio broadcasts of a still as yet unconfirmed origin, though theorized to be for government communication with spies amongst other things.

The musical score and the different forms it takes within my work are also considered. Literal and figurative scores are present within my work, and manifest in different ways and to different effect. Whereas extended musical training is required to be able to execute a traditional musical score proficiently, the use of graphical and other types of score allow non-trained musicians to take musical cues and make informed decisions about the direction of the music that they are engaged in the creation of. This approach works harmoniously with the non-expert nature of the composed instruments, and has a democratising effect on music making, allowing those without specific training to inhabit the role of musician.

Of further importance is the use of open source hardware and software within experimental music making, which directly relates to the release of my composed instruments for experimentation and exploration by other composers. The hierarchy of ownership is addressed in relation to the composed instruments that I have created. Liberating the ownership of the instruments through encouraging others to use them allows an exploration of my relationship to them. A cycle of creativity is created through my removal from and subsequent re-insertion into the artistic process.

Chapter 2 discusses and establishes what it is that constitutes a ‘composed’ instrument and how I have applied this to my own work, specifically within the creation of the *LaFPanS* and *ATVs*. This ground-work is laid so that further discussion of those pieces created with them can be undertaken in the following chapter.

Chapter 3 discusses the pieces created with the composed instruments, investigating the different elements that went into their creation and contextualising them artistically and conceptually.

Chapter 4 investigates the re-use of instruments, including both others’ re-use of my *LaFPanS* and my re-use of an open-source instrument, the Arduinome, that has had wide success within different music-making communities.

Chapter 5 discusses the conclusions arrived at from the exploration of my work.

2

On the origin of the composed instrument

The concept of the 'composed instrument' is central to the body of work contained within the portfolio that accompanies this thesis. It developed from practical experiences that began to emerge from the creation of *Thinking Path*[4], a sound-art installation. Whilst not a composed instrument in its own right, the installation would subsequently inform the various trains of thought that went into conceptualising the composed instrument. The concept that the installation should function as an instrument, as well as an intention to encourage an exploration of the piece by the audience, are central to the development of these ideas. Like Fluxus 'Events'[5] that came before it, these features mean the piece "could be performed by almost anyone" (Higgins, 2002: 72) and contribute to a "non-hierarchical density of experience" (Smith, 1998:1). This was central to the approach of the Fluxus group of artists and operates within the composed instruments, setting the path for the discovery of their potential by those engaged with their performance, and for other composers creating work with them. Practical musical experience of those engaged with the installation could range from zero to those professionally trained on traditional instruments; all would be able to interact with the piece, and each interaction would be as valid as any other, contributing to the aesthetic of the work. Furthermore, that *Thinking Path* coalesces to become a single instrument informs the way in which both *Numbers Station* and *ATV01*, two further installations that also make up a part of the accompanying portfolio, emerge out of their respective composed instruments.[6] Throughout this section, the

[4] Documented on the accompanying DVD 1

[5] Minimal performances, such as George Brecht's *Solo for Violin, Viola, Cello or Contrabass* (1962) for which the score simply reads 'polishing' and Nam June Paik's *One For Violin* (1961) in which "the performer raises a violin overhead at a nearly imperceptible rate until it is released full-force downward, smashing it to pieces" (Friedman, 1990; 114)

[6] As will be discussed in their respective sections and documented on the accompanying DVD 1

presented composed instruments will be used as working models to explore the ways in which the different elements of the concept apply, in order to contextualise and demonstrate the theory in a practical way.

Thinking Path was created for a special themed edition of the regular 'Late Shift' series of evening events at the Sainsbury Centre for Visual Arts to celebrate the 200th anniversary of Charles Darwin's birth. Consequently the ideas behind it were contextualised within these boundaries. The title of the installation took its name from Darwin's 'Thinking Path', the 'sandwalk', a "narrow strip of land 1 ½ acres in extent, with a gravel-walk around it" (Van Whye (Ed), 2002) at Down House in Kent where he lived and worked and which he would walk around several times a day, contemplating and thinking. The layout of the installation[7] was intended to reflect the shape of this path, and the sounds created to represent and encourage similar feelings of contemplation and relaxation. The installation comprised eleven cymbals, each driven by a motor, along with Arduino microcontroller boards, microphones and speakers. The driver motors were repurposed from mobile phones (their original purpose being to provide the phones' haptic feedback and vibrate alerts), which further fed into the theme of the evening, since they were being upcycled and allowed to establish a new ecological niche, evolving beyond their original purpose and drawing on the idea of the objet trouvé as explored by artists such as Marcel Duchamp and, more closely related in terms of my own work, Fluxus artists such as Joe Jones[8] and Nam June Paik[9].

The repurposing of materials affects the way in which the piece is received by the audience, giving artistic capital to objects that would not normally be considered to have any. The social context of those objects is imparted upon the composition, but is also overwritten by their new artistic contexts. In more traditional art forms, works such as Duchamp's *Fountain* (1917), or more recently Tracey Emin's *My Bed* (1998),

[7] See Appendix 5, Figures 15-18

[8] Specifically his 'music machines' and sound art installations

[9] Especially *Participation TV* (1963)

challenge what is and is not art by presenting everyday items as artistic objects. *Thinking Path*, and indeed the works created with my *Large Flat Panel Speakers* (*LaFPanS*) and *Augmented Televisions* (*ATVs*), challenge what is and is not a musical instrument and elevate every-day objects to the level of 'artwork'. Whilst the new paradigm that begins to emerge from this work has parallels with earlier endeavours, there are also important divergences: whereas Duchamp worked with 'readymades', this new paradigm is labour intensive and requires specific skill sets such as computer programming and knowledge of electronics; whereas his work elevated everyday craftsmen to the level of artist, my compositions explore everyday audiences turned into performers.

Thinking Path is dependent on the activity and participation of the audience, to the extent that without their interaction, the installation would cease being able to function fully. In this sense it also operates in an experiential and symbiotic way. By creating this type of situation, traditional roles attributed to composer, object and audience are broken down to create a different kind of dynamic, both in respect of the production of the work (which must now be considered to include the input of the audience) and also the reception of it. I, as initiator of the composition, am removed from the compositional process once the installation is switched on. The indeterminate, dynamic form of the piece is chosen by the audience through the decisions they make as they learn how to control the installation, which by this stage has also become an instrument in its own right. The experiences of the audience grow and dwindle as new people become involved, and so what the installation is, as both composition and instrument, fluctuates until there is no longer an audience to interact with it, at which point it reverts to its original state of rest, before being switched off at the end of the installation period. This particular installation as instrument is therefore composed and recomposed throughout the duration of each 'run', depending on the choices made by the particular audience group at that time. The nature of *Thinking Path* and the actions of the participating audience members is one of indeterminacy, since there can be no way of knowing exactly how the audience will react or how they will engage with the piece. Within

each audience group, however, a level of predictability and determinacy emerge as the participants develop their collective techniques and strategies for playing it. These characteristics are also evident in both *Numbers Station* and *ATV01*.

2.1: Composing the instrument

The idea and terminology of ‘composed instrument’ has been approached and discussed by various composers and researchers. Schnell and Battier, for instance, define such devices as displaying a significant characteristic where “the two main components of a musical instrument, the sound producing part and the gestural performance part, are decoupled, or isolated one from another”. The “gesture is [therefore] linked to sound production in a non-direct, oftentimes non-obvious fashion” (Schnell, Battier, 2002: 01). This approach is problematic and insufficient within my own framework, since they focus on the technological elements of the completed instrument, rather than the compositional processes that went into its creation. The definition is too narrow and limited in regards to what can and cannot be a composed instrument, which reflect the more general and persistent issues given how broad the discussion on what musical composition is and is not can be. The composed instrument should neither be restricted to considerations of the technological possibilities nor of its implications, but rather reflect upon the resulting consequences for its visual and aural perception, the relationships between composer, instrument, performer and audience, and the development opportunities it affords the original, and other, composers as will be discussed in the following chapters.

2.1.1: Relationships

The following section will focus on specific relationships emerging from discussing the role of the composed instrument. It will be shown that the very definition of a composed instrument is informed by and intrinsically dependent on the relationships between the composer, instrument, work and audience. The conceptual discourse developed from these considerations has fundamentally informed my compositions, as a

balanced and holistic synergy between the elements involved has been sought.

2.1.1.1: Composer/Instrument relationship

There are two distinct elements to the relationship between the composer and the composed instrument. While the first deals with the creation of the instrument the second focuses on the approaches and methodologies used to create pieces with those instruments. *Thinking Path* provided the initial conceptual basis for the composed instrument and therefore has been pivotal for my work moving away from conventional techniques to embrace these expanded thoughts. During its conception as a composition it became apparent that it was through involvement in the process of creating the instrument that the compositional potential was defined, hence, within this process the instrument was afforded compositional properties. Andrew Brown (2001) cites Roger Sessions' (1941) extrapolation of the compositional process into the dual method of 'inspiration' and 'execution', "where a musical idea is generated and undergoes a deliberate process of development" (Brown: 2001, 3), alongside other theories of compositional practice by Newell, Shaw and Simon (1962), whose theories involve 'solution generating' and 'verifying' processes (problem solving), and those of Gardner (1980) and Sloboda (1985) who view a "scheme or vision … as an important part of the compositional process [that] … assumes that a musical space exists but is not clearly defined, and the activity of the composer is to find a pathway through it" (Brown: 2001, 3). In the case of *Thinking Path*, each of these approaches to compositional engagement has occurred twice – once for its creation as a composition, and once for its transformation into instrument. Conceptualising the idea for the installation from the original 'Late Shift' brief fulfils the inspiration/solution generating/vision element, where the realisation of the concept satisfies the execution/verifying/path-finding aspect. The transformation into instrument occurs during the time it is installed and audience members are engaging with it, where their initial explorations give way to a learned experience of its sonic and performative properties.

The act of composition itself becomes a tool that allows the musical pathway to be mapped out when using Gardner and Sloboda's approach. This is arguably true of any instrument, and is explicit in my composed instruments where they define the musical space within which a piece can coalesce and occupy. Newell et al's attitude towards composition being a problem solving exercise is present both in the need for the composed instruments to be able to fulfil the required musical functions to achieve the desired results and in uncovering and working with the inherent properties of the different materials being worked with. Sessions' assertions that composition follows a seed and development process are inherently present in any new artistic or technological endeavour. Phil Archer's (2004) reflections on the wider idea of what is composed are also useful here, that it should not be a "fixed set of instructions" but should be arrived at through "a combination of factors" (Archer, 2004: 18), further cementing that the composed instrument should be one created not with singular goals in mind. Rather, the composed instrument should have the possibility of continued use and development engrained within it, providing a much more open platform that can be repurposed, reused and encourages the act of music-making.

The composer's relationship with composed instruments when creating work with them shares some of the same concerns as has just been discussed, since the approaches to compositional engagement remain applicable. As my first composed instrument the *LaFPanS* provided something of a blank canvas in respect of how to approach the next stage of the compositional process with them.[10] By reflecting on my experience of creating works from composed instruments it has been possible to consider the implications for this type of composition in general, including the compositional choices that are made.

[10] That they look like blank canvases may have also influenced my approach at this point.

The *LaFPanS* were originally upscaled from small prototype versions[11] of the instrument in order to be used within the piece *Numbers Station*, an installation that required eight of the panels be built and arranged in a nonagon[12], where the ninth side was the entrance to the piece. Samples of numbers station broadcasts are electronically processed within the Max/MSP programming environment, the extent of which is controlled by the number of people present and how much they are moving within the space, and played back through the *LaFPanS*. Video is projected through the panels and is manipulated using the same control elements and parameters as that of the sound. This facilitates the detachment of the composer from the composition allowing audience members significant contribution in the completion of the composition. The relationship the composer has with the instrument in this instance is evidently far removed from that of a traditional acoustic instrument being used within a traditional orchestral setting and necessitates that the instrument is not just a part of the composition, but in fact acts as a kind of laboratory from which the composition can emerge. This function of the musical instrument is echoed by Klein (2009), who explains that the medieval Muslim philosopher al-Kindī "attributes the invention of musical instruments to the Greek philosophers … so that they could present and prove scientific principles in a way that was directly accessible to the senses" (Klein, 2009: 122). This view displays clear parallels with Sessions' approach to composition as discussed earlier, and the composed instrument is able to function as a catalyst for further compositional processes whilst emerging from the piece as instrument and fundamental building block of this particular composition.

2.1.1.2: Performer/Instrument relationship

A composed instrument is likely to have some familiar and some unfamiliar properties with which a performer must engage. It is entirely

[11] These prototypes were created independently of the compositional idea for *Numbers Station*, but rather to experiment with and explore the technical possibilities. See Appendix 2, Figures 4 & 5

[12] See Appendix 6, Figures 19-21

possible that such instruments will have no natural acoustic properties of their own, and may live entirely in the digital world per those discussed by Schnell and Battier (2002); such instruments have less scope for natural interaction/feedback between performer and instrument unless the digital and physical are coupled using haptic design principals to enable tactile feedback. However, the lack of acoustic properties creates distance between the performer and sounds being created since they are not necessarily localised to the performer or instrument. The communication between the performer and the instrument is therefore removed by one level. Pedro Rebelo encourages that the relationship between performer and instrument be understood as “a multimodal participatory space (and not one of control)” (Rebelo, 2006: 28) in order to “suggest ways in which the performer engages with the instrument” (ibid). These views on defining the relationship between performer and instrument are particularly useful when considering the composed instrument. The use of the *LaFPanS* in *Code-A*, and the *ATVs* in *ATV01* and *ATV02* for instance, offer examples where there is a distinct lack of physical contact between performer and instrument; the performer must encourage musical results from them through continuous interaction while keeping a physical distance from the instruments. For both the *LaFPanS* and the *ATVs*, the way in which the performer must engage with the instrument is neither obvious, nor fixed since, in the case of the *LaFPanS*, they can be reconfigured to function as microphone or speaker, and for both the software element can change the results from composition to composition. The ability to arrange the instruments differently depending on the composition also affects their behaviour and how audiences are able to interact with them. The manner in which they are employed for each composition fulfils Rebelo’s definition that composed instruments function in a participatory space to suggest and invite rather than insist on a particular method of engagement. Furthermore, such an approach encourages the previously mentioned Fluxus ideal that they are more universally usable without prior training, ingraining that notion into the fabric of the composed instrument. Consequently, the idea of the composed instrument as a platform for non-virtuosic music making begins to emerge. The participants are empowered to get immediate results

without having to learn complex fingering, bowing or breathing techniques, based on the employment of simple interface designs (to the point of requiring no physical contact in the case of the *LaFPanS* and the *ATVs*). The initial sense that the instrument might be complicated to use, due to unfamiliarity, quickly diminishes due to the speed in which music-making can occur. Trained musicians and non-musicians are levelled in their musical approach as it is likely neither will have worked with such devices before. The demands and possibilities are therefore equalised and shared, dismantling the hierarchies of the professional and non-professional music makers.

2.1.1.3: Audience/Instrument relationship

The relationship between instrument and audience is perhaps the least tangible of those being discussed here, not least because the use of the composed instruments turns audience into the performer and gives them compositional input as has been discussed above. The situation that the audience engages with instruments they have not encountered before will have an impact on how they perceive each piece of music as a whole, and indeed because they are new will draw attention in a way that traditional instruments do not. The audience will not experience the composed instrument as a stand-alone item, but will invariably be presented with it contextualised within a piece. That the composed instrument will draw the attention of the audience means a level of engagement is present with it that would not usually exist between an audience and the instruments being used within a more traditional composition. They are coerced into participating with the instrument in a manner more similar to how they would normally participate with the composition as whole, attempting to understand its meaning as much as that of the music that is being made with it. John Dewey's discussion of the experiential engagement between artist, audience and artwork where the artist and audience are co-creators of the experience applies here: "we become artists ourselves as … our own experience is reoriented" (Dewey, 1934: 348). A new discourse in musical engagement occurs between the audience, the instrument and the work that treats the

composed instrument as an equal in the creative process and story of the piece it is being used in.

2.1.2: The language of the composed instrument

The purest, or perhaps most naïve, form of any instrument's musical language will begin to be imbued with other elements from the moment of its conception. Historic associations will begin to accumulate, and the word that names them will come to mean more than the sum of the different elements of the instrument. The word 'clarinet', for instance, signifies that instrument but does not offer any real information about its development, what musical possibilities it possesses etc. For those who have heard music made with it, it colours the instrument with that previously created work, masking its language and potential. The almost infinite possibilities of what an instrument can be begin to diminish as time passes, pieces are written for it, and performances undertaken, and impressions of what it is and is not are forced upon it. For composed instruments that they are 'new' and 'different' becomes a defining element of their language from the outset; they do not look or behave like traditional instruments and will communicate this to performers and audiences before any music has even been produced with them. Each composed instrument's musical language is, therefore, coloured by its newness but also sets it apart from traditional instruments. This newness is an inescapable character trait of the composed instrument that will invariably be impressed upon those composing with them, manifesting in a much more free exploration of the possibilities of each instrument, since these possibilities are unknown quantities. Only through wider dissemination of the instruments will this begin to diminish, resulting in the positive effect of removing the taint of newness but having the negative effect of increasing potential for a less free exploration of the instruments' musical properties by composers and engaged audiences/performers alike, as previous uses become the dominant way of approaching the instruments.

Landy (1991), asks what it is that people are trying to communicate through their compositions. The question should also be asked of the composed instrument in order to further establish the benefits of the concept, beginning with the assertion that the composed instrument must communicate something that traditional instruments do not. The relationships that have so far been discussed inform this question, since it has been recognised that they are different from those that exist for 'traditional' instruments, instead following a more composerly route; it logically follows that what and how the instruments communicate to and with those engaged with them is also different. The lack of (musical) historic associations contained within new instruments will have an impact on the dialogue present between them and those engaged with them; where traditional acoustic instruments have an historic system of reference composed instruments do not. That the composed instrument does not possess these points of reference allows for the open approach to writing for and performing with them. The non-expert performance enabled by the instruments and undertaken by the audience as player is therefore an essential characteristic of the composed instrument's language. This does not preclude performers from becoming well-practiced on the instruments, but continues allowing those who are not to be as viable a part of the music making process.

In the case of the *ATVs*, the cultural language of the televisions is so powerful that it is impossible to escape it, and so must be incorporated in some way into the new compositional and musical language with which they have now been imbued. Diana Thater states: "[Video] played on a monitor like television... subordinates itself to the codes of another medium." (Thater, 1996: 12) Therefore whilst the new language subverts the original somewhat, it cannot completely dissociate the TV from its domestic surroundings. Although the video-producing ability of the un-modified TVs has been removed, so that they are now only able to display Lissajous figures[13] generated by an inputted audio signal, and the *ATVs* require active participation to function rather than the passivity of

[13] See Appendix 3, Figure 10

use characteristic of normally functioning sets, the TVs are still, fundamentally, TVs. The new use of the TVs, however, as with Nam June Paik's work in a similar area[14], begins to move away from the traditional TV code, helped in my own case both by the augmentation of the units and the distance afforded by time; the black and white CRT TVs I am using are no longer a part of everyday life, and for most people have not been for several decades, but have been replaced by much slimmer, homogenous objects, that now often fill the space where previously a work of art might have hung on a wall. That the *ATVs* actively function as contemporary works of art provides a useful comment on modern TVs' place in the cultural landscape and widespread role in Western societies' households, inhabiting the space that their modern counterparts have wrested from traditional canvas-based works of art.

2.2: Summarising the instrument

Composed instruments can exist at a range of points on a scale of types of manufacture: considering my own instruments, the *LaFPanS* were custom-built, the Arduinome is a version of pre-existing open-source hardware, and the *ATVs* are made up of repurposed technology. The fact that this is the case from a technical standpoint helps to illuminate that it is the 'why' and not the 'how' that constitutes a composed instrument, and that there is not one 'correct' technological approach to creating a composed instrument. Instead, it is a set of ideals and a particular approach with certain goals in mind as have been discussed above. The composed instrument acts as mediator, allowing the transition from audience member to performer, informing the compositional process of those working with them so that the function of those traditionally different groups can be explored, and providing their own space within which musicians can work. Because of this they are able to connect with those engaged with them in a manner different to that of traditional instruments, the performers of which would usually require many years of practice to become proficient, and the audiences for which would normally be

[14] Including the aforementioned *Participation TV* (1963), but also works such as *Magnet TV* (1965) and *Double Face Arc* (1985)

passive, rather than actively engaged with the instruments. The main benefit of the composed instrument is the way in which the pieces that are created with them are informed due to the way they challenge traditional musical relationships. The benefits afforded to those compositions are also the strengths of the instrument, which in addition to how they behave musically, include the above socio-cultural factors. Furthermore, composers are free of the historic cultural baggage that traditional instruments possess, and so a more free exploration of the musical properties of the composed instruments is possible. As will be seen in Chapter 4, composers are able to approach the composed instrument from different standpoints and to coax different behaviours not just from the instruments, but also from audiences through the reorganisation of musical hierarchies.

3
Composing (with) the instrument

Some of the implications of creating work from composed instruments have been touched upon whilst defining what it is that constitutes such a thing[15]. The practical creation of these instruments has formed an integral part of my compositional process, not least because of the technological restrictions of what can and cannot be achieved with them and how such things affect the musical choices that are able to be made. Each of them possesses its own particular and peculiar set of restrictions within which it possible to work, and also suggests its own possibilities for extension and augmentation. As with traditional instruments, the physical and musical characteristics of each composed instrument influence the direction of a work made with it, but more strongly than traditional instruments enforce a situation whereby the other elements that make up the piece are subservient to them. In my experience it is important to recognise this when commencing the compositional process in order that, amongst other things, the instrument does not become the sole focus of the work. The performance space is another important element of the compositional process, and for many composed instruments the relationship between instrument and space will be a vital one. This is certainly the case for my own compositional process, although I would not describe my work as site specific; the pieces can work in many different spaces, but those spaces must be chosen carefully.

3.1: Building the composition

In addition to the general accounts on the role and the importance of technology within experimental composition, I have found it particularly helpful to draw and reflect on several theories and approaches from the available literature. Pierre Boulez (1977) saw technology as an enabling

[15] Such as altering the performance hierarchy between musicians and non-musicians and facilitating an exploration of relationships between instrument and those engaged with them.

force with the potential to provide endless possibilities should the composer be brave enough to break traditional taboos. Leigh Landy (1991) observed that technology has always been present in music and is essential to it, though is concerned about the composer's potential for becoming deferential to it. Gordon Mumma (1967) considered the design and construction of the technology he would use in his works as composition in its own right, which forms a distinct parallel to the composed instrument. Daria Semegen (1989) questions whether it matters what technological means are used as long as the desired musical output is achieved. The use of technology within the compositions that make up this PhD portfolio draws variously from these different, but not mutually exclusive, ideas.

It is necessary here to note that I consider myself a builder as much as I do a sound artist and composer; the instruments, compositions and installations I create have a distinctly sculptural character. The involvement of technology in their construction is not a by-product, but guides the form that these 'sculptures' take. At the most distilled level any decisions made in respect of the technology used in the compositional process are directed both by the musical demands according to the types of music I choose to create and the aesthetic factors as a piece of visual art. The need to build rather than to use 'off the shelf' technologies is at the root of this issue when it comes to the use of instruments within my work, but other factors, discussed below, are at play in the realisation of the form the works created with them take.

3.1.1: The reason to build

The act of creating something with physical presence provides the builder with a particular satisfaction. However, more importantly the act of building an object equips the creator with an intrinsic knowledge of its construction and materials that would otherwise be impossible to develop. It is feasible to appreciate something from an outside perspective, and to develop a personal connection to it, but it is not possible to attain the same *type* of intimacy with it as the creator. There is a nurturing bond

inherent, akin to having given birth to the instrument, but this can also blind the creator to the flaws, and indeed possibilities, within that creation. Applied to the development and construction of instruments, composed or otherwise, this situation affects the creative process not just for that instrument, but also for any works made with it by the original builder, both in practical and artistic terms, as the builder experiments with the instrument to fulfil both of the different facets of the design process. It will also affect the manner in which the creator perceives the completed instrument; the builder will not only see the finished article, but will have also experienced first hand and had to decide upon any changes necessary to enable its satisfactory completion. As per the IKEA effect (Norton et al, 2011), a type of cognitive bias that states that a particular blindness to an object's flaws can be present within its creator, there are limitations in any one person's view of any instrument, although the intimacy described could also afford a particular awareness of possibilities. By releasing ownership of the instrument and encouraging others to explore the musical and technological possibilities on their terms, rather than those of the creator, there is greater possibility for the potential benefits to be drawn from the instrument. A derivation of Joy's Law[16] can be extracted from this: no matter how good you are at composing for your instrument, most of the best ideas will be someone else's since you are just one composer and there could be a near limitless number of other people using it.

3.1.1.1: The instruments

Each of my composed instruments has different traits in both construction and nomenclature. The Arduinome, unless you have specific knowledge, does not possess obvious visual characteristics as to its use beyond that it might control 'something', nor does its name provide any information about the instrument. The *Large Flat Panel Speakers* have a descriptive

[16] "No matter who you are, most of the smartest people work for someone else" (attributed to Sun Microsystems co-founder, Bill Joy) in Lakhanni & Panneta (2007; 2)

name, but their use is not necessarily obvious through their appearance. The *Augmented Televisions* have a descriptive name but an appearance that misguides what their modified use might be, though informs the aesthetic and reception of any piece created with them through existing, engrained, cultural associations, which is a property the other two do not possess. None of these instruments are played in a manner akin to traditional ones (although the *LaFPanS* can be struck like a drum to produce comparable sounds should a performer choose to). There is historic precedence for what can broadly be termed electroacoustic instruments to either:

> a) be created using a traditional instrument as the root of the new one, for instance, Jonathan Impett's Metatrumpet [17],
> b) mimic the characteristics of traditional instruments such as Akai's range of wind synthesizers [18], or
> c) to incorporate some form of user interface that has no relation to traditional instruments such as Michel Waisvisz and Geert Hamelberg's *Kraakdoos*/*Cracklebox* [19].

My own instruments tend towards the third of these categories but do so because of the sculptural approach rather than the desire to create something with a new form of operational interface. In the case of the *LaFPanS*, which were designed to act as speakers first (for *Numbers Station*), and later modified so they could function as microphones (for *Code-A*), the primary performance interface[20] is contactless and was developed to enable them to function as both input and output devices. For the *ATVs*, where the physical form of the instrument is extant from its

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[17] See http://quod.lib.umich.edu/cgi/p/pod/dod-idx/meta-trumpeter.pdf?c=icmc;idno=bbp2372.1994.037 (accessed 16/03/14)

[18] See http://www.akaipro.com/product/ewiusb (accessed 16/03/14)

[19] See http://www.crackle.org/CrackleBox.htm (accessed 16/03/14)

[20] A secondary interface could again be argued to exist here in the form of a hittable drum-like membrane, as utilised by Daniel Mills in his work for the *LaFPanS*, *Edification*.

previous use, the primary interface[21] is again contactless, being a small electret microphone[22] attached to the *ATV*. A microphone of some variety was necessary for the input of live audio material into the *ATVs*, and each was required to have its own in order that they could function as individual instruments. In this way they therefore also exist as a continuation of the *LaFPanS*, sharing similar design requirements and functional behaviours. The interface here then is as much a practicality of the structure of the instrument it is a part of as it is a useful way of connecting to the performer.

In the case of the Arduinome, which is a functional clone of a pre-existing, commercially available device (the Monome 40h[23] using an Arduino[24] microcontroller as its platform) the act of building stimulates ideas on how the instrument could be developed; it is therefore a test-bed. My second version, the *Stronome*[25], augments the original technology with that of another open source device, the Stribe[26], a touch sensitive ribbon-based controller, in order to provide a more reactive playing surface in addition to the button pads, allowing for increased expression in performance. The possibilities for the instrument and for pieces written for and performed on it are increased. Using a Monome, or indeed any other off the shelf button pad based instrument, would have prevented conception of the idea. A further important design element of the Arduinome is the case that the technology resides in, and the base that it is fixed to[27]. Both of these elements add to the visual aesthetic of the instrument, once again providing a sculptural appearance and feel. Since the instrument was augmented with a Nintendo Wii Remote and Nunchuck to make use of

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[21] The brightness control could be considered to be a secondary interface since it still affects the image displayed on the screen

[22] A type of small condenser microphone

[23] An 8 X 8 button pad controller interface, see http://monome.org/devices/ (accessed 30/04/14)

[24] See http://www.arduino.cc/ (accessed 30/04/14)

[25] See Appendix 4

[26] See http://www.soundwidgets.com/stribe/ (accessed 25/03/14)

[27] See Appendix 1, Figures 1 & 2

the accelerometer technology contained within, in order to allow for gestural control, a base was required that would still allow this movement. A repurposed surveyors' tripod was used since a ball joint at its top, once a suitable mounting plate had been built, enabled this movement to occur.

The design of the *LaFPanS* emerged from experiments with international mailing envelopes which are made from Tyvek, a paper-like material formed from flash spun high density polyethylene fibres, while investigating materials to create a loudspeaker with more 'instrument-like' properties. A prototype[28] was made and found to be both durable and impart desirable resonant quality to sounds that were played through it. Further research revealed the material was available on a much larger scale, since it is also used in the construction industry to keep severe weather elements out of buildings during erection, which allowed for the possibility of upscaling the instrument. Although initially created as loudspeakers, from which *Numbers Station* was conceived during the construction process, the possibility for conversion to function as microphones, thereby extending the usefulness and possibilities of the instruments, was imagined during the building process as a development for a future project, which would be realised in *Code-A*. The possibility for tuning the membrane using bolts through the frame[29] emerged from the discovery with the prototype panels that the Tyvek would slacken over time, thereby becoming less efficient as a speaker. Ultimately this was not the case with the full-size models, as the industrial-type Tyvek is much more durable than that used in the shipping envelopes. Both of these features may not have been present had I not gone through the different design and construction stages. Per Sebastian Lexer's discussion on performance which states that "any skills, knowledge and experience forming the basis of the … activity will have been transformed in the course of the activity" (Lexer, 2012: 81), the act of creating these instruments through experiment, where new ideas pertaining to the

[28] See Appendix 2, Figures 4 & 5

[29] See Appendix 2, Figure 8

potential technological and artistic development of the composed instrument are formed over time, becomes one of self-reflection.

The creation of the *ATVs* follows a slightly different route due to their being built out of an existing technology with an explicit use. The modification to the scan coils[30] of the TVs to accept audio was a known technical possibility, and artists such as Nam June Paik have undertaken similar modifications previously for artistic purposes. There is also a history of such changes being made in order for TVs to be used as oscilloscopes[31]. The *ATVs* were intended to function both technologically and artistically as a progression of the ideas employed in the *LaFPanS*, thereby providing an additional guiding force. Each TV was required to act as both input and output device, with the signal going to the scan coils also needing to be connected to the TV's own speaker, and a microphone coupled with each. Spill from the speaker into the microphone and the possibility for feedback was also likely, and so became a characteristic of each instrument rather than a problem to overcome. The design requirements for the *ATVs* were required to fulfil the social commentary that modifying technology with such engrained cultural meaning inevitably provokes. The inclusion of augmentations that would enable audiences to directly engage with and generate the audio and visual material transforms the TV from a passive into an active experience. The modifications already described achieve this. Effectively, therefore, what the *ATVs* were required to achieve technologically and aesthetically was guided by two previous technologies: the original TVs and the *LaFPanS*.

The physical nature of the instruments' structure and how they are able to be used within the type of work that I wish to create also informs the desire to build. Since a great deal of the work has installation-like properties, the instruments created must be physically suitable for this type of application. In the case of the *LaFPanS*, where the original experiments undertaken were on a much smaller scale before being

[30] Originally used to trace out a blank screen for the picture to occupy

[31] A piece of equipment to allow the observation of constantly changing signal voltages

enlarged for *Numbers Station*, their size was dictated by that installation's need for them to contain the participants, so that when combined they could form a structure capable of creating an immersive environment. The monolithic, minimalist character of the panels' visual aesthetic gives nothing away about their function, whilst the nature of the Tyvek is useful for the back projection of images (which has become a recurring device in compositions created with them).

For the *ATVs*, whose physical nature is extant, the design and construction of the plinths that they rest on was important to allow them to be at a reasonable height to allow for interaction, but also visually complementary so as to not detract from the *ATVs*.[32] The presence of the plinths also adds a further sculptural element to the *ATVs*, since it is this that presents the instruments as art objects as would be found in a gallery space. Creating sculptural works within music is comparable to the relationship between traditional sculpture and non three-dimensional works. Sculptures can be walked around and viewed from many different angles, where their counterparts cannot. A sculptural object for the creation of music contains the sound dimension of non-sculptural music, but also the three physical dimensions where an orchestra is usually presented as a non-three dimensional entity; it is at this point that the boundary between audience and performer is able to be blurred and the experience becomes relational. A sculptural approach helps to embed the audience within the work.

There are also important socio-political reasons for building instruments. The Arduinome, as has been discussed, is a clone of a pre-existing, commercial device, the Monome, which itself is open source hardware meaning that the full design is universally available, allowing anyone with sufficient technical knowledge to recreate their own version. This allows projects such as Arduinome to become an integrated part of the Monome community, which in turn allows for development of the hardware in whatever way a specific user desires. The idea of open source (software

[32] For practicality they also needed to be able to be easily assembled and disassembled for both ease of transport and ease of setting a work up

and hardware) is socially very attractive, encouraging a sharing of ideas in a free and open way, meaning that those ideas are driven by curiosity and the desire to develop something with which others can engage on a practical level rather than by, for instance, financial gain. This socialist approach to art, and specifically in relation to this discussion the design and construction of instruments, encourages the idea that these objects and the things created with them should be available to and for everyone, and not just as objects to be observed from a distance. By creating the instruments in this way it is more easily possible to convincingly apply those same notions to pieces created with them. This approach and philosophy is applicable both to the creation of my instruments and the works made with them, to the extent that the compositions are often guided by those participating in them, as has previously been mentioned in respect to *Thinking Path*, *Numbers Station* and *ATV01*. Active engagement with the instruments and the pieces by the audience is often essential to their functioning. Both the *LaFPanS* and *ATVs* have been made following the principals of using openly available circuit diagrams for their construction and/or modification, making them more easily reproduced by others should they so wish. Taking such an approach has a democratising effect on music making, and helps to remove ownership of devices by individuals, which in turn encourages a broadening of the artistic possibilities of the instruments. It challenges the idea of hegemonic institutions, renegotiating hierarchies so that those involved in the process are operating on a more levelled playing field; conventional musical authority is challenged. Almost anyone could become the instrument builder, and the traditional need to defer to a shop or luthier is negated. Through their openness potential is created within the instruments, both in terms of developmental possibilities and in the manner in which they could be employed, making their use by other practitioners a desirable prospect.

3.1.1.2: The works

As previously noted, the physical form of my works is directly related to that of the composed instruments that have been used in them. It is also

a response to the idea of the performance space, both in terms of the physical objects and of the sounds being produced.

The structure that the compositions take both changes the space that they have been set up in and also creates a new one within it. They are able to create harmony or dissonance with the space that they are set up in, or foster a situation whereby that space becomes largely unnoticeable and certainly unimportant in respect to having any artistic input in the piece. It is at this point where the compositions become the sole performance space or environment; the site/space simply happens to be where it is situated at that point in time. This situation is not necessarily fixed, however. It is possible for different spaces to impact differently on the same installation. For *Numbers Station*, for instance, being set up in the main gallery space of the Sainsbury Centre for Visual Arts for its first iteration imbued it with the cultural associations of such a space, whilst at the same time challenging the traditional experiences of gallery goers that art is to be looked at rather than physically engaged with, what Julie Reiss would term “break[ing] the rules of proper museum decorum” (Reiss, 1999: 78). When it was set up in the Strode Room of the School of Music at the University of East Anglia, however, which is fundamentally a large empty room, the installation took over and became the performance space. The additional cultural elements of the museum setting were removed and the piece operated more on its own terms. While an interesting social commentary was lost, a focus on the installation in a more ‘pure’ form was gained. Setting *ATV01* and *ATV02* up in the main auditorium of the Norwich Arts Centre, a repurposed medieval church, created a desirable juxtaposition of the ancient and the (relatively) new, and the acoustic properties of the room further added to this effect. That the church, like the *ATVs*, is also repurposed provides a useful aesthetic parallel, since both have found new life in a different function, and *ATV01* and *ATV02* made use of what would have otherwise been an unavailable space had it remained in its original use. For none of my pieces, however, is the specific site/space that they are set up in an integrated part and the intention is that they are able to be installed/performed in different types of suitable venue. These venues

may differ wildly from each other, but each will bring something different to the piece being performed in it, as demonstrated by the different *Numbers Station* installations.

The sounds produced by the installation works have their own sculptural qualities since they are not temporal and have no definite start and stop points. The immersive nature of the works possesses the sounds with a kind of tangibility, so that a participant goes beyond simply hearing to the point of being able to feel their presence, what Michael Brewster (1998) would term “a dimensional substance you can move through without hitting your head”. To extend this idea further, the act of hearing being omnidirectional enables the whole of the sound as sculpture to be experienced simultaneously; the sound becomes the performance space as much as the actual location that the installation is set up in. It is the building of the physical structures, utilising the composed instruments in a sculptural way, which enables this process.

The act of building compositions creates a situation that encourages, but does not impose, audience participation, replacing the passivity of the traditional concert space and creating work that is inclusive rather than exclusive, again democratising the music-making process and renegotiating traditional hierarchies. The participatory engagement in the performance creates a situation where audiences are a part of what they experience, and are given responsibility in the work beyond sitting to listen. Per Jacques Rancière, the listener is no longer inert, but is emancipated since, as with “the relations between saying, seeing and doing”, the act of passive listening belongs to the “structure of domination and subjection.” (Rancière, 2010:13) The installation works will do more or less depending on how much the participant wishes to engage with them, and there is no right or wrong on how, and the level of, that engagement should occur. Whilst it is more difficult to just observe *Numbers Station* due to the relatively small size and enclosed nature of the installation, such a thing is possible with both *Thinking Path* and *ATV01*; no-one is forced to take an active role in the generation of sounds should they not wish to do so and it is a viable action to let others take the

lead. The situation is different for *ATV02*, since the piece will not do anything until it receives a seed signal from a member of the audience, but that seed sound is likely to be a cough, sneeze or shifting of a chair, all of which are involuntary actions that do not require conscious participation; the audience remains active in the performance of the piece, but in a way that does not require anyone to overcome any inhibitions about public exhibitionism. Such activity upends the traditional binary roles of performer and spectator, eliminating the need for the virtuosic performer.

3.2: The body and the instrument

Traditional relationships between the body and the instrument tend towards the instrument being viewed as an extension of the musician, in part due to the intimate contact between performer and instrument and the physical interdependence of gesture and sound production, coupled with notions of instrument technique being internalised to the point where practice can occur without having to think about it anymore[33]. The instruments involved in this discussion, with the exception of the Arduinome, require no physical contact but there can still exist an interdependence of gesture and sound production depending on the way in which the instruments are used. Bodily motion is, for instance, required in *Numbers Station* to control the sonic and visual elements, and can be employed in *ATV01* to generate feedback. Audio engagement is necessary for *Code-A*, *ATV01* and *ATV02*, since they function depending on the sounds inputted into them.

The reactive/interactive nature of *Thinking Path*, *Numbers Station* and *ATV01*, and the manner in which they operate as individual and combined instruments, allows participants to discover and explore the performance space that these works create with their bodies. For works like *Numbers Station* and *ATV01*, where the larger combined instrument

[33] See Heidegger's (1962) discussion of tools as "ready-to-hand" (where the tool is "totally absorbed into our projected purpose" (Thomas, 1999: 68))

is the performance space that the body inhabits and experiences from within, the instrument functions in what Yolande Harris would term an "exocentric (rather than egocentric) space of interaction" (Harris, 2006: 151). Where the installations provide the space for performance to occur, contactless gesture from the audience enables the realisation of the exocentric act and the presence of the body unlocks the potential of the instrument/installation. The feedback systems in place provide a responsive element useful to the performers and key to the way the installations and instruments function. These systems manifest both sonically and visually, and serve a further score-like purpose as will be discussed in section 3.3. Gesture stimulates sonic and visual activity, which in turn stimulates further gesture. For the *ATVs* the visual activity is of particular use to the untrained audience/performer, since it provides an immediate and easily understood causal relationship between them and the instrument. The reciprocal interaction present between the composed instrument and the performer/audience instils a "subject-object polarity" (Corness, 2008; 21) within that relationship. This view of embodiment as reversibility, as theorised by Maurice Merleau-Ponty (1968) is present in, and essential to the execution of, *Numbers Station*, *ATV01* and *ATV02*. Through the relative presence of both the audience as performer and composed instrument, reciprocal engagement occurs, further aiding the renegotiation of traditional musical hierarchies.

The Arduinome requires physical contact to function, but unlike the *LaFPanS* and *ATVs* is not an instrument that lends itself to use in installation-type works. As an instrument intended for more traditional concert-style presentation, physical contact that contains a strong causal relationship is useful in enabling the instrument and its function to be understood by the audience. As will be discussed in Chapter 4, motion control has been implemented on the instrument, improving the causal relationships between performer and instrument, while LEDs provide visual feedback for the performer, dissociating the Arduinome from the computer by removing the need for constant referral to it, and empowering the device as an instrument. Such control is particularly useful in works such as *Code-A*, where the Arduinome is competing with

traditional acoustic instruments, and in the LLEAPP pieces where distinctive performance gestures were deemed to be desirable for the improvisational nature of the works.

3.3: The score

The idea of the musical score has recurred throughout many of the compositions contained within the accompanying portfolio, either in a literal form, as in *Code-A* or in a figurative one as is the case with *Thinking Path, Numbers Station* and *ATV01*. For these latter three works, the score both is, and is not, an overt presence; it is a part of each piece but it is not fixed, and is a product of the interactive nature of each of the works. Each of the different types of scores present within my work is a manifestation of my interest in scores that require the performer to be involved more than simply rendering something that has been written down by a composer. Where *Thinking Path* is concerned, the score is audio based and generated by the actions of the participants as they learn how the installation functions and what sounds can be coaxed out of it. As they learn how to play the installation, so they generate behavioural cues and by listening to the sound material produced can follow these cues to repeat certain actions or avoid them. A similar thing is true of both *Numbers Station* and *ATV01*, where the activity of learning how to play the installation/instruments also provides these same sorts of behavioural cues. In the case of *Numbers Station*, the motion of the participants inside the installation affects the video and audio playback, meaning that there is both a visual and sonic element to the score. For *ATV01*, the visual and sonic scores are created by the types and volumes of noise made into the embedded microphones for each *ATV*, or by proximity to the microphones to create feedback. Additionally, the arrangement of the *ATVs* guides the participators in their playing, and should also be considered to be a part of the installation's score.

The literal scores used in *Code-A* take two forms, that of a 'traditional' notated score[34] and a graphical score consisting of barcode-like imagery

[34] See Appendix 7, Figures 22-32

back-projected through the *LaFPanS*[35]. While the traditional score provides the notes for each instrumental performer to play, it is the graphical score that provides the performers with the information for them to interpret how to play those notes, providing cues on how to interpret characteristics of the music, such as dynamic range, timbre and length of note[36]. A thick line will usually be interpreted as a longer, or perhaps louder, note, whereas a thin line will more often be played staccato. The barcode imagery was chosen due to cultural familiarity and ease of understanding and therefore of interpretation by the performers and audience alike[37].

The barcode imagery serves as score and conductor, allowing the Arduinome performer some control over the density, and therefore also the mood, of the music. Whilst a basic interpretation of the imagery could equate to thinner, sparser lines encouraging a more lively way of playing, with thicker, denser lines producing more drawn out, slower changing notes, the Arduinome performer is required to listen to the manner in which the cellists and clarinettists are interpreting the graphical score. The relationship between the Arduinome performer and the cellists and clarinettists is more nuanced than being simply one of control, but is based on an exchange of information. Since the manner in which the instrumental performers interpret the graphical score cannot be enforced or predicted, the piece has elements of what Stockhausen might have called a "controlled randomness" (Stockhausen, 2000: 65). When coining this term, Stockhausen was discussing his work *MOMENTE*, and goes on to describe how he could "define how thick the line, the melody, may be at any given place; or I could go further and define an upper and lower limit within which the players are moving" (ibid). The Arduinome

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[35] See Appendix 7, Figures 33 & 34

[36] John Cage's *Variations II* deals with similar sets of instructions embedded into the graphical score, though does not have a separate notated element which these instructions are intended to guide

[37] Barcode imagery has also been successfully employed by the likes of Ryoji Ikeda in his installation *Test Pattern* (see http://www.ryojiikeda.com/project/testpattern/ accessed 17/01/14)

performer is able to guide what they would like the instrumental performers to be playing by literally altering the thickness of line. It is not an exact science, however, since the images generated are done so randomly but within set parameters so that tilting the Arduinome left and right produces thinner and thicker lines accordingly, whilst forward/backward motion alters the density of the amount of lines.

Since the graphical part of the score is not fixed, but changes according to the choices made by the Arduinome performer, the act of listening is key to the performance, as each performer will have a different interpretation of the images, but must be aware of how the others are playing in order that the performance does not become too disparate. Furthermore, the 'conducting' of *Code-A* by the Arduinome performer is visualised through the graphical score, adding an extra layer to its purpose.

Even when a notated score is present, the approach taken is that the performers, be they trained musicians or audience members taking on this role, may interpret it as they see fit so that, once again, indeterminacy is at play within the pieces. Additionally, a democratising of the music-making process again occurs and it is the composed instrument that mediates this process.

3.4: Digesting the Instrument

There has been an underlying theme of re-use and potential for development in the works presented in this document, both in respect of the composed instruments and the pieces created with them. The *LaFPanS* developed from experiments with smaller panels and the *ATVs* from the *LaFPanS*. The Arduinome is a development of the open source Monome, which I have further developed to include the previously mentioned 'Stribe' technology to create the *Stronome*. The instruments have been used in various roles in different compositions, exploring both their developmental and creative possibilities and, indeed, it would be entirely possible to create a second version of *Numbers Station* with the

ATVs. David Tudor's preference "to use modular materials which can change from piece to piece … [enabling him] to expand a piece by adding components to it which were not in the original formation" (Tudor, 1988), provides a useful analogue, and this approach has led the way in my desire to include the invitation to other composers to experiment with my instruments and to see what they are able to get from them, both technologically and compositionally. Removing myself from the creative process enables the instruments to be seen and used from a fresh perspective and to both develop and reveal their identity. More than this, it allows me as creator to view them in a new light.

4

(Re)composing the instrument

The socio-political reasons for building instruments, as discussed in Chapter 3, are also relevant when encouraging re-use and development by others. Sharing the instruments and the technology that makes them up, that is to say both the artistic and scientific sides, is essential if any attempt is to be made to create a working community. In the five years since it was established, the continuing development of the LLEAPP group has demonstrated the possibilities for such activities on a practical music making level, nurturing, as it does, a “forum for exploring shared issues around sound, composition, performance and technology and to foster collaborative, practice-based research between practitioners” (LLEAPP, 2009). Such a community is well placed to expand in size and scale, bringing in discussions on new approaches to the creative process, considering other instruments and other compositional techniques and positively serving the wider music-making community through its shared activities. The Fluxus Group of artists again provides useful insight, having a “communal structure” and “discursive function” (Higgins, 2002: 187), that was informed by John Cage’s 1957-59 class in musical composition at the New School for Social Research in New York, which dealt in experiments in music, performance and poetry. Allowing different strains of artistic thought to permeate through each other, promoting experiential learning and “interdisciplinary exploration … and the non-hierarchical exchange of ideas” (ibid: 189), has allowed the survival of this loose group of artists for half a century. The sharing of composed instruments with other composers and practitioners allows their thoughts and experiences to inform the evolution of each instrument and of the concept itself, so that both the physical tool and the idea that it has been created from can change and be of different use to different individuals or groups engaged in the process of the composed instrument. The way in which the *LaFPanS* have been of use to Bennett Hogg, for instance, differs considerably from the experiences of Anthony Bailey, Josh Bowker

or Daniel Mills, all of whom have used them in some way as will be discussed in this chapter.

A further point of note is the issue of ownership. Arguably these are 'my' instruments, but labelling them as such has a limiting effect and implies a kind of inherent collaboration between myself and any other composer who wishes to write for and with them. Where, for instance, Anthony Bailey has written *Contours II*, the piece could be seen as 'Anthony Bailey's *Contours II* using William Vine's *LaFPanS*'. Although I have composed them, like any piece of music they are open to different interpretation, but unlike traditional compositional forms their use by others should not be viewed as a variation on a theme. Even though on a conceptual level they have been composed, the physical objects are still instruments that have been designed and built rather than authored, so there is no need to attach my name to them. While traditional instruments are also played and interpreted differently by each musician, the realisation of the composed instrument as, per Feruccio Busoni's interpretation of the notation and performance of a piece of music and explained by Austin Clarkson, the "'transcription' of an idea" (Clarkson: 2004, 9) sets them apart from this. This same aesthetic informed David Tudor's compositions, and the electronic components from which they are made up fit squarely into the definition of a composed instrument. As stated by Nicolas Collins, "the circuit … became the score" (Collins: 2004, 1). Where Tudor insisted on control of his technology, however, I seek to remove myself from the ownership of the composed instruments. Only through experimentation and use by others is this possible, the action of which is two-directional: relinquishing ownership leads to others being more likely to use an instrument, but it is the re-use that actually allows the process to occur.

4.1: The Arduinome

I discuss the Arduinome first in this section of the thesis since I am the one who has taken a pre-existing instrument and re-cast it in my own situation and for my own needs. Reflecting on my processes and

experiences of (re)composing an instrument has given me valuable insights for the consideration of how others have used my composed instruments and how they might continue to be used in the future. The Arduinome was adopted as a test-bed and prototype for the approach and development of many of my instrumental creations. It has enabled musical practice in several different ways, from the improvisational approach taken in *Stick Vs Monome* and the LLEAPP pieces, through to the more traditionally composed nature of *Code-A.*

As has been discussed, the open-source nature of the Arduinome's hardware and software, along with its modular nature, provides an excellent development platform and has led to the growth of an extremely vibrant and productive community of users and developers, who have created and shared countless Max/MSP patches to be used with the instrument. Notable applications include 'mlrv'[38], a live sample-cutting platform, 'flin'[39], a poly-rhythmic pattern generator and 'polygomé'[40], a performable pattern instrument and arpeggiator. Some users and developers have sought to augment and modify the instrument to serve their own specific needs, through the incorporation of motion control, full wireless connectivity, pressure sensitive keypad grids and rotary encoders, amongst other things[41]. These have extended the creative possibilities of the instrument amongst a still increasing user-base. There are devices that have taken the Arduinome or its progenitor the Monome as a starting point and gone further, such as Flipmu's 'Chronome'[42], and instruments that have been inspired by it, such as the already mentioned 'Stribe'. There are also software versions of the instrument available for smart phones and tablet computers. That countless users have been able

[38] http://monome.org/docs/app:mlrv (accessed 05/05/14)

[39] http://monome.org/docs/app:flin (accessed 05/05/14)

[40] http://monome.org/docs/app:polygome (accessed 05/05/14)

[41] See http://elettrofonesi.blogspot.co.uk/2009/11/arduinome-x16adc-mod.html (accessed 30/04/14) for an example of a user adding potentiometers for additional control options.

[42] http://flipmu.com/work/chronome/ (accessed 27/04/12)

to repurpose the instrument to work seamlessly in different situations highlights the success of the Monome as an instrument.

While experimenting with my original Arduinome it became evident that some sort of motion control would be useful functionally, musically and conceptually in meeting the terms of the composed instrument being a platform for augmentation and development. On a functional level, such control allows for parameter manipulation that is unavailable via push buttons, thereby increasing musical possibilities. On a musical level both causal and bodily expression are enabled, allowing more direct communication with an audience, and allowing the performer to 'feel' the performance in a way more akin to those undertaken with 'traditional' instruments. For pieces like *Stick Vs Monome*, *The Jason Dixon Line*, *3 Minute(ish) Pop Song* and *Code-A*, these forms of expression were essential to the success of the Arduinome within those compositions, since they are performative works meant to be observed by an audience. Incorporating bodily expression facilitates a 'human' element, allowing the performer a direct relationship with the instrument through clearly perceivable causality between gesture and musical result. This can be helpful to audiences, particularly those not used to electronic music performance. Actions able to be viewed as causing reactions are conceptually more easily understood than those dissociated from the behaviour of the sounds produced. I find such an approach to be valuable since there is much about experimental electronics-based music that can be off-putting without adding an extra layer of confusion to the mix. The slow developing sonic nature of pieces like *Stick Vs Monome*, for instance, benefit from audiences being able to see those changes being actioned, providing visual stimulus in addition to the perception of an action causing a certain musical result. In order to experiment with motion control I used pre-existing components that provided the necessary hardware and pre-existing Max/MSP objects available for connection to the computer (in this case a Wii Remote and Nunchuck, simply attached to the case of the Arduinome). This rapid prototyping approach enabled me to explore the expressive possibilities of motion control without having to rewire any of the Arduinome's internal components. Having confirmed

the value of this form of interface I progressed to developing an enhanced instrument that included native motion control, the *Stronome*.

The push button nature of the Arduinome, even when combined with motion control, remains musically limiting. Specific number values are impossible to achieve with the Wii Remote and Nunchuck due to the nature of the accelerometer technology contained within the devices, and experimentation with the prototype Arduinome highlighted the value of including something that can accomplish such fine levels of control. The research undertaken to address this led me to discover the Stribe and the idea of coupling the two instruments. The fact that both the Arduinome and the Stribe are built upon Arduino-based platforms provided some advantages in combining them, including facilitating a degree of code re-use. In spite of the commonality of the underlying platform, constructing the combined instrument still required novel technical efforts, particularly due to constraints on the number of signal channels required for the combined device: the *Stronome* uses a greater number of ADCs (analogue to digital converters) than is available in the Arduinos used in the Stribe and Arduinome. Various approaches were considered, including connecting two Arduinos using their available interfaces, and I ultimately settled on using a more advanced Arduino Mega, taking advantage of its 16 ADC inputs as the approach that would best ensure code compatibility whilst meeting the instrument's technical requirements.

The *Stronome* uses technology from both the Monome and Stribe combined for a more flexible user experience. The device is also fully wireless through the integration of a wireless serial Bluetooth RF transceiver module into the circuit that allows the Arduinome to both send and receive the necessary TTL (transistor-transistor logic) data without the need for cabling. Native motion sensitivity is achieved via a tri-axis accelerometer. The native motion control retains the bodily expression that the instrument had when the Wii Remote and Nunchuk were employed, but creates a more stable and more complete platform to perform with. The visual aesthetic of using games controllers is removed which, whilst initially practical for speed of implementing the motion

control, is visually distracting and imparts undesirable cultural associations onto the instrument, aligning it with a toy and increasing the possibility for it to not be taken seriously as a musical instrument. By coupling the Arduino with the Stribe, ribbon control (where linear motion is registered by touch) is gained in addition to button control, thereby increasing the potential for both causal and bodily expression when performing, and for finer musical control; the possibility for increased musical subtlety is therefore also achieved[43]. Furthermore, the benefits to audience comprehension of how and when instruments are affecting change on the music as discussed above are also increased where greater options for causal control of musical parameters are available. The possibility for creating subtle changes through subtle movement, or more decisive changes through more decisive movements adds sense to what could otherwise be arbitrary theatrical gestures that mimic the dynamic possibilities of genuine fine parameter control.

As mentioned earlier, the inclusion of LEDs in these devices provides useful visual feedback. The meter bridge style lights of the Stribe technology increase this facility so that they could function in different ways, such as level meters, conductor, metronome etc. The importance of visual feedback as employed in the *Stronome* was key when considering how the *ATVs* should function. Ensuring that the Lissajous figures on the screen provided useful visual information to those performing with them was essential, particularly given that they should be able to be used by untrained audience members.

The basic Arduinome possesses useful technology, though lacks those elements that would make it performative. The benefits of this, however, have been to stimulate development so that such technologies that can enable this are included, thanks to the open-source nature of the hardware and software. Experimenting with these technologies has

[43] Other options for control are available, eg MIDI, but the use of ribbon control affords a much higher resolution (1024 as opposed to 128) and so allows finer parameter manipulation.

inspired useful practical and artistic thought in other areas, such as the consideration of visual feedback in other composed instruments.

4.2: Recomposing the *LaFPanS*

To date, the *LaFPanS*, or some version of the instrument, have been used by four other composers: Anthony Bailey (*Contours II*[44]), Josh Bowker (*Interpretations*[45]), Bennett Hogg (*Flow*[46]) and Daniel Mills (*Massacre* and *Edification*[47]). With the exception of Hogg, these composers have chosen to explore the *LaFPanS* as they currently exist, without making further technological modifications or augmentations to them. Each of these three has used at least some of the panels as speakers, both Bailey and Mills utilised some of the panels configured as microphones, and Mills' *Edification* uniquely dealt with the *LaFPanS* as purely acoustic instruments. Hogg's work deconstructs the *LaFPanS*, repurposing the coil element to work with single-pane windows[48], replacing the Tyvek as speaker membrane with an every-day object that comes to function in both its original and new use simultaneously.

4.2.1: Disembodiment

Contrary to my own work with the *LaFPanS*, which are dependent on the presence of the body, the works created by Bailey and Bowker, along with Mills' *Massacre*, are the opposite and each in some way investigates the absence of the human performer.

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[44] See Appendix 8 for composer's discussion of work, and Appendix 9, Figures 35-37 for his score

[45] See Appendix 10 for composer's discussion of work

[46] See http://www.galleryofwonder.co.uk/InfoHogg.html for composer's discussion of work (accessed 16/04/14)

[47] See Appendix 11 for composer's discussion of work

[48] See Appendix 12, Figures 38-44

Bailey's composition, *Contours II*, removes the performer from direct view of the audience[49]. His silhouette is visible through the back-lit panels, creating a new space for the performer to operate in and for the audience to engage with. The virtuosic elements change meaning since the performer is a faceless, disembodied entity that takes on the appearance of a shadow puppet. The speaker panels, to the left and right of the performer, become the other performers in the piece, reacting to and answering the call of the clarinet. Because they possess no human presence, they too are disembodied, despite having a very strong physical structure.

Bailey's work relates to Charles Ives' *The Unanswered Question*, with the clarinet performer taking up the role of representing "the perennial question of existence" (Ives, 1953) previously inhabited by the off-stage trumpeter in Ives' work. Where Ives' trumpeter repeats the same question over and over, Bailey's clarinettist ebbs and flows recasting the question as something less fixed and tangible, but more chaotic and less easy to pin down. The processed audio performed by the speaker panels in turn forms an analogue to the wind quartet, what Ives dubbed the "fighting answerers" in his work. They, again, are chaotic, bringing no conclusion but dying out slowly as the clarinet gives up on its barrage of questioning. The *LaFPanS* here enhance, and make a feature of, the distance between performer and audience which is, again, the opposite of what I have been attempting to achieve in removing the barriers and greying the boundaries between the audience, performer and instrument in much of my own work; here they are recomposed as agents of disembodiment.

As mentioned, disembodiment also plays a part in Bowker's work. The composer reads a poem from behind the panels into a microphone. This is electronically processed in Max/MSP to degrade the audio, being played out through the *LaFPanS*. Each of the panels is adorned with a verse, so that the audience may both read and hear it. The

[49] The same is true for the performer of Mills' *Massacre*, but he chose to use the configuration and lighting situation that Bailey had decided upon for his work, finding it appropriate for his own.

disembodiment is here taken a step further, since there was no back-lighting and so no shadow to indicate the physical presence of the performer. The processed voice coming from the panels further accentuates this, dislocating the performer from a single point.

The modern orchestra is for the regular concert goer embodied knowledge and can therefore, per Don Ihde (1979), disappear for the audience. The disembodiment within the works by Bowker et al here serve the opposite purpose, making the instruments and performance visible, even though the human performer may not be. In turn, this allows for an exploration of the notion of identity for instrument and performer. The *LaFPanS* retain their function as instrument and composition, but also develop an identity as performer, as exemplified by the function of the speaker panels in Bailey's work. The disembodied human performer is detached from the work despite being a part of it, yet moves closer to becoming 'one' with the *LaFPanS* and the composition itself as the idea of the virtuosic performer is dismantled. The faceless nature of the performance allows a mask to develop, whereby the human performer is disguised by the instrument/performer, and the roles inhabited by these two entities blurred together.

4.2.2: Reconstructing the instrument

As mentioned, Hogg's work repurposes the coil element of the *LaFPanS* in order to imbue an every-day object with new possibilities and properties. Experiments were undertaken following lessons learned from the development of the *LaFPanS*, so that such things as the number of turns required around the centre tubing, the material of that tubing, the amount of power required to drive the coils sufficiently, and the best method of attaching the coil unit to the window were taken into account throughout the process.

Initial experiments conducted utilized a test coil built for use with a full sized prototype of the *LaFPanS*. This was fixed to the window in different ways before settling on a glue that would be both durable enough to

withstand the vibrations of being moved constantly over the period of the installation, but would also be easily removed and cleaned from the window at the end of the project's run. Having reached this conclusion and affixed the coil successfully to the glass, Hogg played a selection of the source material he would be working with for the project through the speaker/window, using a small secondhand stereo system as the amplifier, running his laptop through the external input of the system. Whilst the material was audible, the quality was poorer and the volume lower than hoped. Switching out the small stereo system (~10W power) for much more powerful amplifiers (~100W power), the test was repeated and whilst the volume was slightly improved, it was not as much as would be expected given the vast difference in power between them and the small stereo system's built in amplifier. As a result of this test, it was posited that the card used for the test coil was an inappropriate material to use on a glass surface, since the soft nature of the material would be incredibly inefficient at driving the glass. Replacing the card tube with plastic plumbing material and repeating the experiment significantly improved both the quality and volume of the audio and was, therefore, much more promising. The tests proved to be more successful still when applied to a single glazed window that was closer in nature to those that would ultimately be used for the installation.

As can be seen from the technical description of the *LaFPanS*[50] and photographs of *Numbers Station*[51], I have been using microphone stands with one-inch diameter magnets mounted in the microphone clips in order to locate them in the centre of the coils to drive the membrane. This method was inappropriate for Hogg's project, and so a suspension technique was developed[52] to replace this. The final development involved utilising small pieces of foam around the edge of the magnet to

[50] Appendix 2

[51] Appendix 6, Figures 19-21

52 Appendix 12, Figure 40-42

locate it in the correct place, which proved to be successful both practically and aesthetically.[53]

Hogg's appropriation of the sound-producing element of the *LaFPanS* relates to the earlier discussion regarding Duchamp. He has created a complete work that recontextualises the transducer coils within his own artistic framework, removing the strong structural elements of the *LaFPanS* and instead allowing the coils to develop their own visual identity, as well as a new sonic one; the sound reproducing qualities of glass are significantly different from those of the *LaFPanS*. The new artistic context overwrites the old as the coils become an essential element of both the sonic and the visual aesthetic of the work; a new instrument related to but different from the old is produced, thereby creating what could be considered to be the beginnings of a 'family' of instruments comparable to, for instance, the clarinet with its multiple variants of size and shape.

Despite removing all the elements of the *LaFPanS* except the transducer coils, Hogg's work with them still retains a sculptural quality, building up a fresh environment for them to inhabit and creating a new space within which to operate. *Flow* changes the mundane into the exotic, inviting the audience to engage with the window it has occupied. The inclusion of the coils transforms the glass from something that would have otherwise been a barrier between audience and artwork into an integral part of it, and one that makes the audience that much closer to the work; it is no longer a barrier but an invitation. The instrument here is literally re-composed, with different constituent parts going into its makeup, and different characteristics, both physical and artistic, emerging as a result. The results turn the *LaFPanS* into a fluid concept and pave the way for further technological and artistic development, as demonstrated by Hogg's work, and are a reinterpretation of the original composition of the instrument; both versions explore and reveal the natural resonance and sonic characteristics of a material not intended for sound production, and

53 Appendix 12, Figure 43

both recast these materials in a new artistic construct different from their original use.

Where Hogg's work is a literal reconstruction of the *LaFPanS*, the work undertaken by Bowker et al is contextual, changing for and with the situation in which the other composers have chosen to cast them. The same end result is achieved, shifting the identity and role of the instruments and providing the composer with the opportunity to establish a new space within which to create and perform that work. These key elements of the composed instrument, as established in Chapter 2 of this document, foster this unique type of compositional and performance practice; the *LaFPanS* mediate a move towards a more disembodied, less individual-centric mode of performance.

4.2.3: Reclaiming the Instrument

Mills' *Edification* approached the *LaFPanS* as a tool for exploring the relationship between the object and its creator whilst exploring the notion of audience as inquisitor and creator as victim. Choosing to use only the acoustic properties of the instruments and forgoing their function as either speaker or microphone, he composed a work that would ultimately result in their (at least partial) destruction, putting me at the centre of the work and responsible for their demise, whilst having no control over it. The inherent nurturing bond between creator and creation is subverted through the sadistic nature of Mills' work, but in so doing forces a new level of interaction and understanding. The destruction of the *LaFPanS* necessitates their reconstruction if they are to be able to be reused again, reinserting me into the creative process from which I have removed myself by encouraging others to take control of the instruments.

The process of encouraging others to take ownership of the instruments and to use them in any way they see fit initiates a cycle of creativity. Whilst Mills' work forced this cycle to be restarted following the performance of *Edification* due to the destruction of the *LaFPanS*, the sequence had begun the moment another composer began to use them.

If one person has further ideas sparked by this process, then the same can happen for other people as well, and can also be conceptually transposed to a broader compositional approach, creating wider artistic benefit. Each successive cycle becomes a widening spiral, building on the previous one, with the start point shifting accordingly. It is a process of review that requires an examination of previous work and approaches to create new ones and solve existing 'problems'. Lexer's discussion on the development of performance over time, where the act becomes a "reflexive journey of the self" (Lexer, 2012: 81) is again applicable; the creative cycle enables the instrument to be reclaimed through a process of becoming self-aware.

4.3: Reviewing the Instrument

The *LaFPanS* have here been used as an example of a composed instrument to investigate the potential benefits that they, and by extension the concept, can have for other composers, the experiences of whom can then feed back into my own work and expand my own thought process in this regard. The sharing of this instrument has unlocked characteristics, such as the disembodiment of the performer, that I had not explored and demonstrates further both the 'IKEA Effect' and Joy's Law in practice, as described in Chapter 3. Sharing the instrument serves in the process of unlocking its potential.

The potential inherent within composed instruments is what enables their use by other composers. This in turn has been facilitated by approaching them not as fixed entities, but as objects intended to be recomposed, changed and augmented by anyone who might wish to use them, and allows composers to make use of them in an explorative way that is not possible with traditional instruments. These same concepts not only inform how these instruments are used, but also have the potential to inform broader compositional practice as contemplative experimentation.

5
Conclusions

The approach taken within this thesis has been to contextualise and explain the reasoning behind the creation of the accompanying portfolio, which includes both composed instruments and works made with them. The concept of the composed instrument and the development and design of these has become a fundamental tool in my own compositional approach. However, beyond these personal benefits it has proven useful to others, with wider scope for increased dissemination, and encouraging a democratised approach to music making that differs from traditional hierarchies of composer-performer-audience.

My own approach to the composed instrument differs significantly from conceptions proposed by others such as Wanderley (1998), Schnell and Battier (2002) and Fiebrick (2010), eschewing a primary focus on the technological and instead recasting the concept as a device for encouraging a reassessment of the roles of composer, audience and performer, allowing the boundaries between active and passive participants to blur; those who are usually passive are enabled to actively engage in the compositional process while the normally active composer/performer relinquishes some control over the ultimate creation. The concept has aligned somewhat with the Fluxus group of artists, fostering the transition from audience to performer through universal playability and the levelling of musical hierarchies. While familiarity with the composed instrument can lead to an understanding of it, the notion of the virtuoso is eliminated since the input of the unfamiliar player is as valid as that of the familiar player. Traditional notions of musical authority through virtuosity are removed since the untrained audience is able to engage with the composed instruments in as valid and meaningful way as a professional musician might. The act of music-making can occur more quickly, generating an increased number of musical results in a shorter space of time. Sound art installation works such as *Thinking Path*, *Numbers Station* and *ATV01* necessitate active engagement by the

audience in order to function, thereby involving those people in both the compositional and performance processes.

This approach engenders a new discourse in musical engagement between the different 'levels' of people engaged with the composed instrument and works created with them. The role of the performer is investigated in different forms than can be achieved with traditional instruments by enabling anyone to fill this role. Where the audience is also asked to function as performer, as in *Thinking Path*, *Numbers Station* and *ATV01* it functions in dual roles, and so questions the very nature of these positions. Such enquiry serves not just to explore the different possibilities for change within musical hierarchies, but also encourages the composer to consider these roles during the compositional process. Physical objects aside, the idea of the composed instrument is one that can be seen to open up a discourse between the composer and their own relationship to the performer, the audience, and the compositional process.

Despite seeking to alter traditional musical hierarchies in order to level the musical playing field, as creator of the composed instruments documented within this thesis I retain an authority over them that others cannot attain, but also suffer from cognitive biases relating to the instruments' flaws as a result. These can both be overcome to an extent, in respect to other composers, by seeking to distance myself from ownership of the instruments through facilitating their use, deconstruction (in the case of Bennett Hogg's work, *Flow*) and even destruction (as per Daniel Mills' *Edification*) by these people. Where the audience and performer are concerned, they will almost inevitably follow the guidelines present in each piece, however broad they might be and so in terms of this hierarchy I, as composer, remain at the top of the conceptual pyramid despite the audience and performer also being engaged in the compositional process. They are still operating within the boundaries that I have set out.

The idea of the composed instrument is one that encourages re-use not just by other composers in their primary, extant form, but also through augmentation and technological development. That the concept itself developed from an installation work, *Thinking Path*, is telling in the way that instrumental advancement is both possible and desirable within the framework of the composed instrument. Whilst this framework can be argued to be loose on a technological level due to the broad scale of manufacture involved in their creation, from the custom built nature of the *LaFPanS*, through to the pre-existing and subsequently modified open-source form of the Arduinome and *Stronome* respectively, and repurposing of technology that went into the *ATVs*, it is this looseness that encourages inclusiveness and experimentation. The Fluxus group of artists and their activities are broad and disparate and yet have continued to make art for over fifty years; the lesson learned from this is that inclusivity fosters productivity and positive artistic results. It is hoped that the same will be true for the concept of the composed instrument.

This thesis and the accompanying body of work has clearly demonstrated the value of this conception of a composed instrument: not only is it of academic significance, expanding thinking on the relationships between instruments, compositions, performers, audiences, composers and builders, but it has also been shown to have real practical significance, opening up novel vistas of compositional potential. Given these dual significances, this clearly represents a development that merits substantial ongoing investigation across both the academic and practitioner spheres.

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Appendix 1
Arduinome

The Arduinome (a portmanteau of Arduino and Monome) is, together with Max/MSP running on a Mac computer, a musical instrument for generating and modifying sounds. It possesses 'Monome' functionality and uses Arduino technology to do so.

Arduinome uses a Duemillenove processor board and a homemade input/output shield. The inputs are provided by a matrix of 8 x 8 push-buttons which are scanned by MM74HC164N ICs under control of the Arduino. The scan output is sensed by MM74HC165N ICs whose output is fed to the Arduino.

Each of the push-buttons is hollow and translucent; there is an LED beneath each. This 8 x 8 matrix of LEDs is pulsed on a row and column basis by MAX7219CNG ICs. The row pulses are generated by MAX7219CNGs and, when there is a corresponding opposite column pulse from the MAX7219CNG ICs, a LED will light. The strobe-rate for these LEDs is approximately 138 kHz, which is higher than the critical fusion frequency for the eyes and so appears as a steady glow.

The parts list for the Arduinome can be found (as of 25/04/14) at:

http://flipmu.com/work/arduinome/hardware/

The board layout for the input/output shield and how it fits together is (as of 25/04/14) at:

http://flipmu.com/work/arduinome/instructions/

The code to load into the Arduino is obtainable (as of 25/04/14) at:

http://flipmu.com/work/arduinome/download-code/

The following are photographs of my Arduinome:

Figure 1: Arduinome mounted on repurposed surveyors' tripod

Figure 2: View of the tripod mount

Figure 3: Internal view of Arduinome

Appendix 2
Large Flat Panel Speakers

The *Large Flat Panel Speakers* (*LaFPanS*) are built using a framework of softwood battens with a membrane of Tyvek™ stretched over like a canvas. They were upscaled from a smaller prototype as described in Chapter 1. Eight of the full-size *LaFPanS* have been constructed at the time of writing.

Figure 4: Prototype panel (rear view)

Figure 5: Prototype panel (front view)

The corners of the framework are braced using 6mm ply triangles and the Tyvek is secured with staples from a staple-gun.

The operation of the *LaFPanS* follows closely that of conventional loudspeakers with the exception that the voice-coil does not travel within a closed magnetic circuit, it sits in the near-field of a cylindrical neodymium magnet. The voice-coil consists of a cardboard tube that is a close but sliding fit over the cylindrical magnet. It is one inch long and overlaps two thirds of the cylindrical magnet. The magnet is one inch (2.54cm) in diameter and one inch long. This allows for the rear portion of the magnet to be used as its support.

The voice-coil is scramble-wound onto its cardboard tube and consists of 250 turns of 32a.w.g. enamelled copper wire with its ends brought out to

the edges of the batten framework for attachment to the amplifier it is used with. The voice-coil is attached to the Tyvek using handycraft glue.

The magnet is normally supported in the jaws of a microphone clip on a microphone stand. This gives considerable scope for minor adjustment and fine-tuning but an alternative method of supporting the magnets would be to use further battens and bring the support back to the main batten framework. This has not been implemented at time of writing.

The *LaFPanS* are, in conventional terms, ‘active’ speakers – that is, they have built-in amplification and are fed from nominally line-level signals of about one volt RMS. This allows a good match between the amplifier used and the speaker and removes the danger of over- or under-driving the units. Various discrete-component amplifier configurations were tried before settling on the Toshiba amplifier chip finally adopted.

The amplifier chip is the TA7205, which has found wide use in car audio systems. It has the desirable property of operating over a wide power-supply voltage range. This is important for the intended application since extra power cables can be avoided by using small 9 Volt batteries known as ‘PP3’ (aka 6F22).

The amplifiers built are constructed on stripboard and follow the manufacturer’s Application Notes closely. The inputs are coupled using 10uF capacitors to ensure adequate bass response that is an essential part of the speaker specification.

Four of the *LaFPanS* have been converted for possible use as microphones. This has been done by breaking the connection between the TA7205 and the voice-coil and instead using the voice-coil as an output so that it becomes the coil of a dynamic microphone. This connection is used with a local microphone pre-amp and the signal can be sent to wherever it is needed for any particular installation. The action of breaking the voice-coil connections could be implemented using

appropriate connections to a standard ¼ inch jack: inserting a jack-plug would then seize the voice-coil connection for external use.

Figure 6: Diagram of a *Large Flat Panel Speaker*

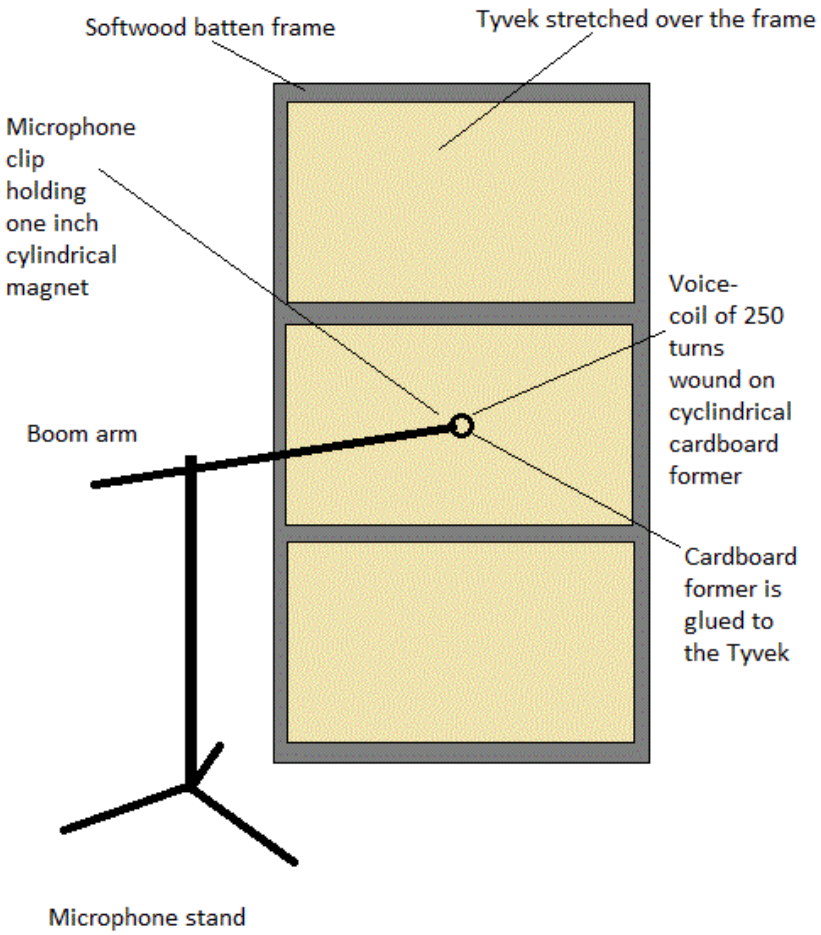


Figure 7: Toshiba's schematic for the TA7201 power amplifier

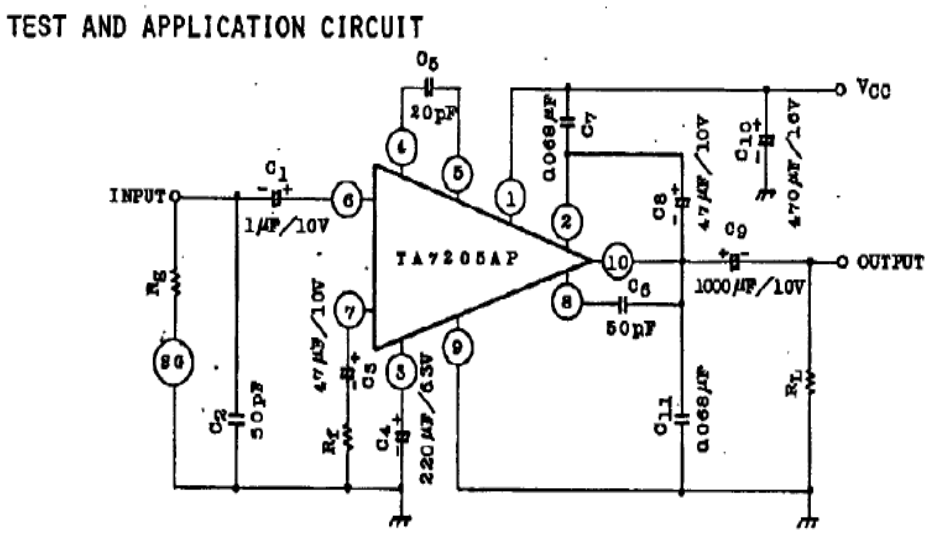
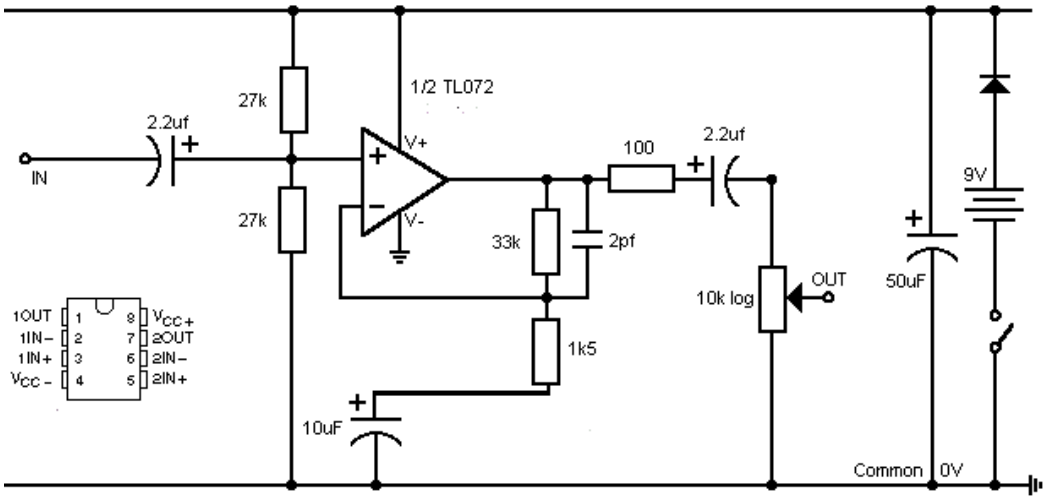


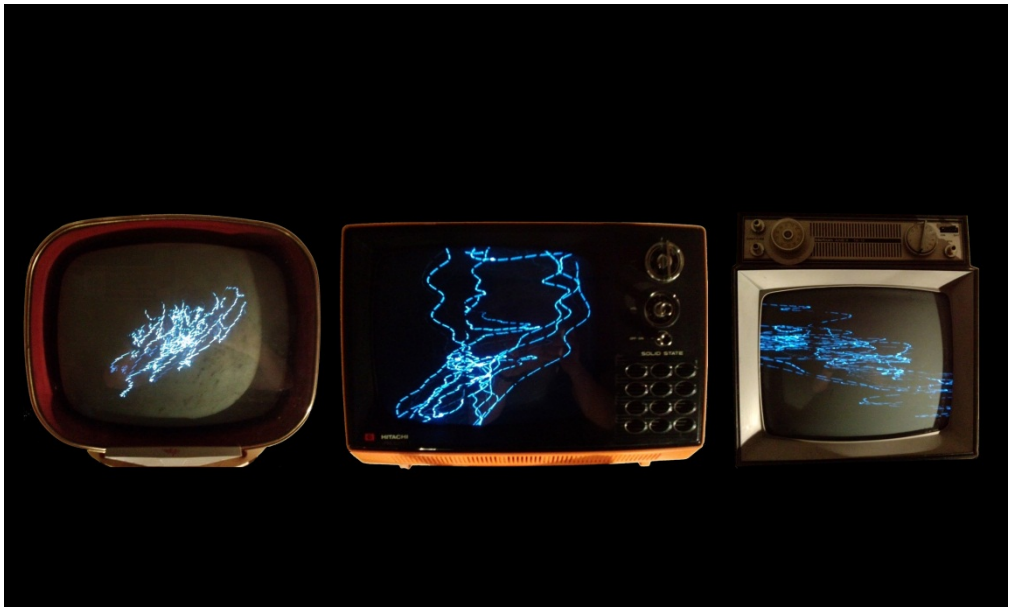
Figure 8: Close up view of *LaFPanS* tensioning bolts

Figure 9: Microphone pre-amp as used for converting a *LaFPanS* into a microphone



Appendix 3
Augmented Televisions

Figure 10: Three *ATVs* in action, displaying Lissajous figures (L-R: 1950s Kolster Brandes, 1970s Hitachi, 1960s Teleton)



Introduction:

Cathode Ray Tube (CRT) televisions were made from the 1930s to the 1990s (approx.), after which time they were superseded by flat-panel displays based upon a matrix of picture elements using Liquid Crystal, Plasma or Organic Light Emitting Diode technologies. The *Augmented Television* (*ATV*) concept requires the use of a CRT since the excursion of the displayed spot (the “cathode ray”) from some central point on the screen needs to be controlled in each direction using the audio part of the *ATV* instrument.

Throughout the CRT era there were several changes. Screen size attainable tended to increase from 9” diagonal up to 24” or more. The glass bulb of the CRT changed from round to broadly (and increasingly) rectangular and the glass front became flatter. The sets were initially designed to the 405 line standard (in the UK) which was replaced (with an overlap period) by the 625 line standard starting in the early 1960s.

Colour became available from the late 1960s onwards but monochrome ("black and white") sets were still made right up to the end of the CRT era.

Outline:

In any CRT television there are pairs of scan-coils wrapped around the neck of the CRT. One is designed and positioned to scan the screen horizontally. The other is for vertical deflection. Therefore any position on the CRT face can be reached by the spot of the cathode ray. For the *ATVs*, separate audio signals are fed into the horizontal and vertical scan coils, the original TV deflection signals having been disconnected. There is no intentional variation in the brightness of the spot.

Being able to disconnect the TV's native deflection signals without causing damage to the TV's circuitry, maintaining the correct CRT voltages, obtaining steady brightness for the spot, injecting audio for the TV's own loudspeaker and attempting to achieve reliability and safety were issues to be addressed. They were achieved in different ways depending upon the original TV design and condition as found.

Audio signals:

Each television has been equipped with a pair of phono ("RCA") sockets. One socket is connected to the horizontal scan coil and nothing else. There is a high level of insulation and so is safely isolated from any potentially dangerous voltages.

The other phono socket is connected to the vertical scan coil. It is also connected to an audio amplifier and thence to the TV's own loudspeaker. In most cases, the amplifier is the TV's own but this was not always possible. In some cases all of the TV's original electronics had to be disabled if it was in too poor condition. In other cases the TV's original audio amplifier was too deeply embedded into other TV functions and was controlled using voltages from the volume control. For these cases, another volume control was provided during the conversion and an

amplifier of the type used in the *LaFPanS* was adopted. Where the incoming vertical-deflection audio was too loud an attenuator was used. In cases where the original TV circuitry did not provide mains isolation, an audio transformer was used to ensure electrical safely.

Figure 11: Rear of the Hitachi P-32-311 TV showing audio input

Disconnected TV drive signals:

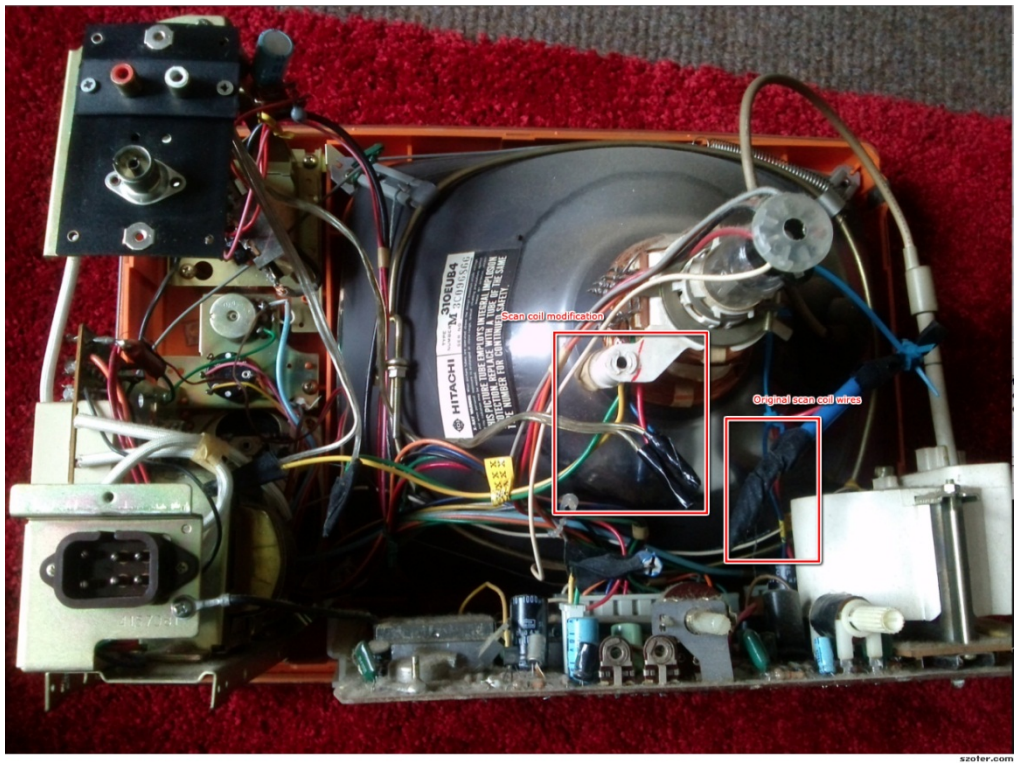
In all TV designs these are provided by separate internal circuits. Horizontal drive comes from the “line output stage” and vertical drive comes from the “field (or frame) output stage”. Both of these stages are designed to be loaded by the scan coils so for the reliability of the valves or transistors the scan coil loading is replaced by something else. In the case of the vertical scan coil, this loading is provided by a 5 Watt resistor of 1200 Ohms.

The line output stage of a television performs the horizontal scan function but is also used to derive the extra voltages required by a CRT – most significantly the Extra High Tension (EHT) of around 10,000 Volts required by the cathode ray for its final acceleration onto the screen. The stage is therefore designed to resonate like a tuning fork but with a

frequency of around 10kHz for a 405 line TV and around 16kHz for a 625 line TV. The line scan coil is often part of this resonant circuit and so different loading solutions were required for different TVs. Very often, especially for later-design TVs, it was sufficient to provide an identical resistive load to that used to replace the vertical scan coil. In other cases it was found that either the output device (valve or transistor) overheated or the EHT and related voltages collapsed. In these cases the loading was provided by either another line scan coil from a scrap TV or was a specially wound inductor made from about 10 metres of wire wrapped around a ferrite rod.

In cases where the original electronics had to be declared ‘too far gone’ there was no need to provide this artificial loading.

Figure 12: Inside the Hitachi P-32-311 TV showing scan-coil modification



Replacement electronics:

For various reasons, some televisions had irreparable native electronics. This might have been the original terminal fault that led to the TV’s replacement, in which case it was extremely fortunate that the television

had not been thrown away decades ago. Another situation discovered was where the voltages presented to the CRT were varying excessively due to the absence of any conventional TV signal.

During the collection phase of the project, some televisions were obtained that were unusable for various reasons but which provided “donor” electronics for televisions which had ‘too far gone’ electronics of their own.

Where electronics from a donor TV were used, these had to be small enough to fit inside the case of their new home. Since donor electronics came with their own scan coils these were simply mounted near their drive electronics and away from any magnetic material that would have given unpredictable loading.

In every case where donor electronics were used it was discovered that the audio amplifier present in these electronics was entirely satisfactory for the ATV application. However, these were designed to drive an 8 Ohms (impedance) loudspeaker rather than the TV’s native 3 Ohm loudspeaker so to ensure the reliability of the audio amplifier’s output stage, a series resistor of about 5 Ohms was used. The small amount of signal loss caused was of no consequence.

Each set of donor electronics was required to be powered from a 12 Volt DC source. In most cases this was provided by a small power supply enclosed within the ATV cabinet. One, however, used the plug-top power supply that came with the donor television.

Cathode Ray Tubes operate by having electrons liberated from a hot cathode being propelled towards their phosphor-coated screen. The cathode is heated using a separate voltage of either c.6 Volts or c.12 Volts. The 12 Volt versions were able to use the same supply as the donor electronics but the 6 Volt ones required a separate supply. For convenience this was provided by a separate supply rather than use 6 Volts derived from the 12 Volts. This greatly aided debugging.

CRT electrode requirements:

The heater requirements have already been covered, above. The Extra High Tension (EHT) is provided by either the TV's native line output stage or by the line output stage of the donor electronics. This is important for safety reasons since these EHT sources are incapable of providing enough current to do any harm.

The other CRT electrodes are the cathode, grid and one or more anodes. Where native electronics were used these were, in general, provided as originally designed. Some however required modification along the lines of the donor electronics method described next.

The grid of the CRT was connected to zero Volts. The cathode needs to be a few Volts positive with respect to the grid – the amount of positive bias determining the spot brightness. It was therefore connected to the brightness control which had one end at zero Volts and the other end, via a resistor of c.300k Ohms, at High Tension (HT) in the region of 100 Volts.

The anodes provide initial spot acceleration and electrostatic focus (depending on CRT type) respectively. They are therefore connected to HT as above with the focus electrode connected via a 2M Ohms potentiometer (adjusted for sharpest spot).

Discussion on audio amplitude:

Different TV manufacturers adopted different trade-offs in the design of scan coils. Therefore it is not possible to accurately predict the amount of audio drive needed to achieve suitable deflection of the CRT spot. An audio amplifier was provided for each scan coil to maximise the opportunity for spot deflection. Since each audio amplifier had its own "volume" (gain) control, the maximum range was covered.

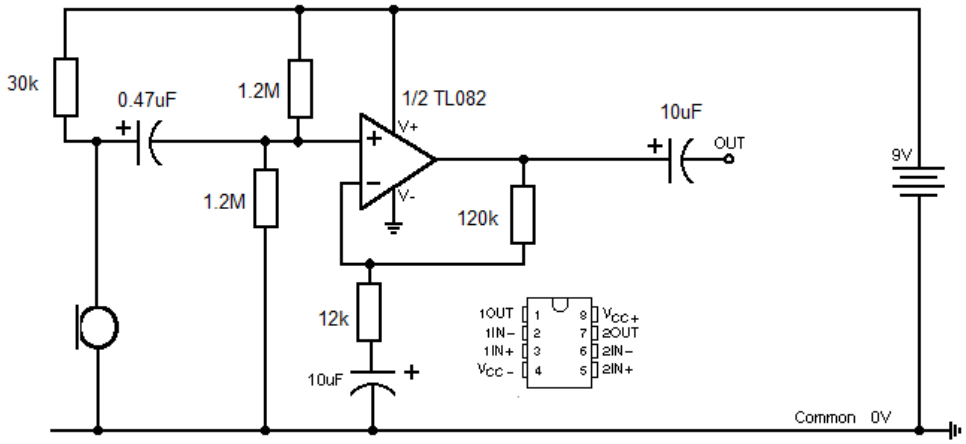
In practice it was found that some combinations of amplifier and scan coil did not cause full deflection of the spot and this became a characteristic

of the individual *ATV* instrument. There is scope for revising the audio amplifier matching and perhaps making use of further transformers to step up or step down the coil impedance as “seen” by the amplifier driving it.

Microphone pre-amp:

Each ATV has a microphone, intended to point towards the audience participant who is nearest to its screen. The microphones comprised electret elements feeding into an op-amp whose output drives a computer’s analogue to digital converter interface. Electrets require an electrical bias to power their internal electronics and this is provided by the 30k Ohms resistor shown in the circuit below.

Figure 13: Microphone pre-amp circuit



Appendix 4

Stronome

The *Stronome* (a portmanteau of Stribe and Arduinome) is, coupled with Max/MSP, a musical instrument for generating and modifying sounds. It possesses 'Stribe'[54] and 'Arduinome'[55] functionality and uses Arduino[56] technology to do so.

The components added to the Arduinome to create the *Stronome* are:

- 4 flexible strip potentiometers, 2 each side of the push-button matrix
- Bar-graph LEDs beneath each strip potentiometer
- Accelerometers to implement motion-sensing capability

The control program running on the Arduino board ensures that the bar-graph LED that is lit corresponds with the last place a finger was touched onto the flexible strip potentiometers. This is achieved by having the strip potentiometers feeding into the ADC inputs of the controller, which then computes which LED to light. The selection of LED(s) should be lit is done using the familiar row and column strobe method as used for the LEDs beneath the push-buttons and using MAX7218CNG ICs.

[54] http://soundwidgets.com/stribe/ (Accessed 02/04/14)

[55] http://flipmu.com/work/arduinome/ (Accessed 02/04/14)

[56] http://www.arduino.cc/ (Accessed 02/04/14)

Figure 14: First model of *Stronome*

Appendix 5

Thinking Path

Figure 15: View of *Thinking Path* with visitors

Figure 16: Further view of *Thinking Path*

Figure 17: Detailed view of *Thinking Path*

Figure 18: View of *Thinking Path* from ground floor of the Sainsbury Centre for Visual Arts

Appendix 6

Numbers Station

Figure 19: *Numbers Station* as set up in the Sainsbury Centre for Visual Arts

Figure 20: *Numbers Station* as set up in the Strode Room, UEA School of Music

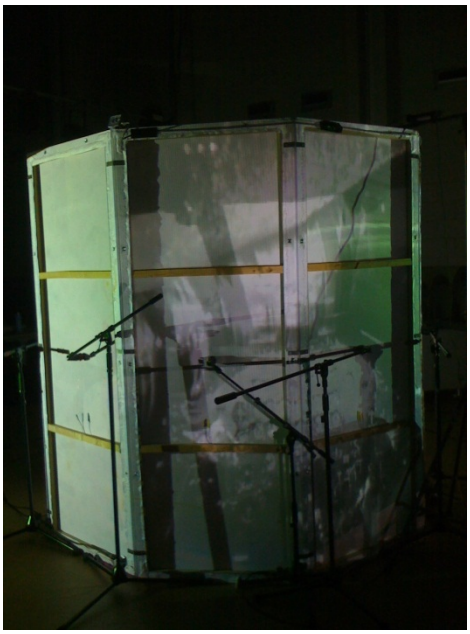
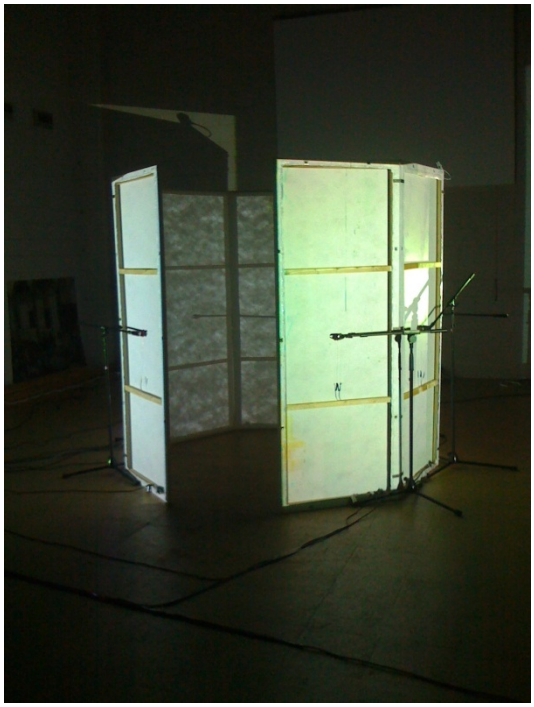


Figure 21: *Numbers Station* as set up in the Strode Room, UEA School of Music



Appendix 7

Code-A (Scores)

Figure 22: *Code-A* Movement 1 (Cello, p.1)

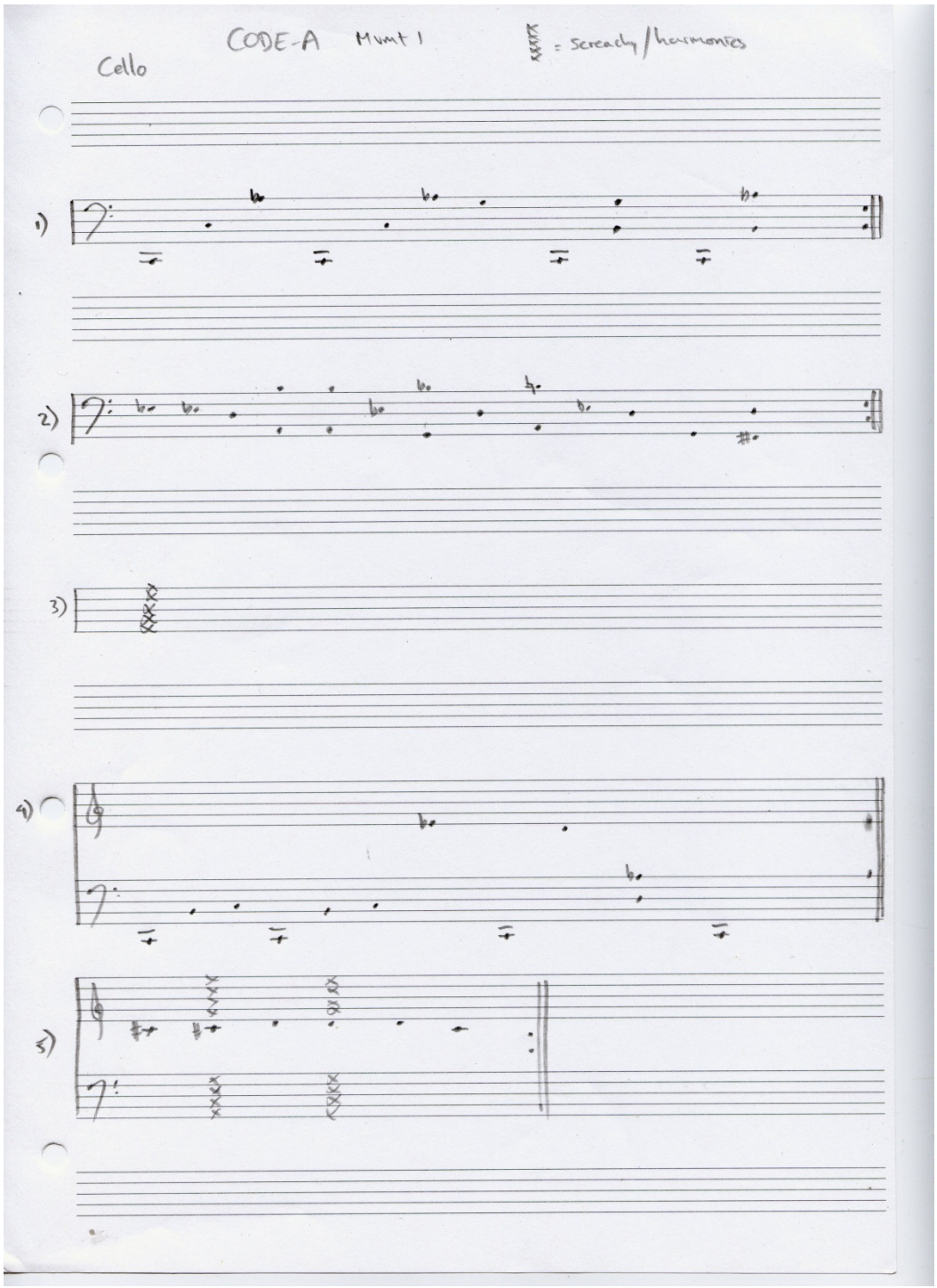


Figure 23: *Code-A* Movement 1 (Cello, p.2)

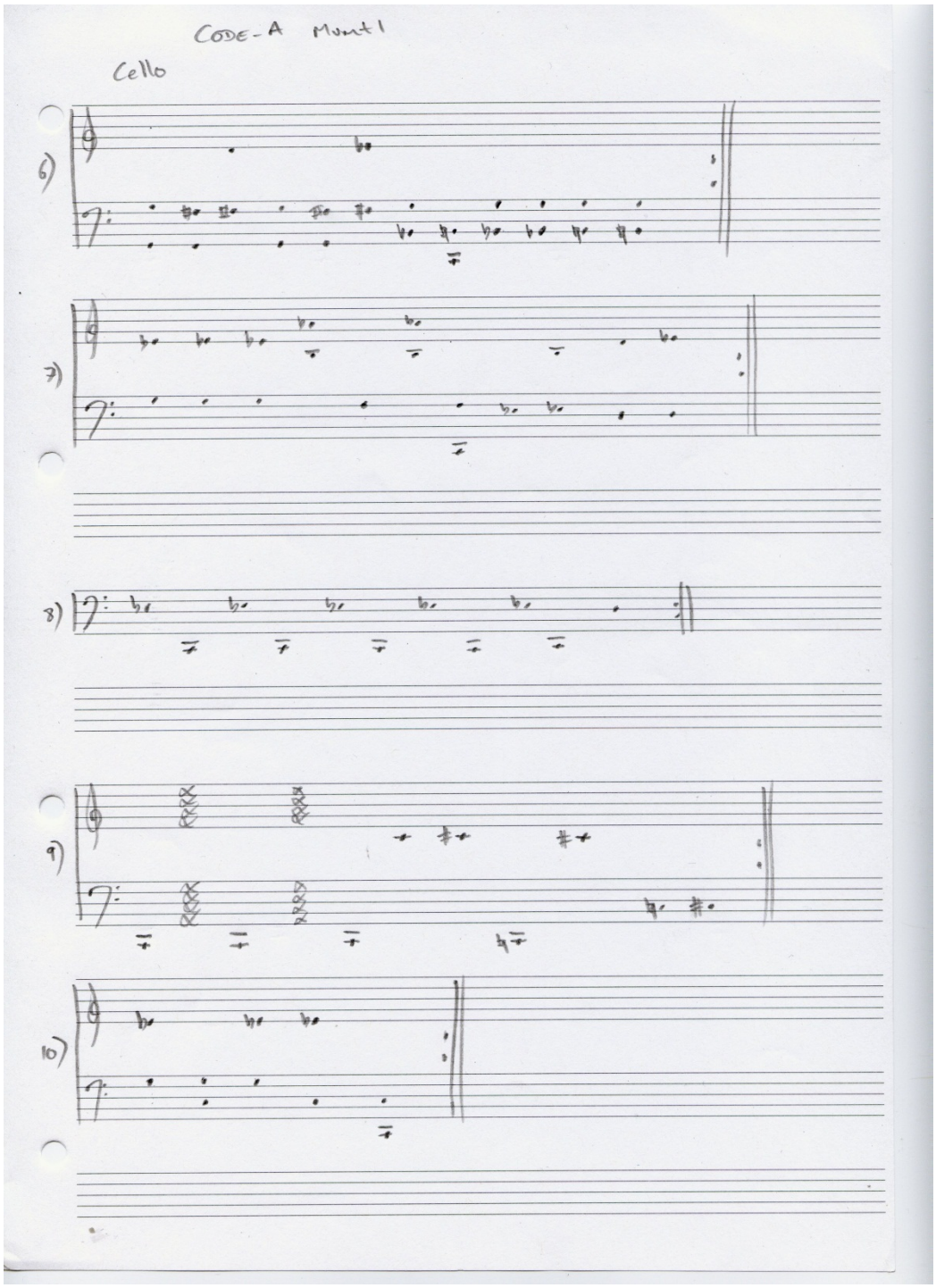


Figure 24: *Code-A* Movement 1 (Clarinet)

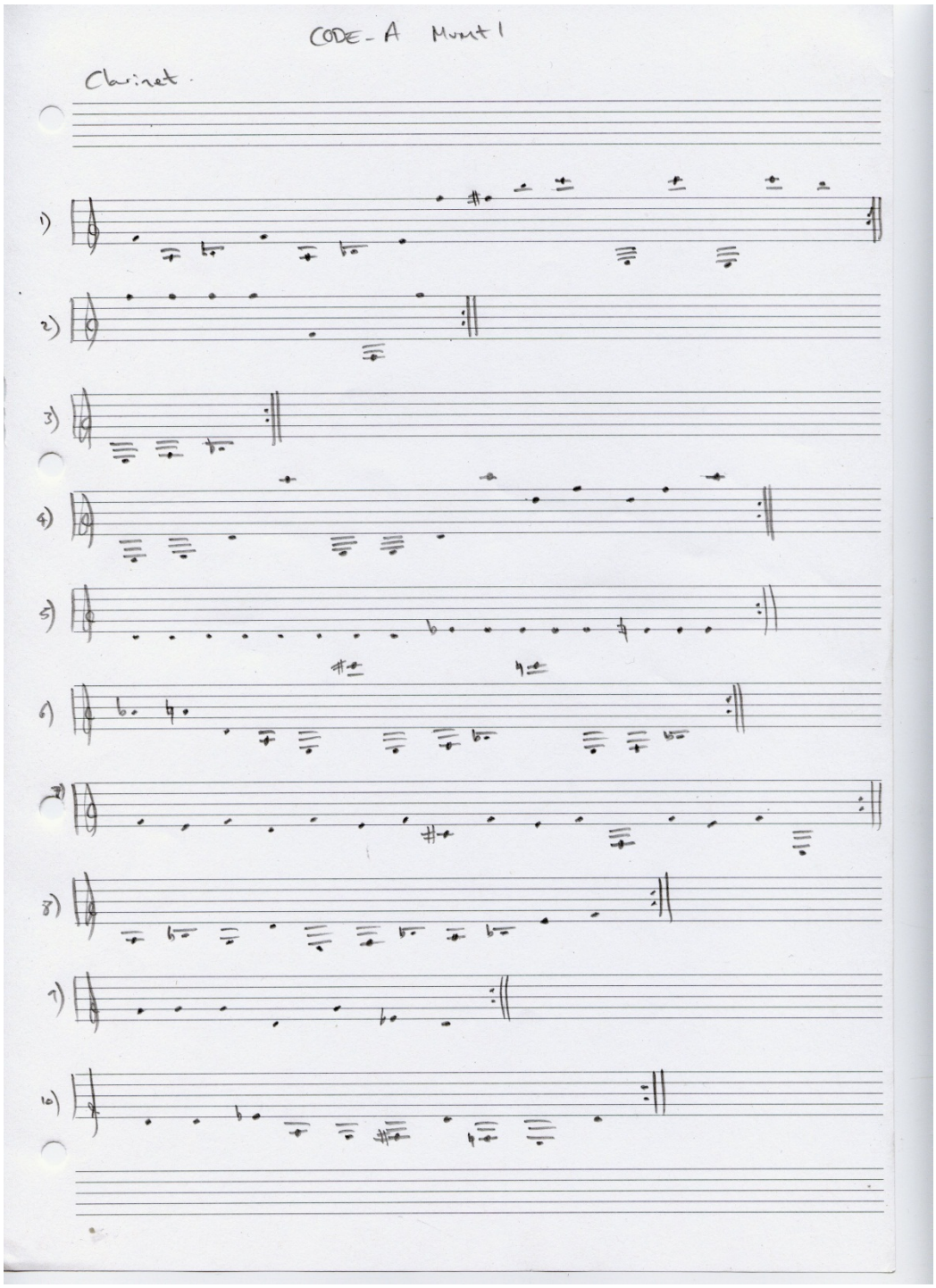


Figure 25: *Code-A* Movement 2 (p.1)

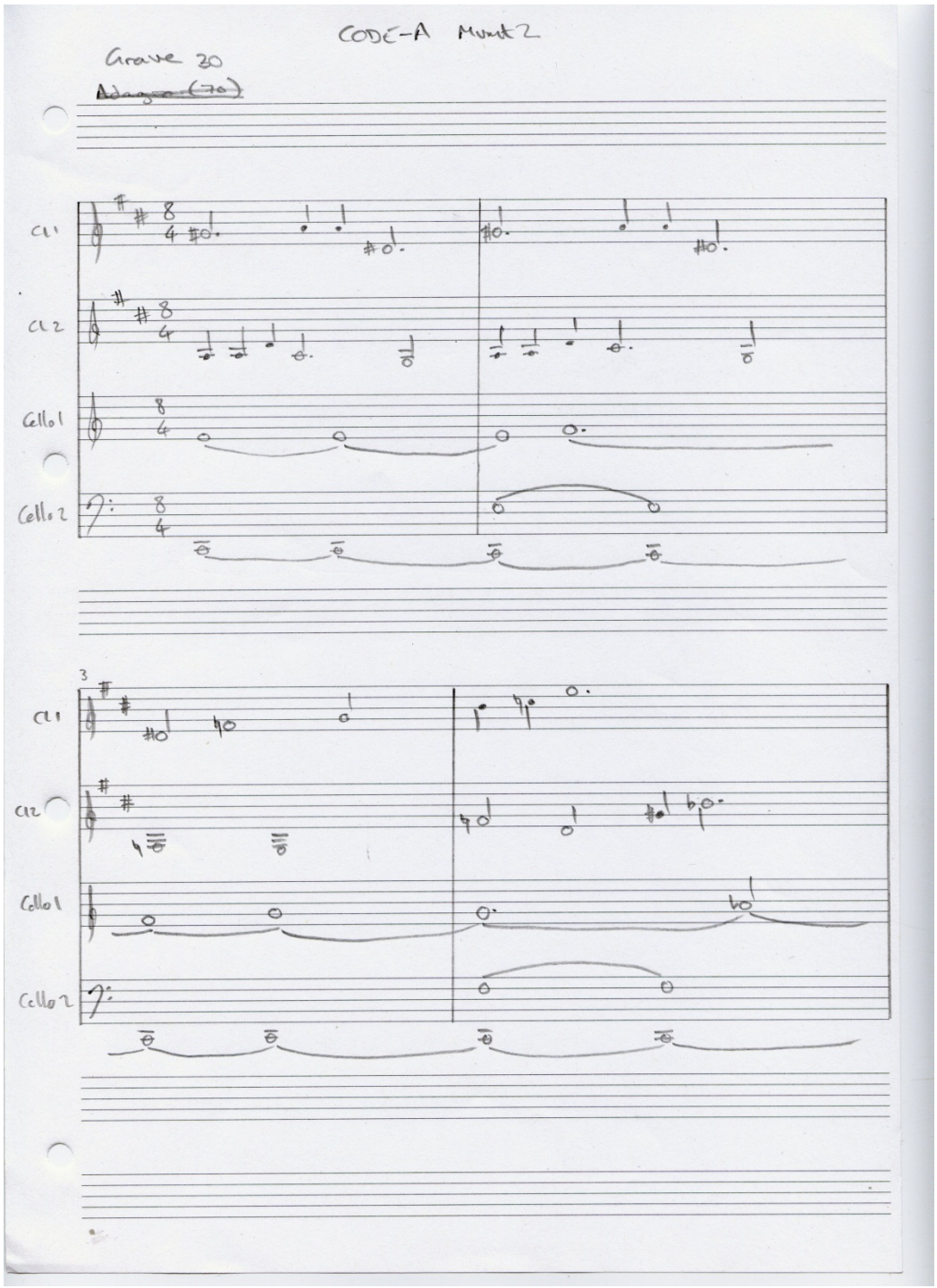


Figure 26: *Code-A* Movement 2 (p.2)

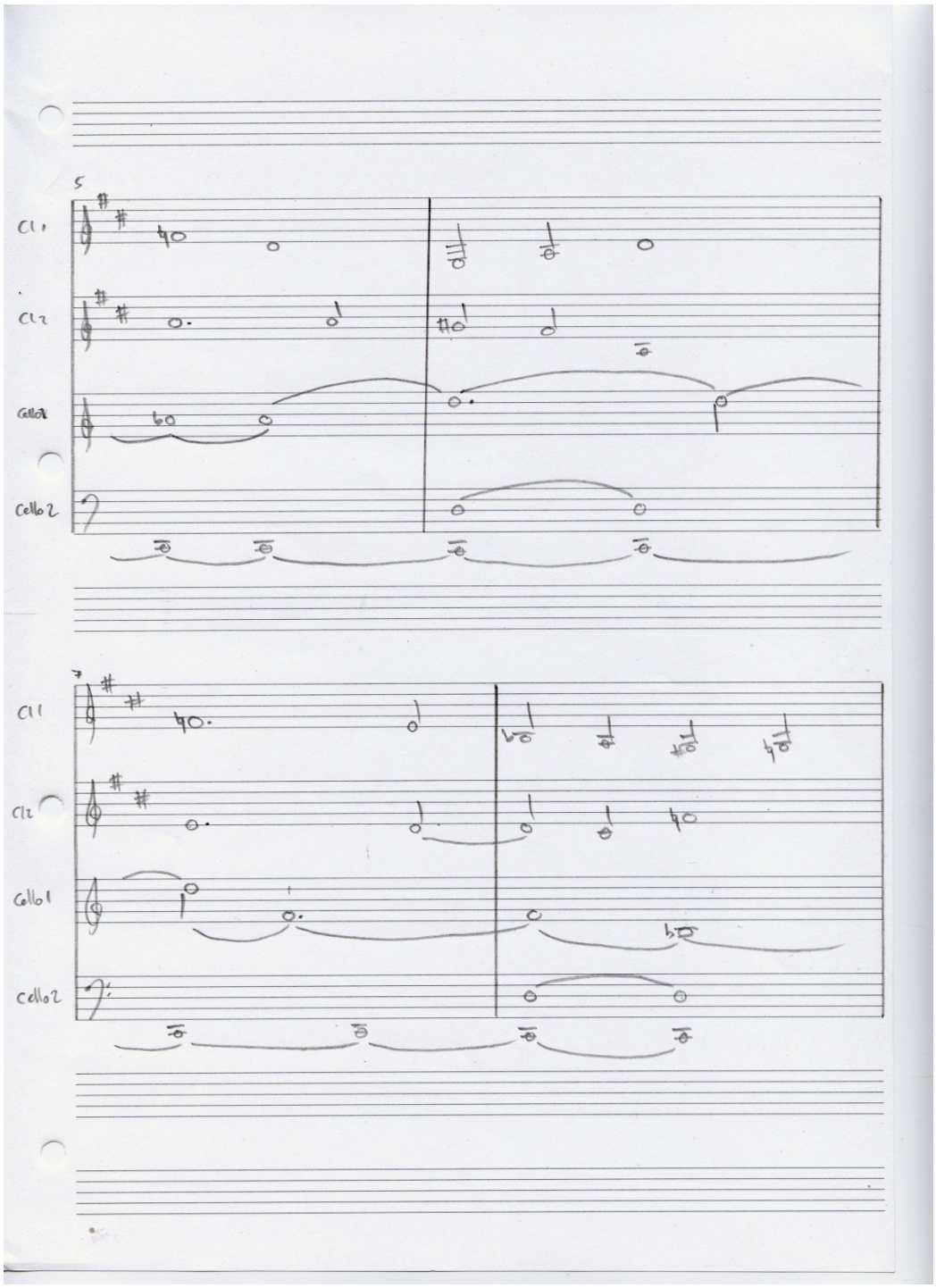


Figure 27: *Code-A* Movement 2 (p.3)

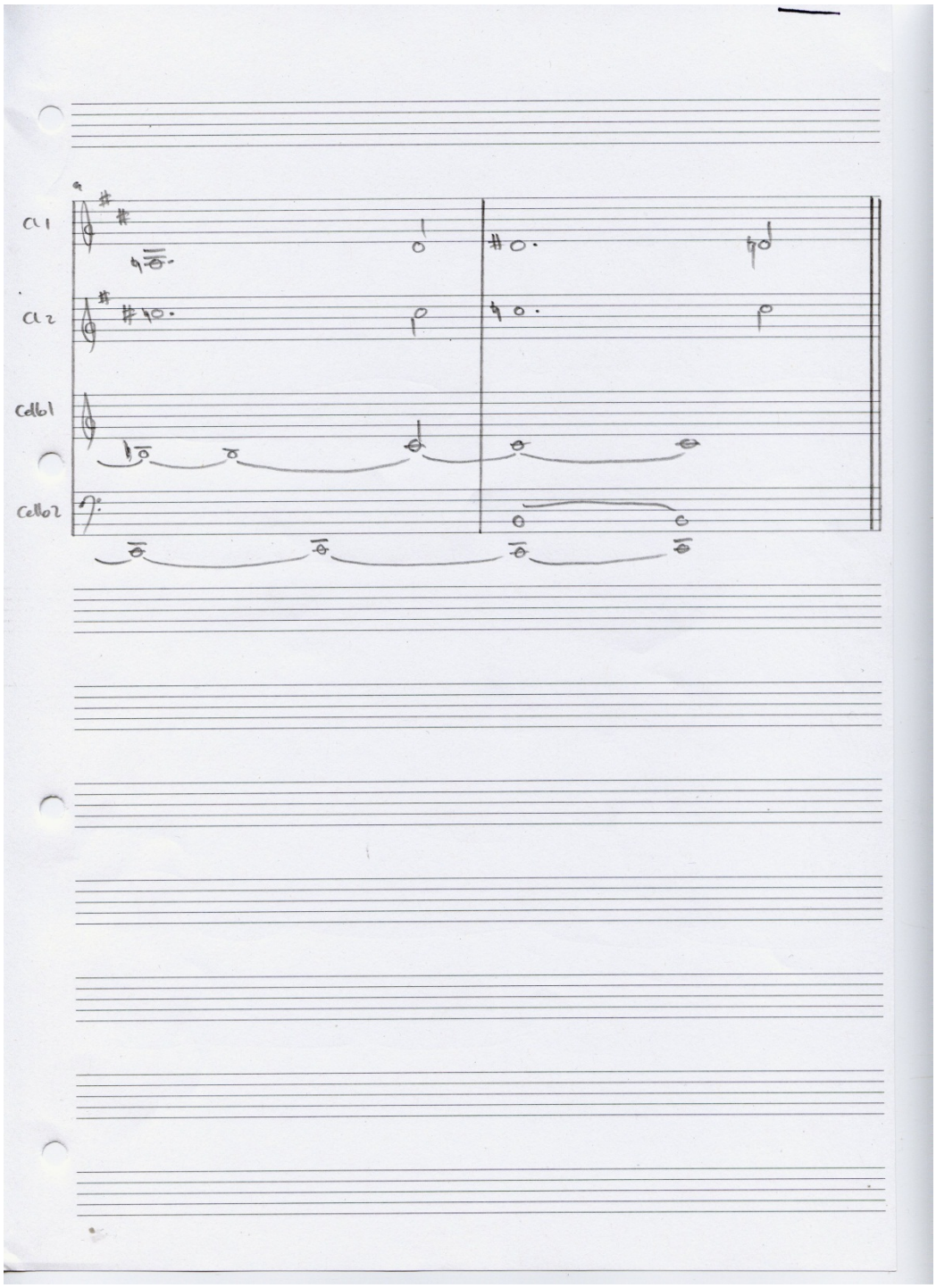


Figure 28: *Code-A* Movement 3 (p.1)

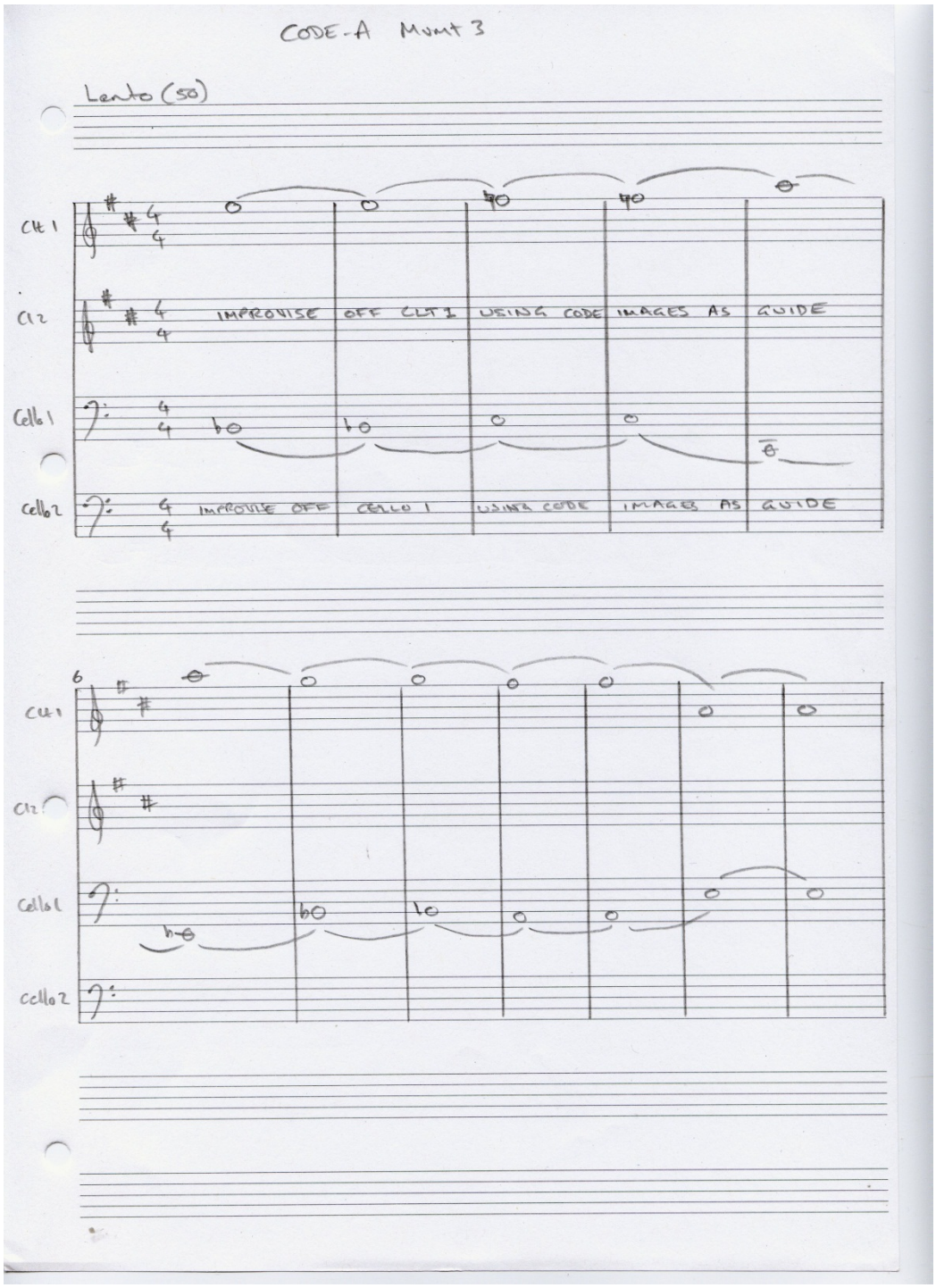


Figure 29: *Code-A* Movement 3 (p.2)

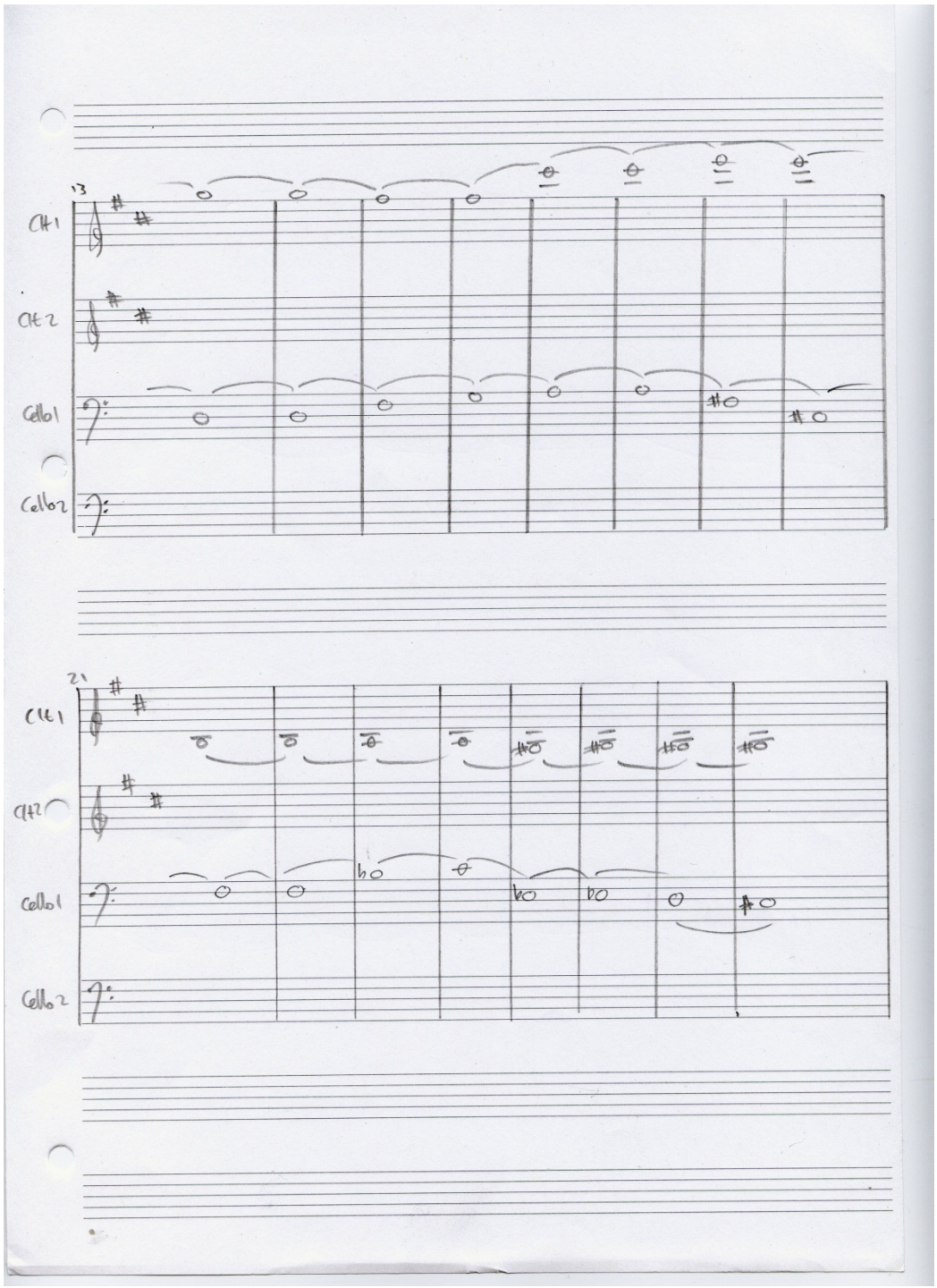


Figure 30: *Code-A* Movement 3 (p.3)

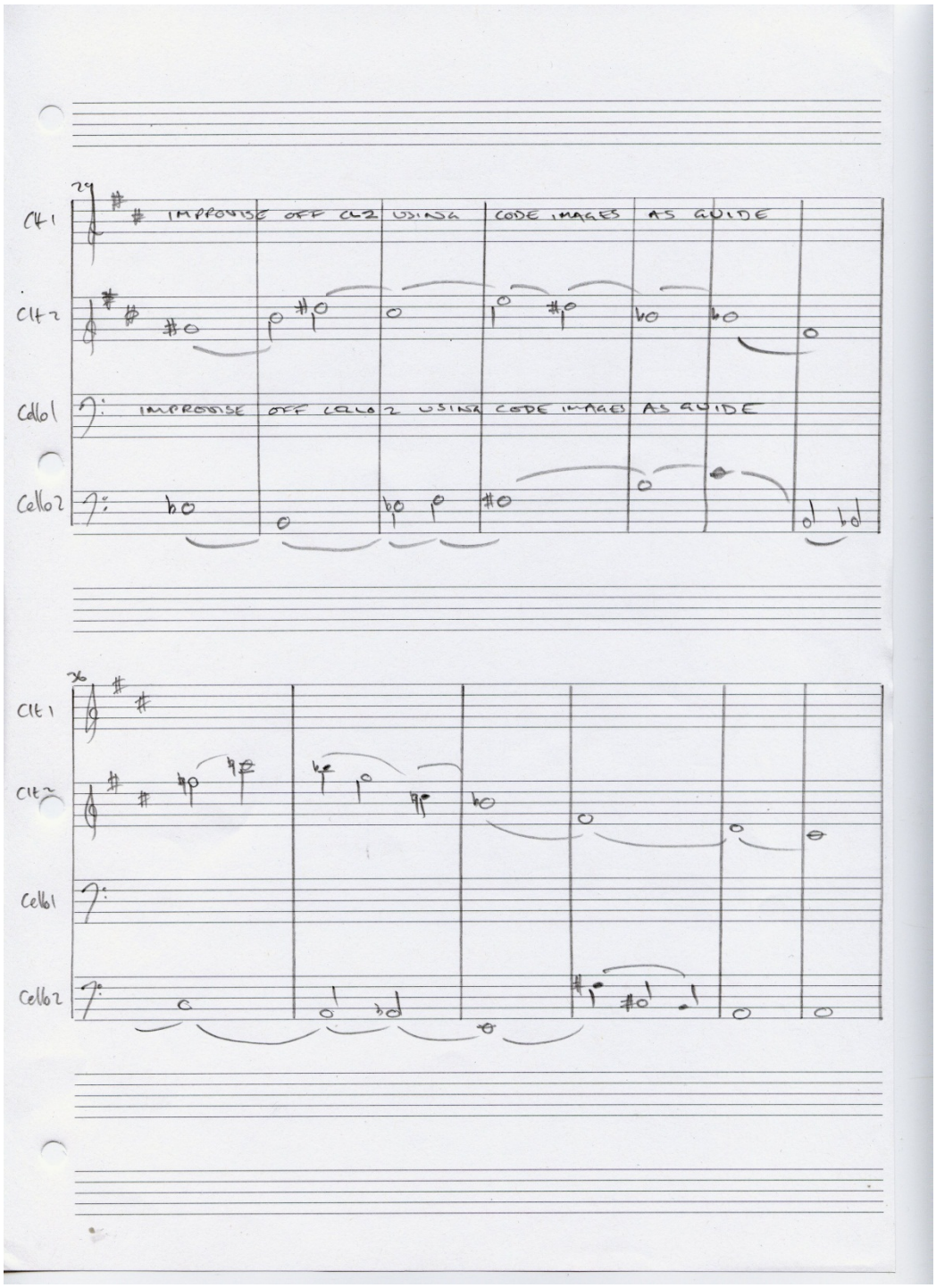


Figure 31: *Code-A* Movement 3 (p.4)

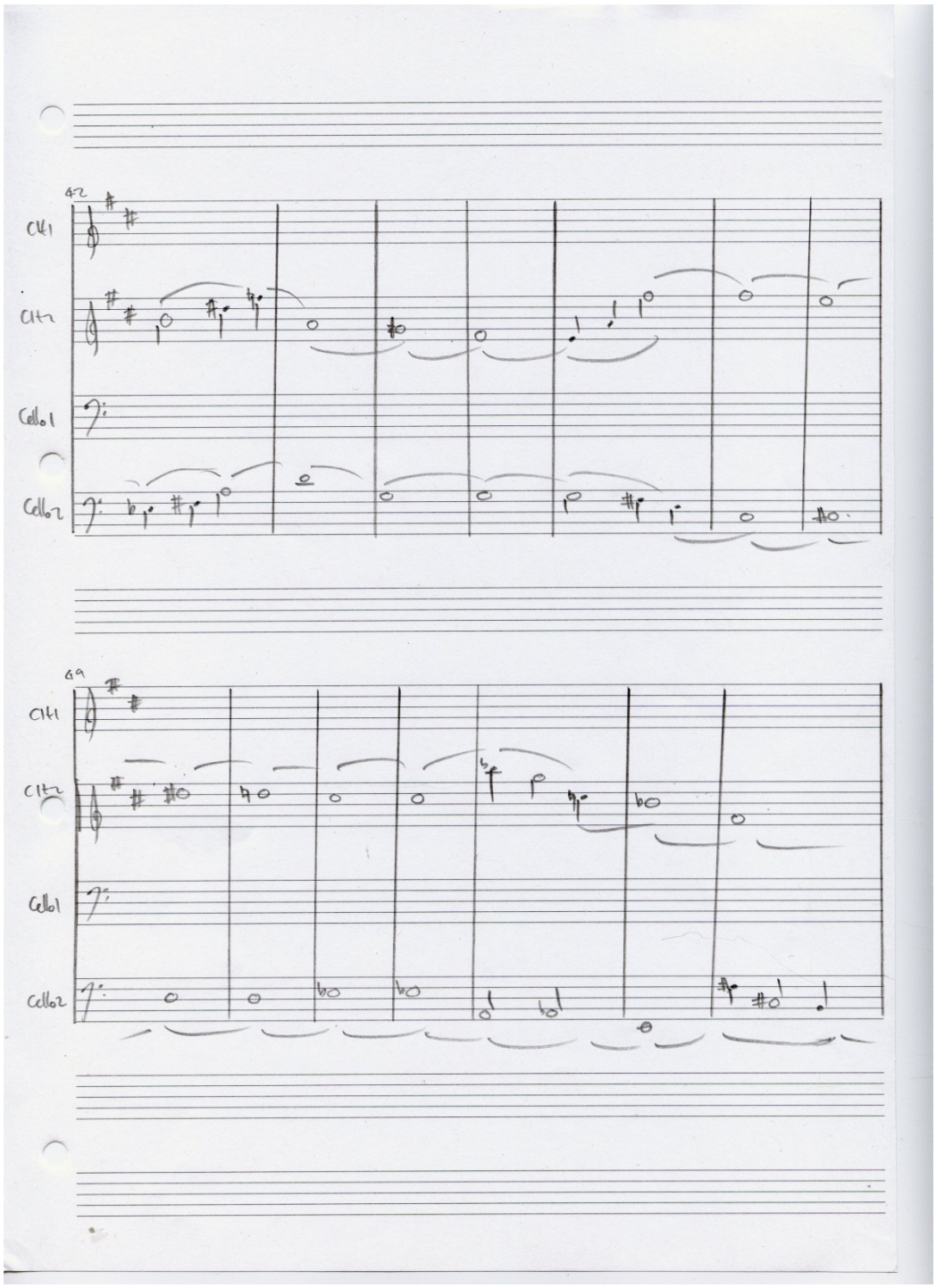


Figure 32: *Code-A* Movement 3 (p.5)

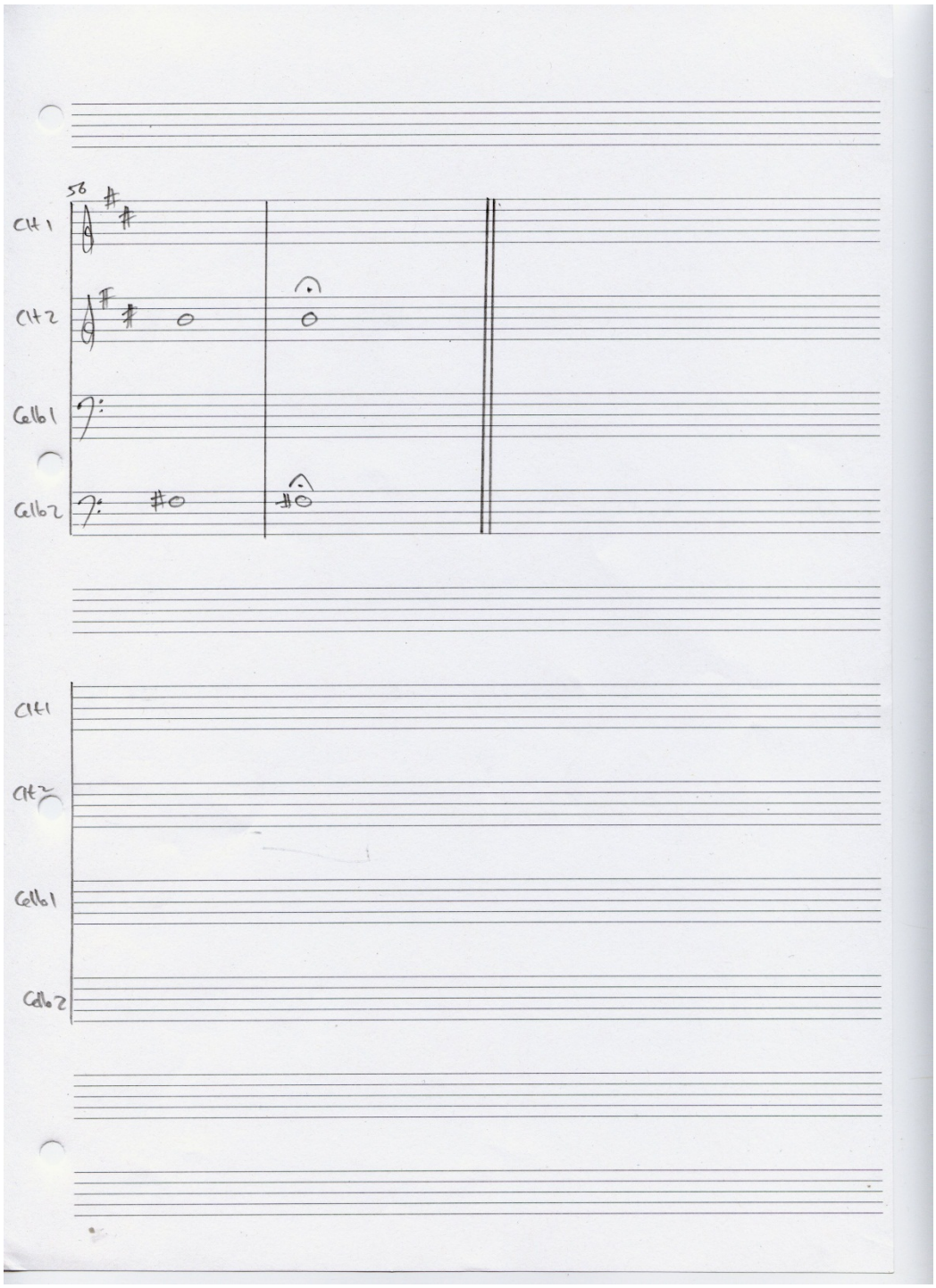


Figure 33: Barcode graphical score example 1

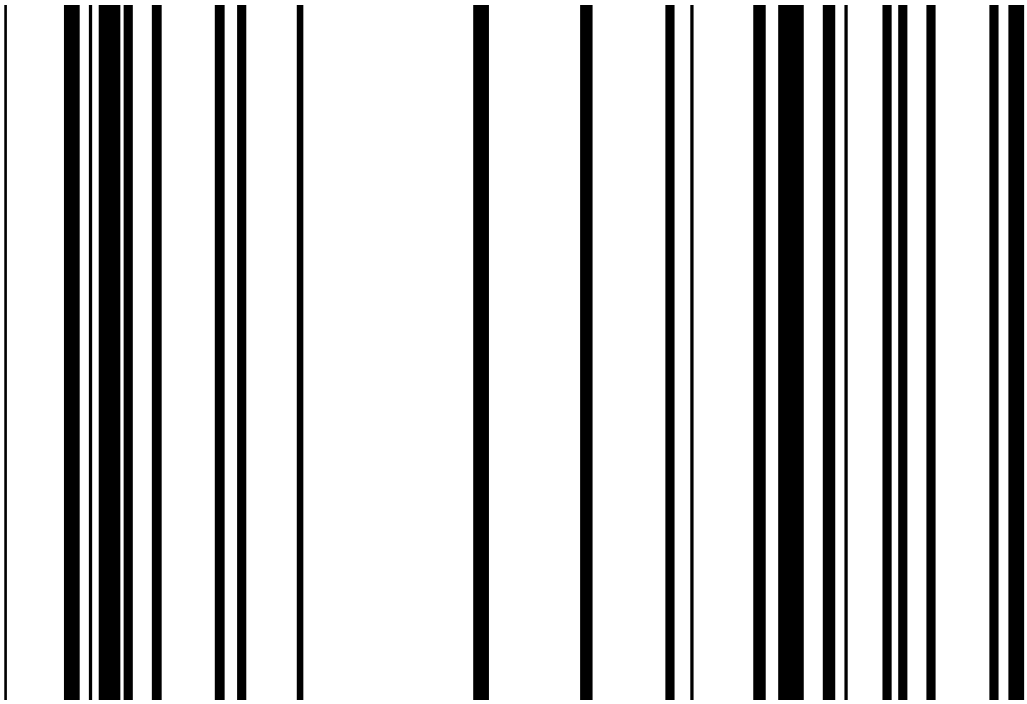
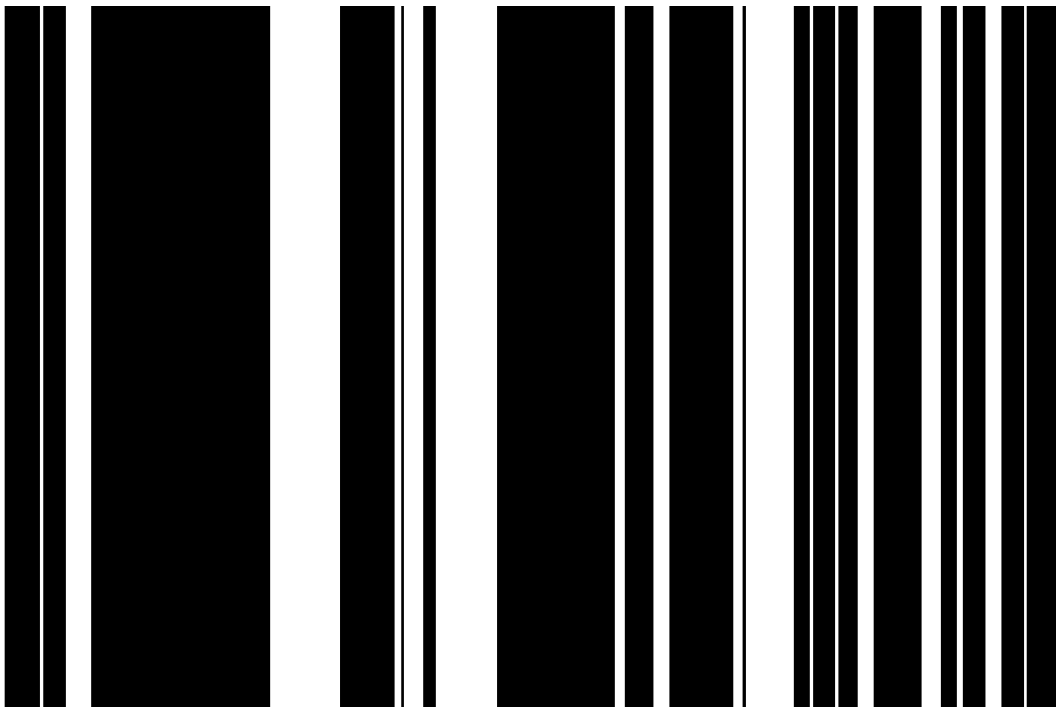


Figure 34: Barcode graphical score example 2



Appendix 8
Anthony Bailey: Contours II (for clarinet and electronics)

In 2012 I was booked to play clarinet for an interesting project at UEA to play in Code-A by William Vine, a lovely work for two cellos, two clarinets and electronics and specially built speaker panels built by William.

I was fascinated by the speaker panels in particular and was interested in how subtle they could be and how an instrument could work with them. So, after a conversation with William about how to write for acoustic instruments in collaboration with electronics, I decided I definitely wanted to write a piece to explore these possibilities.

The work I came up with was Contours II.

This is based on the interval of a minor 6^{th}, and grows from a simple opening up of these intervals in the lowest register of the clarinet. These are at first quietly stated and unaccompanied. From this calm, simple opening all the material for the piece is developed.

My idea for the electronic accompaniment was to have it resonate and magnify the contours of the clarinet line, at pitch - but in chopped up fragments scattered around the panels in a way that an echo might bounce and split around a mountainous valley. Sometimes rhythmic with a pulse and sometimes not. So perhaps on their own they might not hold together but when heard with the live sounds dominating them, the whole is of a source and its echoes simultaneously.

The element I have enjoyed most about this piece is that the electronics blend with the live sounds and don't sound too processed. It is still possible at all times to hear where the sound has come from. The other element that is most enjoyable is the possibilities of playing along with ones self and being able to spontaneously adjust note lengths and

phrasing to match and play alongside the sounds feeding back to me. Thus making music not science.

I found the panels themselves a beautifully theatrical element creating a lovely visual atmosphere, lit as they were from behind. The ability to space them out from us in whatever configuration we wanted was also very satisfying.

Anthony Bailey 2014

Appendix 9

Anthony Bailey: Contours II (Score)

Figure 35: *Contours II*, Page 1

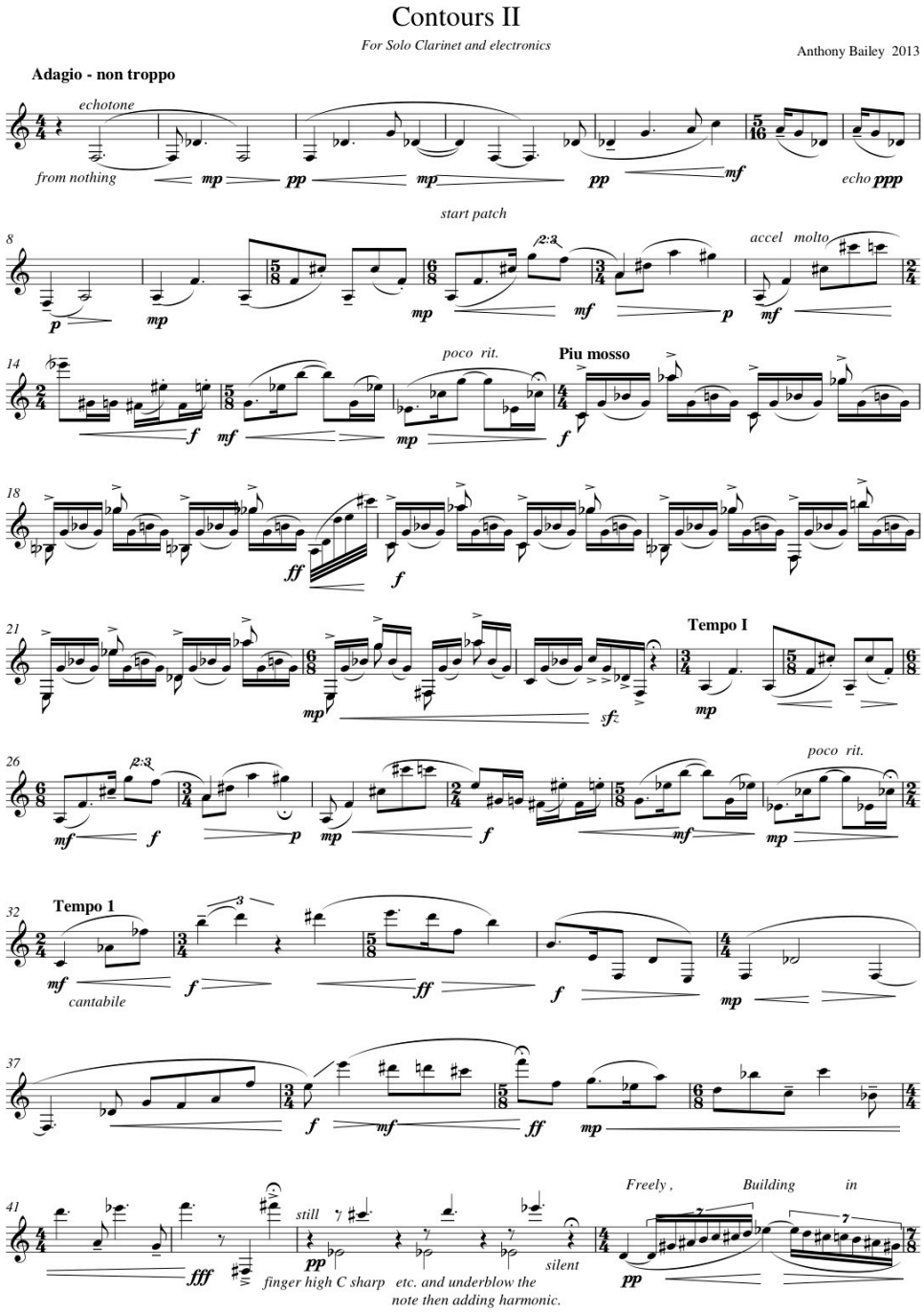


Figure 36: *Contours II*, Page 2

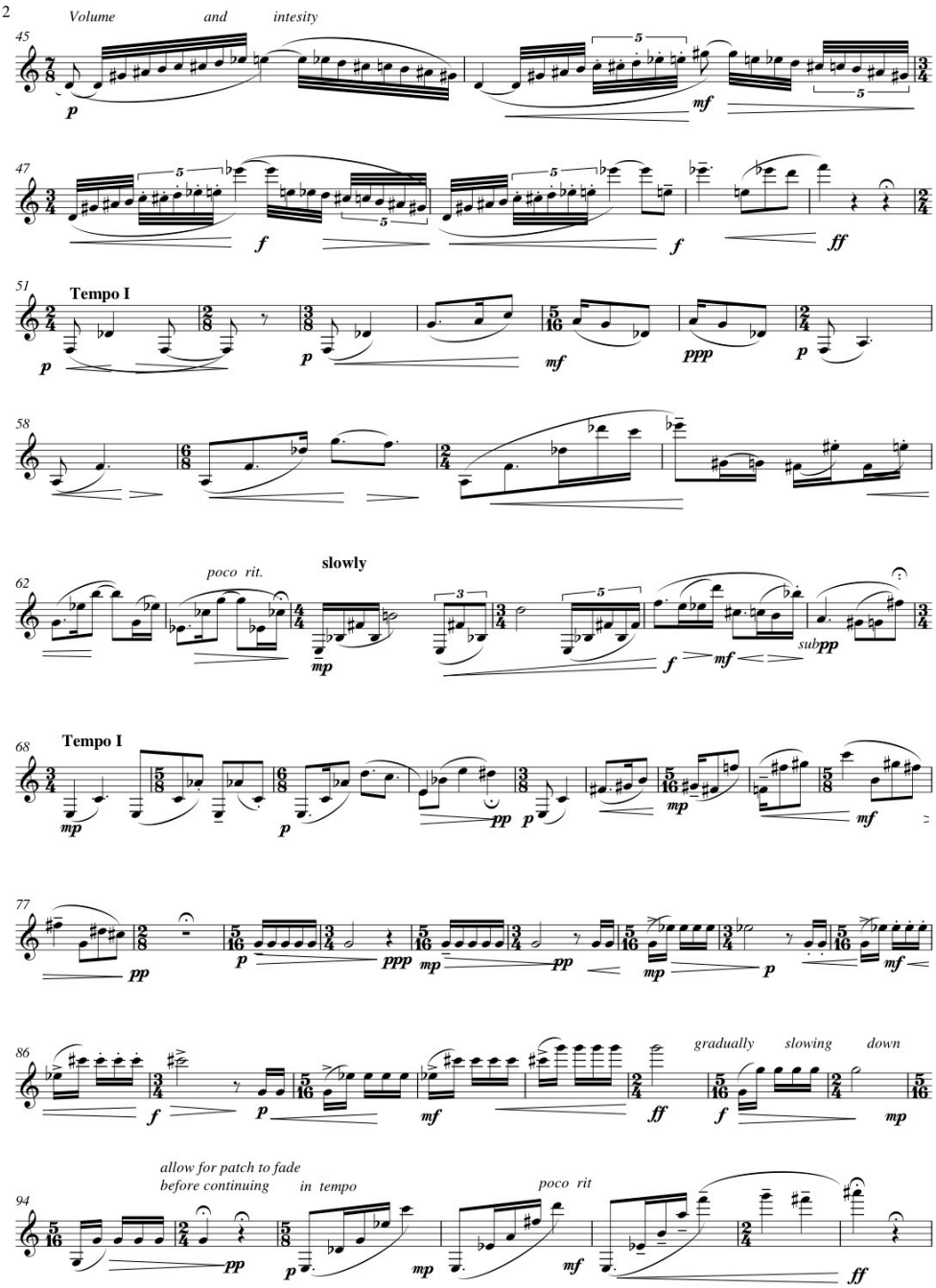
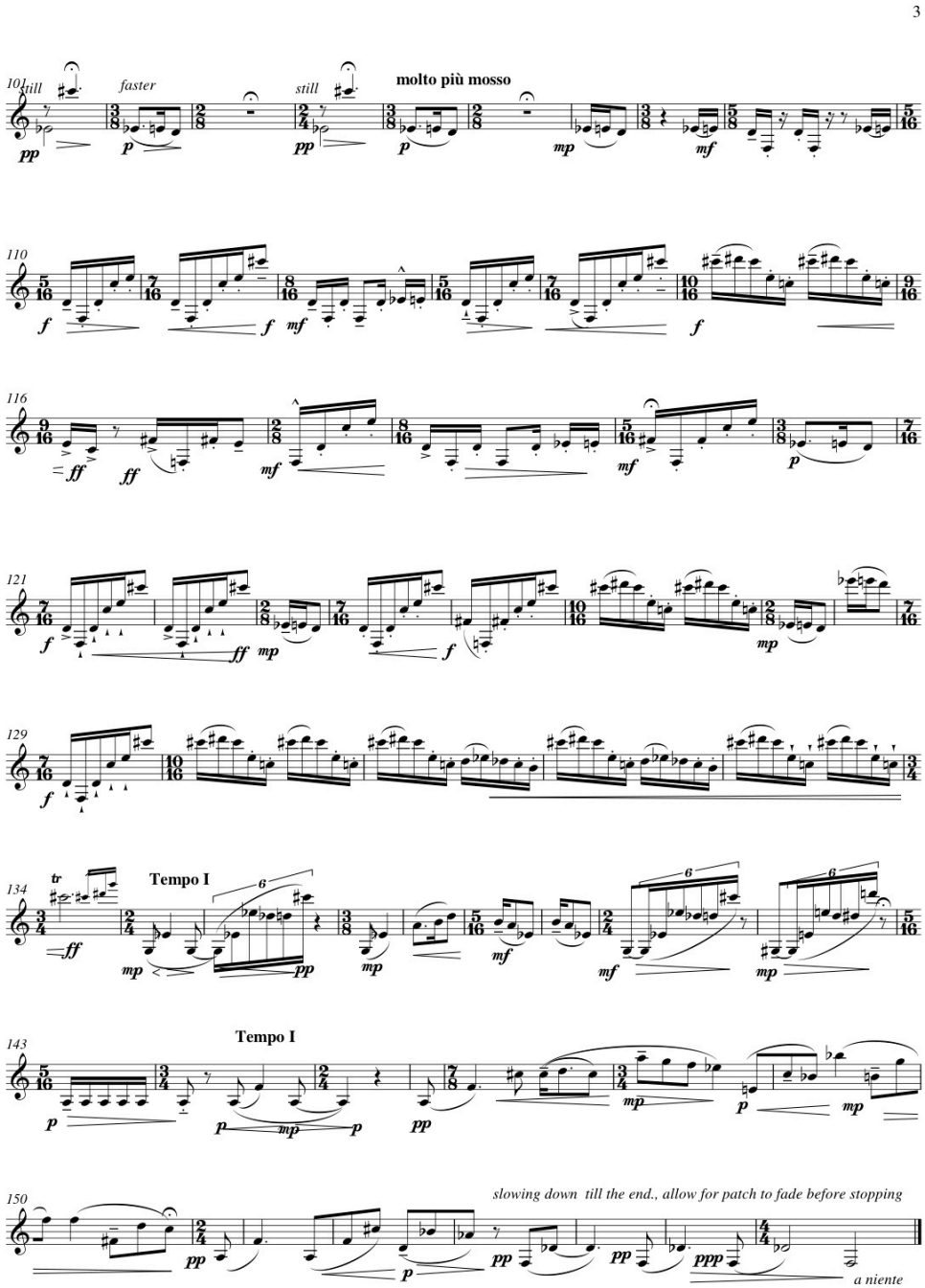


Figure 37: *Contours II*, Page 3



Appendix 10
Josh Bowker: Interpretations

Interpretations - Composer's Discussion

The idea behind the piece was representation. It was more about the aesthetics of performance than the performance itself. As such, the strikingly beautiful and stark flat panel speakers which Bill Vine had built were perfect for use. I saw Bill's piece *Numbers Station* and was impressed with the both the ingenuity behind the speakers, and their presentation, so when the time came, I approached Bill and asked if I could use them for this piece. In my piece I erected the speakers in a wall (as opposed to the nonagon that Bill had created for *Numbers Station*) and performed a poem from behind them. I only used seven of the speakers as the poem I was reading only had seven verses. Each speaker was adorned with a visual representation of a verse. The visual representations were A2 pieces of black card on which were chalked two versions of the verse, each verse being made of two cards. First there was the words to the verse scrawled quite messily and overlaying one another, then on top of the words was the waveform of a recording of me reading the poem which I had copied as exactly as was in my capability to do. The flat panel speakers were the perfect mounts for these due to their large size and spartan appearance. This meant there was ample room to attach the drawings, which I did via blu-tac, and that they also did not detract from their boldness by cluttering the surrounding.
Unfortunately using blu-tac to affix the pictures directly onto the speaker's membrane did interfere somewhat with the speaker's ability, dampening their effectiveness, but it was overall not a huge issue, and was not greatly noticeable. The audible elements of the performance were my voice acoustically, and then a corrupted version of what I was saying subtly layering it underneath which was coming from the speakers. This corrupted version was put through processes of equalisation removing all of the top end, and some reverb. The intended effect was to create an ambiance that sat beneath the acoustic voice adding to the atmosphere

of the poem. The speakers themselves running off nine-volt batteries are not particularly powerful, which meant that the volume levels were almost ideal (if perhaps just a touch too quiet) to accompany acoustic spoken word. It also meant the audience had to get right up close to the speakers. Unfortunately I had either set up one of the speakers incorrectly, or one of the output channels on the interface was faulty as one of the speakers was far louder than all the others and distorting wildly, and instead of my aforementioned desired effect, what was mainly audible was the acoustic voice accompanied by a slightly delayed rhythmic buzzing from one of the speakers. Unfortunately, due to time constraints I did not have time to amend this before the performance. However if one listened carefully to the other speakers the desired effect was achieved.

This piece would not have worked with any other form of speaker as the cluttered appearance with grills and dials would have been wrong. Also most speakers not being perfectly flat or indeed large enough to fit the pictures would be an issue. There would have been other ways around this, perhaps putting up large canvases in front of regular speakers, but I feel the effect would have been lost somewhat. The flat panel speakers were the ideal in this situation, they managed to fill the grey area I was working in that lay between functional music equipment and art presentation.

Josh Bowker, 2012

Appendix 11
Daniel Mills: Massacre and Edification

I first encountered William's work as an undergraduate at UEA, but it wasn't until after I graduated that an idea for a piece involving the LaFPanS began to take root in my mind. Aesthetically they are distinctive objects and their size and shape makes them rather imposing. As speakers also they possess a distinctive quality- they reproduce sound imperfectly and inefficiently but in what was to me a very attractive way. The LaFPanS' limited dynamic range and their highly coloured rendering of sound suggested several possibilities to me. However, as a composer, one of my primary fields of interest is in the relationship between Artist and Object and it was William's willingness to explore this that triggered an idea for a piece.

Intrigued by the work of Marina Abramović (in particular *Rhythm 10*) and Chris Burden, I had previously explored the concept of the performative destruction of my own work as a kind of self-immolation, creating several pieces in this manner. I had found the experience to be profoundly cathartic- in that act I was able to articulate myself far more eloquently than I could through the manipulation of musical language alone. With this piece I saw the opportunity to make William and his relationship with his work my subject. The craftsmanship evident in the construction of these panels was striking- William tells me that all told, he put more than 50 hours into their construction. This meant that these objects were not disposable and could not be easily replaced. Therefore, their destruction would have real consequences- the stakes in any performance would assuredly be high.

However, I didn't want to make a piece about destruction alone or about destruction for its own sake, simply because the degree of nihilism implicit in such an act made me uncomfortable. The piece needed a context, a reason for being. In order to find this, I looked to my subject. In 2012 the management of UEA made the decision that the music

department would be closed. William, who was at the time in his final year of his PHD, took a lead role in the campaign to get this decision reversed. To put it briefly, he was tireless and for a short time we all thought it would be enough. The ultimate failure of our campaign hit us all hard.

This shared experience would become the theme upon which my piece drew. The panels took on the role of the institution. Eight performers bearing the panels would encircle William, before closing in around him, boxing him in. The climax of the piece would be William's escape- and the destruction of the panels. The piece would be indeterminate in nature, with the audience being delegated the responsibility of bearing the panels. William would be given the power to determine the pace at which his fate came to meet him- the audience were arranged in a loose circle and instructed to take a step inwards each time William struck his panel- but not its nature. Because of this, the way the climax of the piece would play out could not be predicted ahead of time. William and I knew that there would be a confrontation, but the outcome was uncertain. I considered this necessary so that the piece would work on a dramatic level- a vitally important factor because the thematic basis that informed the piece's creation would be unknown to the audience.

In this piece, entitled *Edification*, the unique sonic characteristics of William's panels weren't utilised. My concept dictated that the piece be about their physical properties- their imposing stature and drum-like resonance- rather than about their capacity for reproducing sound. This was something I realised quite early on in the process and with some regret. I was enamoured with the sonic possibilities of these objects when used as speakers and I wished to explore them. Fortunately, in a second piece entitled *Massacre,* I found the opportunity to do so.

Massacre is a piece originally designed as an installation. At its heart is a conflict between computer and performer. Both the computer and the performer are given a palette of five pitches. The computer selects one of these at random and the performer must determine which of the possible pitches (which are notated for them) the computer has selected and then

sing this pitch into a microphone. When the computer detects the correct pitch, it selects a new one. The computer generates feedback throughout the piece and this gets louder and louder, the cycle only being broken when the computer program (max/MSP) detects the note it is looking for. At this moment, the microphone input is ‘frozen’ using a granulation effect. This ‘freeze’ lasts for as long as the singer can hold the note. As soon as their voice fails, a new note is chosen and the feedback cycle begins once more. In its original form, the piece was designed to last for forty minutes and it was presented in an exhibition of installations. The idea was that the human element of the piece become noticeably exhausted as the piece progressed and that the audience, revisiting the work at different points in the exhibition, would perceive the mounting tension created by the performer’s physical stress. William’s rendition of the piece represented my first attempt to reconceptualise *Massacre* as a performance. Utilising William’s panels changed the hierarchy of the composition- where previously the feedback element of the piece had the capacity to dominate it, here, due to the limited dynamic range of the panels, that possibility no longer existed. This meant that the piece became more about sound and less about struggle. The result was a performance much more delicate in character, and more subtle. William’s performance of Massacre served to underline his relationship with the LaFPanS in the minds of the audience, as well as the LaFPanS’s remarkable qualities, meaning that the stakes at play in the performance of Edification later in the concert are more readily apparent.

Daniel Mills, 2014

Appendix 12

Bennett Hogg: Flow

Figure 38: First window experiment

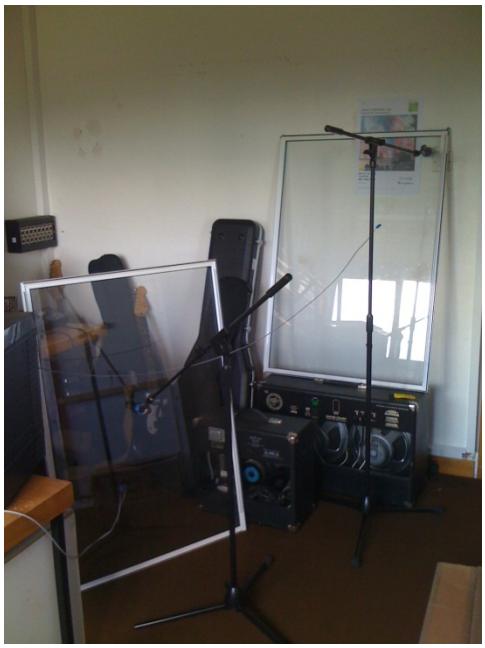


Figure 39: Window experiment – phase 2

Figure 40: Window experiment – phase 3

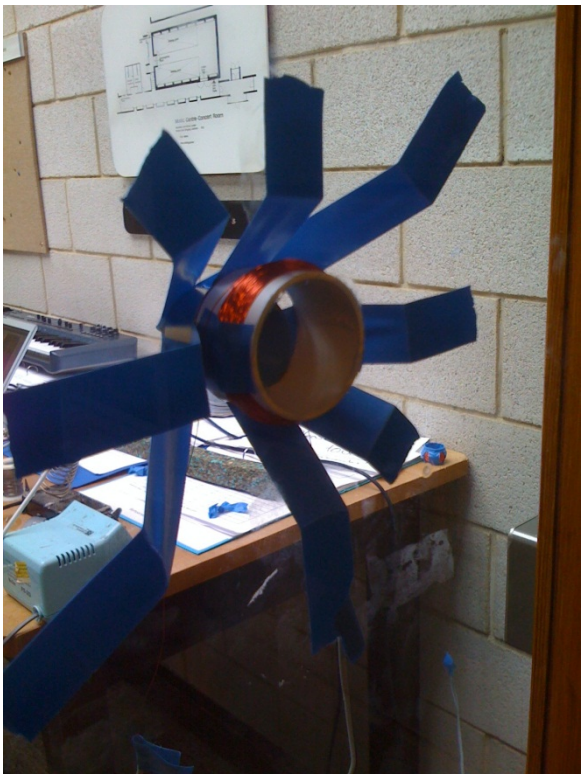


Figure 41: Window experiment – phase 4

Figure 42: Window experiment – phase 5

Figure 43: Window experiment – phase 6

Figure 44: *Flow* installed at Newcastle University (photo © Bennett Hogg, used with permission)

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