

Mobilising John Cage: The Design and Creation of Score Generators for the Complete John Cage Variations I–VIII.

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Abstract

The John Cage Variations provide a useful snapshot of a range of score writing techniques employed by Cage throughout this career. From very complex preparations and realisation of parts required in Variations I and II, to the almost non-existent scores of VII and VIII, the complete Variations provide a range of opportunities and challenges. In 2011, Western Australian new music ensemble Decibel developed a software-based score maker and player for the works and presented a series of concerts of the Complete Eight Variations. The performances have led to the development of the John Cage Complete Variations App for the iPad tablet computer, developed in conjunction with Peters Edition. Drawing on the ensemble's experiments with real-time and scrolling computer score generation and performance, and their unique make up of performers, composers, sound artists and programmers, the group has made the realisation of these works more accurate and possible in real-time for the first time. This paper discusses the approach taken by the group for the concept, design, creation and eventual performance of the scores for John Cage's Variations I – VIII, including the packaging of the works into an application. It will also cover the challenges presented by the range of different score formats to the packaging of the collection as a whole.

Keywords *John Cage, graphic notation, real-time scores, screen scores, music performance, music computing.*

The *Variations* offer a unique insight into the development of Cage's approach to composition practice, traversing aleatoric composition techniques, spatial arrangements and the use of a wide range of electronics. Composed between 1958 and 1967, the *Variations* are a varied collection of compositions, yet create a trajectory of technical and compositional interests. They take score forms that range from very precise instructions (*Variations I, II, III, IV, VI*), journal-like reflections on early performances (*Variations V*), hand-written sketches (*Variations VIII*) to only a few typewritten words (*Variations VII*). The works encapsulate Cage's interest in found-objects such as maps and star charts, system design, spatial sound production and multimedia and expand upon his tool box of instruments, introducing antennas, light sensitive resistors and telephony. Whilst a full analysis of each of the *Variations* is beyond the scope of this paper, the key compositional tools will be discussed in light of their adoption to digital

realisation. The App has proved to be most effective for the realisation of the scores with the most precise instructions, outlined above, yet Decibel has made interpretations of *Variations V* whilst leaving the brief text of *Variations VIII* and *VIII* as the only material included in the App. *Decibel* is an ensemble of musicians, composers and programmers based in Perth, Western Australia that have been working with screen scores, graphic notation and improvised music since their foundation in 2009.

Digital Score Players

The methods and justification of the adoption of the Cage Variations scores into digital readers have been discussed extensively in other places (Hope et al, 2012; Vickery et al., 2010, 2011, 2012), and the focus for this paper is on the transition of the scores from networked laptop computers to the tablet computer, namely the Apple iPad. This grew directly from the development of a stand alone graphic score player Application (App) developed by Decibel to realise their own compositions: A brief explanation will provide some useful background context here. The *Decibel ScorePlayer* App was originally developed to provide coordinated reading of graphic notations on tablet computers. These notations do not have a pulse or meter, yet require coordination for performers that may have traditionally, but not very effectively, been provided by a clock or other complex conducting methods. In addition, using a digital score facilitated realtime generation or transformation of the score materials during performance (Kim Boyle, 2010, 2013).

In the *Decibel ScorePlayer*, the score material passes by a line, not unlike the reading of an analogue tape on a tape head (Hope, Vickery, 2010). The scores can be stopped, moved ahead or back, slowed down or sped up in the player for rehearsal purposes. Works that operate in this paradigm include Cat Hope's *In the Cut* (2009) and *Longing* (2011). Later, additions to the score reader challenged the left to right reading paradigm by providing different points to read the score from. Hope and Vickery's *The Talking Board* (2011) uses circles that are programmed to move in different ways over a canvas is the score. Both the playhead and moving circle paradigms were adopted in the realisation of the Complete John Cage Variations scores.

The *Decibel ScorePlayer* was migrated from a laptop running MaxMSP to the iPad in 2012, and the *Decibel ScorePlayer App* was released on the App Store by *Decibel* through Edith Cowan University in 2012. It came pre-packaged with several scores created by composers within the *Decibel* ensemble, making it a score publishing as well as reading tool. This combined publishing and reading tool paradigm is the one used to create the *Complete John Cage Complete Variations App*; the App not only provides the mechanisms to read the scores, but it provides the scores themselves. The scores appear literally, but also in a form that facilitates and assists their performance as discussed below. Whilst the *Decibel ScorePlayer* enables the addition of other scores, the Cage App is hermetic - the score versions are fixed. However, in keeping with Cage's exploration of what he called "found-systems", images may be uploaded by the user for several of the *Variations* (Cage, 1966).

The ScorePlayer on Tablet Computers

The migration of the *ScorePlayer* to the iPad overcame the limitations of networked laptops that had become apparent in Decibel performances. Whilst MaxMSP provided flexibility for the prototyping of systems, its stability had become an issue in performances. In *Variations I* and *II*, each performer has a different score generated for the performance. This requires a systematic coordination of the computers so that the works start and end together at an agreed length. Despite developing a network utility in MaxMSP (James, 2011) to enable clear identification of network traffic and connectivity on networked computers, there were still issues of dropout and instability. The utility still required a number of complex settings to be adjusted on each performer's computer before the performance. The reliance on the network utility for dependable performance in MaxMSP meant that for other ensembles to use our score player and scores, they would be required to duplicate our network system exactly, which was not ideal (Wyatt et al., 2013). The *ScorePlayer* App is programmed to automatically find and connect wirelessly to any iPad that is running the same score, using any available existing network to link the iPads together. In this way the end user does not need to know anything about the underlying network configuration, which instantly increases the usability of the player for non-technical clients (Wyatt et al., 2013). As in the *Decibel ScorePlayer*, the *Complete John Cage Variations App* features a 'network status' button at the top left of the touch screen, so the user can see (and check) other users on the network. This is important for *Variations I* and *II* in particular, where coordinated performance is essential.

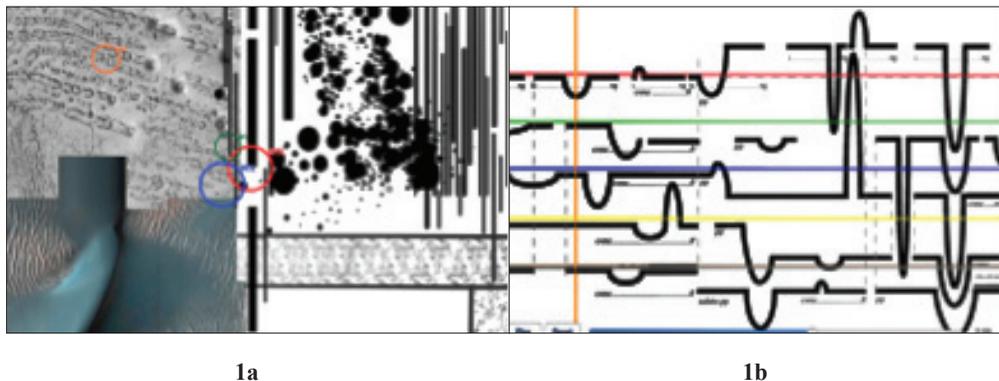


Figure 1a A screenshot of Lindsay Vickery and Cat Hope: *The Talking Board* (2011);

1b A screenshot of Cat Hope: *Longing* (2011), as it appears in the Decibel ScorePlayer.

The *Decibel ScorePlayer* was built according to a modular framework that enabled that split of basic player functions (reading) from the more specific rendering code (generation). This provided flexibility for the introduction of new screen score paradigms, facilitating the development of the different *Variations*. For example, where *Variations I* and *II* use similar score generation and reading functions requiring real-time generation and scrolling functions, *Variations III, IV* and *VI* have completely

different requirements, as they generate a score in real-time to be read as a static image, not moving or scrolling in any way.

The limitations of MaxMSP were also becoming apparent in the generation of the scores themselves. As the images being used in the scores were increasing in size, the smooth running of animated scores became problematic, with jittery performance and crashes becoming more common. Whilst this was controlled to some extent by engaging a jitter matrix to store the images, the result was still not as smooth as what could be achieved using lower level programming languages, such as Objective C, which makes up part of the iOS programming toolbox.

John Cage Variations on the iPad

The first of the Variations to be exported from MaxMSP to the iPad was *Variations III*. In this work, Cage provides a transparent plastic sheet with 42 circles printed on it. He instructs that a score is created by cutting out each of the circles and dropping them on a second blank transparency. The largest group of touching circles becomes the score, and all other circles are disregarded. Cage (1963) describes the process for performing the work in the following way:

Starting with any circle, observe the number of circles which overlap it. Make an action or actions having the corresponding number of interpenetrating variable ($1 + n$). This done, move to any one of the overlapping circles, again observing the number of interpenetrations, performing a suitable action of actions, and so on.

The digital version generates this aleatoric process in real-time at the touch of a button on the screen. On computer, this required clicking the space bar to generate a new score, on the iPad a discreet reset button on the bottom left of the touch screen generates the score, a much more straightforward and obvious instruction for any user. *Variations III* was the simplest to implement on the iPad as it was constructed using computer languages easily translated to the iPad iOS (Wyatt et al., 2013). Whilst the App only generates one score on each reset, the score is duplicated across all iPads on the network. The score could be interpreted by a soloist or group, as Cage's original score states the work is intended "for one or any number of people performing any actions" (Cage, 1962).

The next *Variation* to migrate to the iPad was *Variation IV*. In this work, Cage requires "a plan or map of the area used for performance, and optionally a copy of it on transparent material" (Cage, 1963). Circles and points are dropped onto the map and lines are drawn between the points and one of the circles. The performers take up positions in the performance space at any point along one of the lines.

In the App version users may add a map of their own performance venue by dragging an appropriately named image file into the iTunes file sharing facility. This functionality was created for the *Decibel ScorePlayer* App, and the file is created using the *Decibel ScoreCreator* App, a free computer application that was created to enable the uploading of images. The instructions for doing so are provided on the *Decibel* web site, where the simple and free application is provided to turn any .JPG or .PNG format

file into the format required by the App. The iPad is then connected to a computer, where the file (in the case of *Variations V*, a map) is added to the *ScorePlayer* App through the share capacity of iTunes. The *John Cage Complete Variations App* does away with the need for a *ScoreCreator*, enabling the upload direct to the App through iTunes, without having to create a new file format.

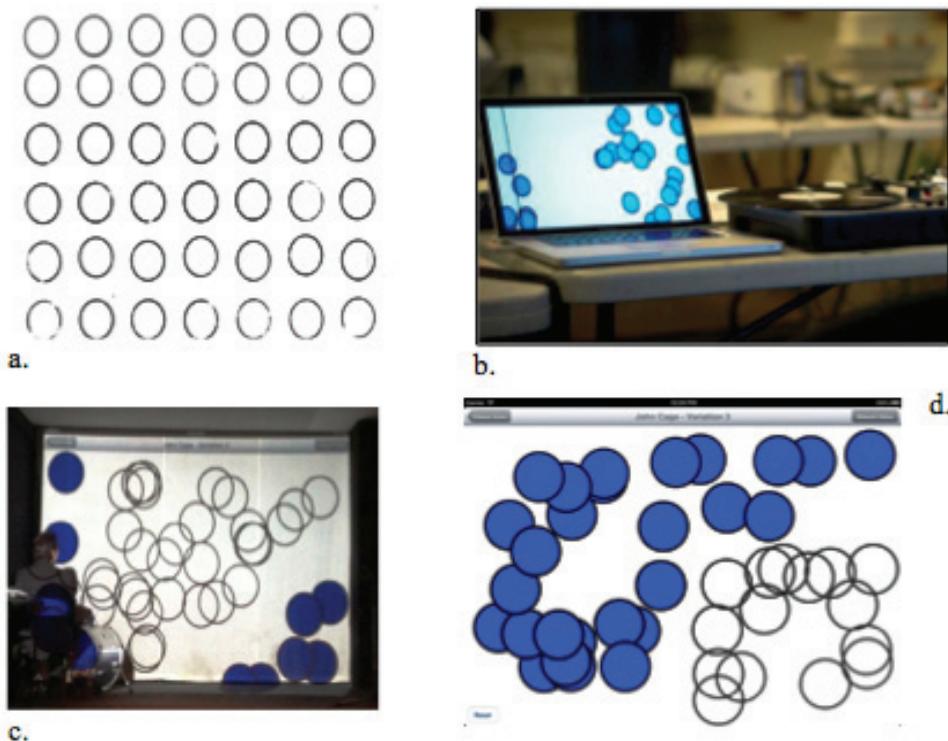


Figure 2a Excerpt of the score materials for John Cage; *Variations III* (1963);
2b Decibel's *Variations III* score on Laptop;
2c Projection of the score in a live performance;
2d Decibel's *Variations III* score on iPad.

The App version extends the programming required for *Variations III*. When migrated to the iPad, we decided to give the points different colours to facilitate the placement of performers who assign themselves a colour, making quick interpretations of positions relative to the map possible. As with *Variations III*, a 'reset' button is provided so the user may generate as many plans as they require in quick succession. When *Decibel* performs this piece, we choose the plan live on stage, by connecting the iPad to a projector, generating as many plans as necessary until we find a placement that is possible and interesting.

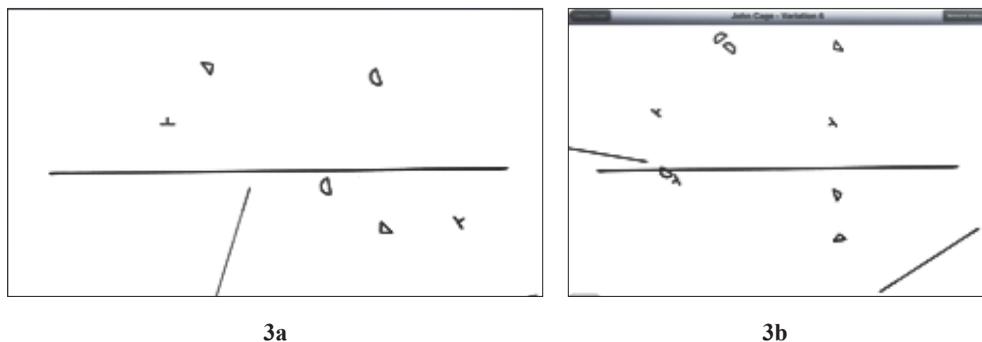


Figure 3a Decibel's *Variations IV* score on Laptop (Palermo February 3, 2012);
3b Decibel's *Variations IV* score on iPad (Brisbane April 4, 2012).

Variations VI was the next to be migrated to the iPad. Unlike the other *Variations*, *VI* uses Cage's own calligraphy for the 'dropped' symbols in the score, as these were very specific and their orientation is key to the interpretation of the score. Unlike *Variations III* and *IV*, which provide a fixed number of points or circles to be distributed in the score, *Variations VI* requires the specification of the exact number of icons to be dropped. However, like *Variations III* and *IV*, the score can be generated in real-time, using the reset button in the lower right hand corner.

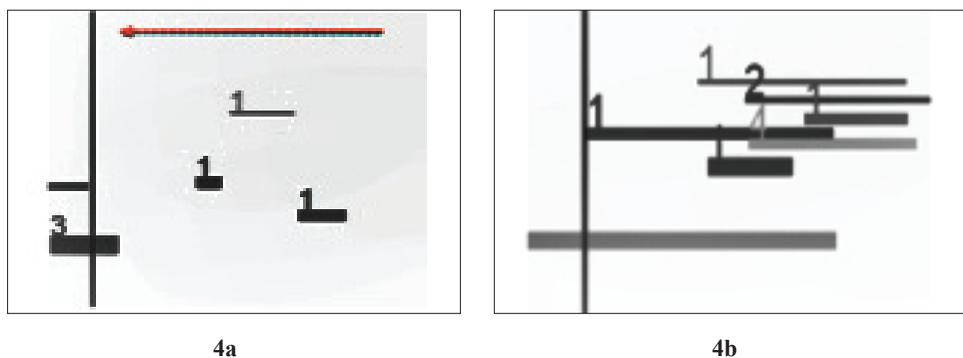


Figure 4a Decibel's *Variations VI* score on Laptop;
4b Decibel's *Variations VI* score on iPad

When *Variations III*, *IV* and *VI* were rendered on the tablet computer, they look very much like they would if the original score materials were used - transparencies, circles, lines, points and maps are rendered digitally instead of by hand, but appear very similar to the eye. Yet the rendering of *Variations I* and *II* results in a somewhat stylised graphic score that appears very similar on the iPad to the way they looked on the computers.

These were amongst the last *Variations* to be migrated to the iPad due to the complexities of generating the graphics in real-time. The data generated (measurements of distances from points and lines) creates a graphic notation which scrolls from left to right across a 'playhead', which signifies the point of performances, whilst showing

what is coming up, enabling performers to prepare. This scrolling technology was adopted direct from the *Decibel ScorePlayer*, yet the programming to generate the actual scores, in real-time, was developed especially for these Cage compositions. The computer code creates programmatic representations of Cage's slides, which can then be easily flipped or rotated at random to produce many different permutations. Once this is done, the distances from each of the points to the lines is measure, and these become the parameters used to generate the events displayed on the screen.

The scores feature numbers that indicate 'events' as specified in Cage's score, the positioning of a line on the screen via the horizontal axis depicts pitch, the darkness of the line the density of timbre, and the thickness the volume. Each iPad will generate its own score, eliminating the need for users to choose how many parts are required according to the size of ensemble. As with the *Decibel ScorePlayer*, the user can determine the length of the performance by choosing a time frame, using the 'duration' button on the bottom right hand side. There is no duration for any of the *Variations* specified by Cage. In *Decibel* performances of the Complete John Cage *Variations*, each Variation has an approximate yet fixed time assigned to it, outlined in the table below. Once the assigned time has passed, the scores fade to black. These times have been chosen from a curatorial perspective, so the complete concert has different foci and fits into a concert length program. Judy Lochhead has observed a large range of performance lengths in John Cage works, and lists performances that range from 30 minutes to 2 minutes for each *Variations I, II* and *III*, noting that a characteristic of many late twentieth century works is that the score materials provided by the composer do not necessarily provide the representation of an 'ideal' piece (Lochhead, 1994). The ability to choose the length of the score for *Variations I* and *II*, rather than to fix it in the App, enables this freedom of interpretation as intended by Cage.

Title	Duration	Instrumentation	Curatorial Rationale
Variations I	7 min	Bass flute, bass clarinet, cello	Soft, warm start with a focus on low frequency. Deliberately acoustic
Variations II	5 min	Flute, clarinet, viola, cello, piano	Contrasting instrumentation from Variations I, but more complex interactions.
Variations III	3-4 min	Drum set and an radio connected via Arduino .	Circles remind us of drum shape. Was often performed solo by Cage (Pritchett, 2009). Artist chooses a score immediately before performance.
Variations IV	7-10 min	Performers interact with the space by moving furniture, whistling etc which is recorded in the space and played back through speakers.	Score suggests that performers "do other activities" in addition to music (Cage, 1963). Speakers moved as part of the performance. Group chooses a score collectively immediately before performance.
Variations V	10-11 min	Theramins and light sensitive resistors interacted with by dancers (1-4), plantpot , bicycle, turntables, a.m. and short wave radios, news reports, pick ups, gieger counters, Brackage video, live of dancers.	Deliberate choice of analogue sound means to provide contrast with VII, and identify a sound of the works era. Freely improvised. Dance improvised, with the use of props.

Figure 5 A table showing the durations, instrumentations and brief introduction to the curatorial rationale for the *Decibel* performances of *The Complete John Cage Variations Project*.

Figure 5 (Cont.)

Variations VI	5 min	Bass guitar and electric cello with effects	Reflection on the trend for rock musicians/songwriters to perform Cage works (Heiss, 1993).
Variations VII	10-15 min	Skype calls, podcasts, internet radio, you tube videos, iPad music apps,	Choice of digital sound means to contrast with V, and reflect on 'sounds of the ether' (Cage, 1972). Freely improvised.
Variations VIII	6 min	No input feedback bass clarinet	An interpretation of the "no music, no recordings" and other score comments (Cage, 1978).
TOTAL	57 minutes		

Variations V, VIII and VIII have provided the biggest challenge to making the scores into a 'Complete Variations' App. Whilst these *Variations* make the performance of all eight diverse and exciting, they are not scores in any representative sense. In *Variations V* for example, the only indication of any score provision comes on page 2 of the 5 pages of text, which are mostly lists of equipment and things to do. The statement: "As though there were a drawing of the controls available and - on transparency - transcription from astronomical atlas which (were it superimposed) would give suggestions for use of controls" (Cage, 1965) points to some kind of score to observe. Again a system designed for Decibel compositions, namely the techniques developed for *The Talking Board* composition discussed above, was employed here. An astronomical map that resembles the ones found in Cage's own *Fontana Mix* (1958) is used as the canvas, and the coloured circles move over it: Users may also upload their own astronomical chart.

Variations VII and *VIII* are the least prescriptive of the eight works, indeed *Variations VII* simply consists of seven Statements and *Variations VIII* of almost illegible scribbles on a page. In the *Complete John Cage Variations App* these works are only represented by the text from the scores themselves.

Permitting Flexibility of Parameters

A drop down menu for some individual *Variations* has been provided in the *Complete John Cage Variations App*. This menu appears in all *Variations* that require parameter input, and is unique according to the different nature of input required. For example, *Variations IV* and *V* require the number of performers to be entered, while *Variations VI* requires input of the number of systems, components, sources and speakers. These are all itemised on different drop down menu formats as required.



Figure 6 Drop down menu for Decibel's *Variations VI* score on iPad.

The Benefits of Tablets and Apps

Laptops have proved rather unwieldy and precarious in music performance situations, often obscuring the performers and not providing the flexibility to be moved around on stage as required by the instrumental configuration of each of the *Variations*. Whilst a core computer is required for audio processing in certain *Variations*, the score readers perform relatively simple tasks that do not require audio outputs. The iPads can be easily connected to a projector if the ensemble wishes to project the scores and share them with the audience. In addition, the App can be downloaded by anyone with an interest in Cage's work, without any technical programming expertise, and may enjoy them as a visual work, not just as a cue to performance. Publishing scores within an app offers a new and exciting way to disseminate compositions and scores, as *Decibel* has discovered with the embedded scores in the first release of their *Decibel ScorePlayer*.

A brief mention of the use of score projection in the *Complete John Cage Variations* performances is worth a discussion here. When Decibel performed the project using laptop computers in 2012, certain scores were projected in the performance space using between 1 to 3 independent projectors. Each of the scores for *Variations I* were shown and read from the projections. In *Variations II*, the projectors went to black, as it was not possible to show all scores. The sharing of the scores put the performers under considerable pressure to perform the score 'correctly', as most of the public will develop an association between the score and the reading of it. In *Variations III* and *IV*, the projection of the single score offers an opportunity for the performers to share with the audience their selection of a 'desirable' score in real-time. In *Variations VI*, the projected single page score can be referred to by the performers during the performance, and in *Variations V*, the map facility is projected alongside a live video feed and, in *Decibel's* performance, a Stan VanDerBeek film developed for

the premiere performance in 1965. There were no projections for *Variations VII* and *VIII*. The *Complete John Cage Variations App* enables the projection of scores with the simple addition of an iPad to VGA adapter. However, the additional live film and VandDerBeek films *Decibel* featured in their rendition of *Variations V* are not included in the App, meaning that extra computers are required. However, this is the only point of difference in the transition of the scores for the project from laptop to iPad.

Conclusion

At the time of writing, the *Complete John Cage Variations App* is being finalised for the Apple App store, with a user interface being designed to bring together all the different *Variations*. The project has brought to light interesting questions around the contrasting approaches of internal mechanisms to facilitate performance compared to the public release of this mechanism. The *Complete John Cage Variations App* offers one interpretation of these works for performers and scholars to consider, and whilst the interpretations of the Variations inherent in the App are without doubt *Decibel's* own, they are also those of John Cage. This raises some interesting questions around digital publication methods, and the open structures they facilitate. The intellectual property held in the interactivity and the back end design of the App belong to *Decibel*, but also to Apple, MaxMSP and the individual programmers themselves, creating copyright and licensing challenges. Yet the strength of the project lies in the practice led methodologies employed in its development, resulting in a 'performers' approach to the works, the App format enabling this work to be shared amongst performers beyond *Decibel*, enabling the many unique interpretations of the works as Cage intended. The App provides a combination of tools, interpretations and approaches that can be used for musicological study, as well as performance. In collaboration with Peters Edition, who will endorse the App on a non-exclusive basis, and provide permissions to use some of Cage's own fonts in the rendering of *Variations VI*. The App breathes new life into this exciting music, making it more readily available, easier to perform more accurately and simpler to access.

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Biographies

Dr Cat Hope is a composer, sound artist, performer and academic. She is a classically trained flautist, self-taught vocalist and experimental noise bass player with an active performance profile as a soloist and in music groups. She is the director and founder of Decibel and has toured internationally as a noise artist. Cat's PhD was entitled 'The possibility of Infrasonic music' and is currently a full time researcher at the Western Australian Academy of Performing Arts at Edith Cowan University. She has won a number of awards ranging from a nomination for Citizen of the Year (arts category 2011) to the Inaugural APRA|AMC Award for Excellence in Experimental Music. <http://www.cathope.com>

Dr. Lindsay Vickery is a founder member of Decibel, SQUINT, HEDKIKR and Magnetic Pig. His current compositional preoccupations include the relationship between modes of presentation of the musical score and musical structure, between electronic/acoustic, composed/interactive and interpretative/improvisational approaches. He writes and presents on a range of topics, most recently on the history of the score, nonlinear music and the realisation of Cage's scores. He has performed at numerous festival including ISEA, SWR Tage für Neue Musik, Shanghai, Sydney, Adelaide and Perth International Arts Festivals, MATA, NWEAMO and WHATISMUSIC. He is coordinator of Composition and Music Technology at the Western Australian Academy of Performing Arts at Edith Cowan University and holds an MMus (UWA) and PhD (QUT). www.lindsayvickery.com/

Aaron Wyatt is an accomplished violist who appears regularly with the West Australian Symphony Orchestra. While classically trained, he maintains an avid interest in other genres and greatly enjoys being involved in new music projects. He has played with the Döggöx Art Orchestra, an 18-piece jazz/funk ensemble and has directed the Resonator Quartet in a performance of Michelle Van der Aa's *Quadrivial* for the 2008 Totally Huge New Music Festival. More recently he played for the premier of composer Chris De Groot's new work *Ménilmontant* – music for the 1927 silent film by Dmitri Kirsanoff. He has an Honours in music, and programmes for the Decibel new music ensemble.

Stuart James has a masters in research into correlations between sound and video using Wave Terrain Synthesis. More recent compositions and performances have also stemmed from this research as well as granular and frequency domain synthesis. In addition to running a commercial studio, Stuart is completing a PhD in timbral synthesis.

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