Music Composed for Calm and/or Catharsis Using a Compositional Toolbox for Emotional Evocation – Inspired by and Directed Towards Healthcare Contexts and Self-Managed Wellness

Volume I

by

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Declaration

This dissertation is the result of my own work and includes nothing, which is the outcome of work done in collaboration except where specifically indicated in the text. It has not been previously submitted, in part or whole, to any university or institution for any degree, diploma, or other qualification.

In accordance with the Department of Composition guidelines, this thesis does not exceed 80,000 words, and it contains less than 150 figures.

Signed: .....

Date: .....

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Abstract

Experiencing emotions through music listening is a universal experience. In the age of COVID-19 and an ever-mentally enslaved population, music that encourages calm and/or catharsis is more relevant than ever (Gallagher et al., 2020).

Many researchers have studied the power of music on the brain: that music can change our emotional state, which specific musical features elicit specific affects, and the importance of musical experience as a tool for wellness. As composers, can we utilise the data that researchers before us have collected surrounding emotional response to music, form a framework for and create music to pointedly evoke an intentional emotion?

This dissertation seeks to build on the solid foundation of music and emotion researchers' past theories, and demonstrate how to further utilise the power that music has in both our everyday lives, and also in healthcare settings – providing an output of a large suite of music for use for calm and catharsis, and a Compositional Toolbox for Emotional Evocation that composers might use to effect positive emotional change.

In two pilot studies: one for children and one for adults, this dissertation tests music written using said Toolbox, to observe its effect on two scales: arousal, and pleasure.

The studies also utilise visuals as a secondary means of sensory control, and to investigate whether the multisensory application of music and visuals enhances emotional evocation over isolated experience.

Participants listened to and watched examples of stimulus, and using a Likert-type scale, rated how exciting/calm (arousal) and happy/sad (pleasure) each sample made them feel, or they think would make someone feel. An analysis of pieces from these studies is included in this dissertation. Mixed-method, deductive, and thematic analysis was used for data, which was collected via surveys and interviews.

It was found that music using the Toolbox was more emotionally evocative, more calming, and happier overall than that written without. Most of the pieces achieved their emotional aims, and positive correlations between the use of music and visuals together have arisen. Music without the visuals appeared to be calmer than that with visuals in one of the studies. Further enquiry into the measurement of catharsis, some clarified study design, and studies with larger participant pools are recommended going forward.

This dissertation begins to attribute tangible feedback to promote the use of the Compositional Toolbox for Emotional Evocation as a framework for emotional composition.

Acknowledgements

A very personal Facebook post was included in this dissertation (figure 2), and I am grateful to have had permission from composer John Mackey to do so. Further, this dissertation would not be what it is without the support of some important individuals.

First, to my supervisors Matthew Hindson and Philip Poronnik, thank you for trusting me with this weird and wonderfully non-standard music dissertation. I hope this is the first of many interdisciplinary research projects like this to come for us. Music needs science and science needs music – it's abundantly clear.

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supported, the shoulders for my tears and the champagnes for my wins, I thank you from the depths of my heart. I am sobered and humbled to know a love like all of yours.

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Introduction

It is a creative person's calling to form connections between objects, places, and thoughts that are not otherwise obvious. One might even say it is their duty to do so. The study of music in conjunction with other disciplines is the path to progressing our understanding of our beloved music overall. I have done this with the complementary discipline of psychology in order to make meaning regarding music creation in new and novel ways.

In my research, I have found that compositionally specific music created and programmed for psychological wellness is an especially under-utilised tool. I hypothesise that this is due to a lack of a systematic framework for composers to adhere to in order to achieve pointed affect (observable emotion) in listeners. Many researchers before me have studied and validated the power of music on the brain, that music can change our emotional state, which specific musical features elicit affect, and the importance of musical experience as a tool for wellness. What is left, is room for a framework to be created for the composer to utilise these discovered tools in amalgamation, and create music for a profound purpose. The need for tailored programming in musical remedy is a conversation that's happening ubiquitously in the fields of neuroscience, psychology, physiology, design, and music (e.g., the This Sound Like Science – Music and the Mind series in August 2018 at City Recital Hall, hosted by Inspiring Australia). This highlights the growing need and interest in music as a wellness tool in society today.

This research is the practical and real-world application of the Compositional Toolbox for Emotional Evocation (CTEE or the Toolbox) that I developed in my previous research (Nicolas, 2018). The CTEE was designed specifically as an analytical tool and compositional device to

better understand, more specifically and scientifically, why existing music has such emotionally affective power over individuals.

This doctoral dissertation further develops and revises the CTEE, moving it from a theoretical framework for composition and analysis to a practical tool to inform compositions that can affect human emotions and responses for wellbeing and health. This thesis reports on two pilot studies that examine the efficacy of the CTEE. Both studies developed a suite of composed pieces programmed using the CTEE for each scenario as well as an extended portfolio of works that can be used for further similar applications. This dissertation also builds on the work I do as a composer. I have worked closely with The Hush Foundation – an organisation that connects healthcare and the arts (Watson & Forrest, 2020) – initially in 2018, writing a piece to reflect my fieldwork conducted at the Westmead Children's Hospital, and subsequently in the album I am now writing for the Hush Foundation to provide calm and/or catharsis as relief from a pandemic. I am also working with the interdisciplinary Charles Perkins Centre at The University of Sydney, where in 2022 I launched a new research node, Health and Creativity, with an immersive musical experience that aimed to excite and reinvigorate an audience of centre supporters. My research at the Charles Perkins Centre will build on the area of research detailed in this thesis, with the hopes of contributing tangible, new thought parameters and solutions around music and health. In my practice as a composer over the years I have amassed considerable expertise in creating music for emotional experience. This dissertation serves as a platform for the continuation and exploration of the CTEE and related strategies in wellbeing and health.

In recent decades, there has been a dramatic spike in pharmacological interventions for mental health issues, encompassing all levels of severity. In Australia from 2000–2011, there was a 58.2% rise in the provision of psychotropic drugs (benzodiazepines, antidepressants, antipsychotics, and ADHD medications). There were major increases specifically in

antidepressants (95.3% increase in DDDs/1000/day), atypical antipsychotics (217.7% increase) and ADHD medications (72.9% increase) (Stephenson et al., 2013). Between 2007 and 2015, the dispensation of psychotropic prescriptions increased by a further 23.5% (Pharmaceutical Benefits Scheme (PBS) (2016), as cited in Brett et al. (2017)), and between 2015 to 2019, there was an increase of antidepressant use of 7% for females and 9.2% for males (de Oliveira Costa et al., 2023). In spite of concerns about their efficacy and the many possible side effects of long-term use, antidepressant prescriptions continue to increase significantly for treating mild-to-moderate depression (Stephenson et al., 2013). The ubiquity of mental conditions due to COVID-19 also highlights the need for tools for emotional self-management and wellness. Through 2020–2022, many Australians experienced COVID-related fear, anxiety, and panic. This was exacerbated by the ramifications of the bushfire disasters experienced shortly before the initial COVID outbreak in Australia. It is expected that during a pandemic, people will experience higher levels of panic, anxiety, depression, and other mental health ailments. This is worse for people in the healthcare industry, people undergoing quarantine or those facing potentially life-threatening disease (Black Dog Institute, 2020). In a study conducted by the Black Dog Institute, 78% of participating Australians reported a decrease in their mental health since the onset of the pandemic (Black Dog Institute, 2020). In August 2021, Australian mental health aid organisation Lifeline noted its daily record of call numbers had been broken four times within the month. They finally logged 3,505 calls in a single day – the largest number of calls since Lifeline was founded 58 years previously (Truu, 2021). Overall, the number of calls to the organisation was 40% higher than in 2019. They were also averaging longer call times. Similarly, Beyond Blue (another key Australian mental health organisation) has undergone an extreme number of requests for support in the same period, and demand for their services has increased by 29% since the 2021 Sydney lockdown period ensued (Beyond Blue, 2021). The increasing levels of mental stress in today's society highlights the absolute need for research in the field of musicological intervention in health as an adjunct or complement to standard

medical interventions. In a recent study conducted by Carlson et al. in 2021, it was found that during the pandemic, many people's music habits changed, but their music listening either remained unaffected or increased. Particularly, self-selected music and live-streamed concerts gained popularity. The researchers' analysis showed connections between using music to regulate mood, musical engagement, and anxiety levels.

Music is a universal language in that it has the potential to transcend cultural barriers and communicate with people sans lexicon (Reuell, 2018). Any non-pharmacological tool that can facilitate calm and/or catharsis is a welcome aid in the combat of psychological health problems in Australia, and around the world. The research presented here aims to initiate the creation of music rehabilitation platforms that are compositionally programmable. In this way, this project can contribute at all levels: from the layperson struggling with emotional balance to the practitioners assisting patients in healthcare, from the patients themselves to their carers.

The basis of the CTEE was my Master's dissertation *Compositional Mechanisms in Popular Music: Emotional Affect on the Subconscious Mind*, which investigated how popular 21st-century music manipulates the emotions of its mass audience. The project took a widely consumed Western musical genre and used the first version of the CTEE to investigate how laypeople are unwittingly emotionally influenced in a variety of contexts such as elevators, shopping centres, bars, clubs, gyms, and cinemas, as well as through our radios and televisions. The current thesis progresses this work into a practical framework: moving from the "the fundamental question: why does music have such power over us?" (Perlovsky, 2015) to the practical application of the CTEE in composition. Part of the evaluation and analysis process was to develop theories as to how we as composers can write music to specifically evoke emotions or emotional release. The primary emotions focussed on in this study were calm and/or catharsis.

The study of the emotional power of music requires identification and understanding of human susceptibility to emotional manipulation. To validate the analysis of emotions in music in this dissertation and to understand how emotional influence can arise from musical experience, a review of literature is essential. Part of this dissertation will offer an examination of the psychological mechanisms which are activated during emotional evocation which make us feel certain emotions when listening to music. Musical emotional experience is subjective and highly predicated by a listener's cultural and contextual exposure. This dissertation aims to identify mechanisms of emotional evocation that transcend these boundaries by referring back to the underpinning physiological and psychological principles of emotional experience that are universal. It will then describe two pilot studies conducted on children and adults that were designed to gauge the efficacy of my CTEE through its use in music composed specifically for calm and/or catharsis. Both studies also included the peripheral use of visuals as a means of multi-sensory immersion (and their potential role as a music-adjacent or standalone tool for emotional response). This is an interdisciplinary undertaking in which my primary expertise is that of a composer. However, during the course of my past 10 years in composition and performance, I have had the benefit of observing and researching the practice of some inspiring psychologists/neuroscientists/music therapists and other collaborative influences to inform the design of the studies. This is a dissertation by a music composer that journeys through the psychology of music.

To begin, the terms "affect," "mood," and "emotion" all describe similar psychological phenomena, just with varying lengths of endurance. "Affective phenomena" or simply "affect" are often regarded as the main umbrella terms, though there is no unanimous agreement by researchers on what this includes (Baltazar et al., 2016). This researcher understands mood as a sustained state of experiencing an emotion, whereas emotions as more susceptible to rapid variation (Beedie, 2007). For a more comprehensive enquiry into the distinction of the terms, I suggest reading Christopher Beedie's "Towards empirical distinctions between emotion and

mood: A subjective contextual model" in *A subjective contextual model. Mood and Human Performance: Conceptual, Measurement, and Applied Issues* (Beedie, 2007). The literature in this exegesis will occasionally refer to affect, mood, and emotion interchangeably, and this author, though concerned more specifically and primarily with emotion as an affective phenomenon due to its alleged propensity for rapid variation (and therefore susceptibility to alteration through external influence), considers them a variation of a theme and inclusively relevant.

It is now critical to address the notions of calm and catharsis – the primary affect, and affective experience targeted for expression or evocation throughout this research. The *Oxford English Dictionary*, published by Oxford University Press (2021) (OED henceforth), defines *catharsis* as a purgation, a release of energy, and a relief from strong or repressed emotions (affect). Similarly, OED defines *calm* as an absence of strong emotions, a soothed feeling, and tranquillity. The Circumplex Model of Affect suggests that affect arises from two key neurophysiological processes: valence, spanning pleasure to displeasure, and arousal or alertness. Affect is a combination of these aspects. The Circumplex Model of Affect suggests affect in relation to these aspects as below (Kadar et al., 2016), and seems to represent a

common interpretation of the intersections of affect and arousal/valence that this author has observed across the various literature in the field:

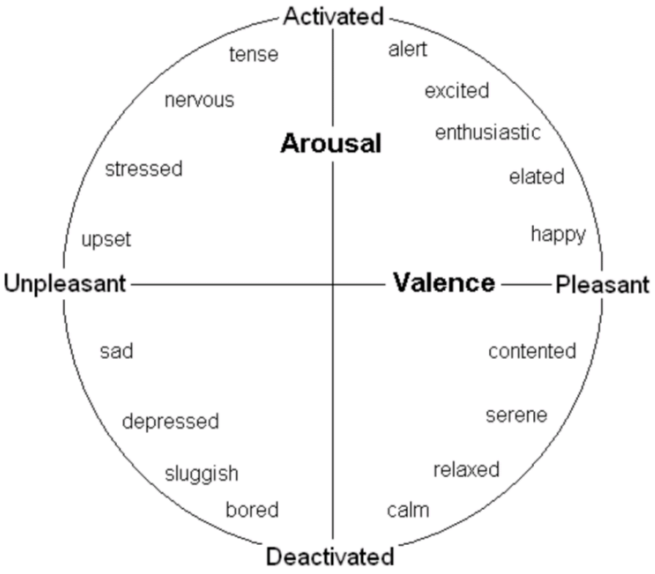


Figure 1: Circumplex Model of Affect

The Discrete Model of Emotion is a second prolific affect model. It categorises emotions into twelve affects: interest, joy, surprise, sadness, anger, disgust, contempt, self-hostility, fear, shame, shyness, and guilt (Izard, 1977). It offers emotions a unique set of parameters based on their correlative affects. The discrete model of emotion offers a straightforward and easy-to-understand classification of distinct emotions, while the circumplex model provides a more comprehensive and nuanced representation of emotions based on their location in a two-dimensional space. Each model has its strengths and weaknesses, and the choice between them often depends on the research question or practical application at hand. On that note, for the purposes of communicating calm and catharsis which are closely linked to arousal, the research in this dissertation will utilise the Circumplex Model of Affect.

As can be seen in the Circumplex Model of Affect, calm is deemed a product of pleasant valence, and very low arousal. It also closely borders unpleasant valence. For this dissertation, calm is identified as the emotion (affect) that results from low arousal and mostly pleasant

valence (again, due to its proximity to the unpleasant valence quadrant), and catharsis (from the Greek for *cleansing*) is identified as the experience of calm following the energetic build to a climax. Calm is not exclusive to pleasant valence, and the separate facets of arousal and valence are distinguishable in this research. Although much of the music produced for this PhD pairs calm and positivity (or happiness), there are some instances where this is not the case – in an effort to acknowledge that valence matching for calming is just as important as the calming itself. Pieces presented in the portfolio of this PhD, such as *Bloom*, *The End*, and *Ground Level of My Mind's Eye*, contain moments of the evocation and/or expression of ostensible unpleasant valence affect (sadness, nostalgia, grief). These moments are carefully included in the emotional trajectory of each work and are crucial to the narrative building of each emotional journey. Overall, however, it should be noted that attempts at communicating calm after experiencing the full duration of the musical stimuli in the studies in this dissertation are aimed at paralleling positive valence. A discussion of music's ability to induce negative affective states (including low arousal and negative valence affective states that can be akin to depression) can be found in the background section of this research (see section 1.2). Stress, anxiety, and the like result in the activation of the sympathetic nervous system. In order to combat associated affective phenomena, activation of the parasympathetic nervous needs to occur through calming and/or calming via catharsis measures (Amorin-Woods, 2021). Calm and catharsis are hence the most appropriate affect/affective experiences to evoke through music for the purposes of alleviating stress, sadness, and other adjacent affective phenomena associated with significant current social events such as the COVID-19 global pandemic.

The structure of this dissertation is: (1) **Background enquiry** — a comprehensive review of the relevant literature to create a snapshot of the research that has substantially contributed to our current understanding of the relationship between music and emotions; (2) **Study 1:** The Wellness Project (a study for adults) — a pilot study to test the efficacy of the CTEE in creating

music to evoke and induce perceived calm and/or catharsis in adults; (3) **Study 2:** Music and Video for Calm and Catharsis (a study for children) — a pilot study to test the efficacy of the CTEE in creating music to calm children (with the addition of visuals); (4) **Further Compositions** for Calm and/or Catharsis and a Compositional Analysis; and (5) **Conclusion**. Both studies aimed to confirm the utility of the CTEE as a framework for emotionally guiding music, as exemplified by the expansive portfolio of works for calm and/or catharsis that were created for this dissertation. The scores for these works can be found in Volume II of this dissertation, with a link to Dropbox where the accompanying recordings can be observed.

Chapter 1:
Background – Emotional Dialogue and Music

> *Nearly everyone enjoys listening to music. Why? Undoubtedly, because music moves the emotions. But this answer replaces one puzzle with two: how does music communicate emotions, and why do we enjoy having our emotions stirred in this way? No one knows…*
> *(Johnson-Laird & Oatley, 1992, p. 13)*

Music can evoke powerful emotional response. It carries emotional substance, and interacts with a listener's key basal psychological functions. Music has been proven to influence emotions for decades, with studies dating back almost 90 years (Hevner, 1936). Experiments around musical emotional experience have occurred in more modern contexts in the past 20 years: in shopping centres (Dubé & Morin, 2001; Garlin & Owen, 2006; Milliman, 1982; North et al., 1997; Yalch & Spangenberg, 1990); in dating experiments (Shigeno, 2014); in testing its effect on hypertensive blood pressure patients (where the music lowered participants' systolic blood pressure as a result of calming) (Do Amaral et al., 2015); and – quite prevalently at the moment – in dementia patients where music is being studied for its efficacy in assisting patients recall otherwise lost memories (Götell et al., 2009; Lam et al., 2020).

There are multiple theories explaining the way humans experience emotions. Macurdy (2013), asserts that humans experience emotions in three steps:

1. Nervous energy is aroused

   e.g., conflict, addiction;

2. The tendency to react is impeded;

   e.g., a lack of resolution to conflict, or lack of access to addictive substance

3. Energy builds up and manifests as emotion.

This seems to be specific to negative valence emotions. Another popular theory is that of cognitive appraisal, made exceedingly prominent by researchers Richard Lazarus and Susan Kleppner Folkman in their 1984 book *Stress, Appraisal, and Coping*. Cognitive appraisal is the psychological process where individuals interpret and assess events in their lives, leading to emotional and behavioural responses based on their interpretations (Scherer, 2019). The process has two main stages:

1. Primary Appraisal: The initial evaluation of the event's significance and impact on personal goals, values, or well-being. Events can be categorized as positive, negative, or neutral.

2. Secondary Appraisal: After the primary appraisal, individuals assess their ability to cope with the situation, considering available resources, skills, and past experiences.

Cognitive appraisal significantly influences emotional and behavioural reactions (affective behaviour) to events. Different interpretations of the same event can result in diverse emotions and responses. For instance, someone appraising a job interview as an exciting opportunity may feel enthusiastic and confident, while another perceiving it as a daunting challenge may experience anxiety or stress.

Cognitive appraisal and McCurdy's theory of emotions occurring in three steps are both psychological theories that aim to explain how emotions are experienced and expressed, but they approach the topic from different perspectives. The main difference between cognitive appraisal and McCurdy's theory lies in their scope and focus. Cognitive appraisal is a broader psychological process that encompasses the evaluation of events and their impact on emotions and behaviour. On the other hand, McCurdy's theory specifically outlines the sequence of steps involved in the experience and expression of emotions (in particular it seems, to negative valence emotions), with cognitive appraisal being just one of those steps.

Whilst there are many theories regarding human emotional experience which, like those discussed above, have varying approaches and focus, it is important to take away that there is a solid foundation of understanding by scholars as to how we *feel*.

> One does not need to have any formal knowledge of music – nor, indeed, to be particularly "musical" – to enjoy music and to respond to it at the deepest levels. Music is part of being human, and there is no human culture in which it is not highly developed and esteemed. (Sacks, 2010, p.347)

Some researchers believe we are the only species that has an understanding of musical tone, contour and the organisation of sound that is music (Hauser & McDermott, 2003). Others argue that there is a definite comprehension and manipulation of music by other species, such as the Australian Lyrebird, and we are simply new to understanding such semiotics (Cooke, 2019). In early instances of experiencing music, before radios and transmitters, one had to seek out performance. Music evolved to become a way to develop social relationships and a marker of cultural practices, and therefore had a purpose that was emotionally fulfilling and holistic (Savage, 2019).

1.1 Music Makes Us Feel

Music communicates emotions (Madell, 2019; Juslin, 2019). Musical "communication" is music's ability to either: make a person feel something new (or deepen existing feelings) from listening, or express/portray emotion (regardless of whether the listener actually *feels* it or not) (Juslin et al., 2011). Scholars have long contended the distinction of musical "expression" and "evocation" and conducted studies on said distinction. In a 2003 European study, the majority of participants described music's ability in doing both concurrently. They characterised communication as music itself "communicating emotions" (i.e. expression) and performers "playing with feeling" (i.e. evocation) (Lindström et al., 2003). In another study, 76 percent of listeners agreed that music expresses emotions (Juslin et al., 2004). Music's ability

to communicate emotions depends on the composition of the work and the performance of the work. For more deliberation on the terms, see Juslin's "From mimesis to catharsis: expression, perception, and induction of emotion in music" (2005). For the purpose of this dissertation, this composer *attempts* to communicate emotion generally, whether it is solely expressed, or innately evoked to/in the listener.

A study by Miell et al. (2005) depicts examples of how music makes us *feel*. It explains that music can play a variety of roles in our daily lives, such as altering mood, provoking catharsis, comforting, enhancing mood, facilitating enjoyment, and even alleviating stress. As well as supporting this premise, numerous researchers have also concluded that the emotional response to music is universal. While cultural variations may determine how we interact with music, it tends to elicit joy and excitement in people around the globe. (Behne, 1997; Juslin & Laukka, 2004; Panzarella, 1980; Sloboda, 1991; Sloboda & O'Neill, 2001; Hargreaves & North, 1997; Blacking, 1973).

As well as stimulating and developing our mental faculties, music changes our emotional state (Park et al., 2019; Pascual-Leone, 2001). As such, composers have long been fascinated by music's emotional effects (Scherer et al., 2001). Using Thompson and Robitaille (1992) as an example, connections between various compositional facets such as pitch and volume, and the evocation of joy, sorrow, excitement, dullness, anger and peace, have been substantiated.

Juslin and Västfjäll are two prominent researchers in the field of music psychology who have contributed significantly to understanding the mechanisms of emotional evocation in music. Some key points of their theories are as follows:

1. Communicative Function of Music: According to Juslin and Västfjäll, music has a communicative function that enables composers and performers to convey emotions to listeners intentionally as a means of expression. It focuses on the emotional cues

present in the music itself. For example, a fast and intense piece may evoke excitement or anxiety, while a slow and melancholic melody may induce sadness (Juslin, 2001).

2. Listener Characteristics: Individual differences play a crucial role in the emotional experience of music. Factors such as personality traits, musical expertise, cultural background, and past experiences with music influence how a person perceives and responds to emotional cues in music. For instance, a person with a greater ability to identify and express emotions may be more sensitive to the emotional nuances in music (Juslin et al., 2010).

3. Indirect vs. Direct Mechanisms: Indirect mechanisms involve the listener's cognitive processing and interpretation of musical features. For example, a fast tempo might be interpreted as indicating excitement, and a sad melody might be associated with feelings of sorrow. Direct mechanisms, on the other hand, bypass cognitive processing and evoke emotions more autonomously. These mechanisms are likely rooted in more primitive and evolutionary aspects of human emotional processing (Juslin et al., 2008).

4. Cognitive Appraisal Process: First coined by Richard Lazarus, Juslin and Västfjäll acknowledge its role in musical emotional experience. The theory proposes that emotional evocation in music involves an appraisal process where listeners unconsciously and automatically assess the musical elements and their congruence with their personal experiences, cultural background, and current emotional state. This appraisal process leads to the experienced emotion (Juslin et al., 2010).

5. Personal and Contextual Factors: Individual differences, such as personality traits, musical expertise, and current mood, can significantly influence how a person responds emotionally to music. Additionally, the context in which the music is heard,

such as the social setting or cultural environment, can further modulate emotional responses (Juslin et al., 2001).

Juslin and Västfjäll's theories have been influential in shaping research on emotional responses to music. Their work highlights the complexity and richness of the emotional experience that music offers and underscores the interplay between objective musical features and subjective individual differences in shaping our emotional responses to music.

Compositional form and its subsequent influence on emotions was also investigated (Gabrielsson & Lindström, 2010), where a greater degree of musical intensity (as measured by tempo, speed, and loudness) led to greater emotional responses, and a decrease in intensity led to a lower level of emotional reaction. As a composer, analysing the emotional impact of the music which we create is becoming a crucial part of our craft and one that is constantly being enhanced and evolved.

Only over the past three decades, has the research around emotional vernacular in music become truly substantial. It is common for scholars to neglect to account for a person's "aptitude for mood disturbance" and/or their headspace *prior* to musical experience (Garrido & Schubert, 2013). Acknowledging that susceptibility to emotional change differs for individuals , and even more so that some are encountering substantial emotions *prior* to musical experience, is a crucial contributing factor to the results. This dissertation aims to ask these questions where possible, or to mitigate the interference of these factors, by asking participants in studies how the audio samples might make ‘someone’ feel, rather than how they make ‘them’ feel in that moment. This approach also aims to sidestep potential barriers to emotional self-assessment.

In the case of people struggling with either their psychological and/or physiological health, the intervention of music can be a powerful tool (Gustav et al., 2021). Juslin and Laukka discovered

in the early 2000s that 67% of the 141 respondents in their study (aged between 17 and 74) said they felt that music both conveys and communicates emotions. Most importantly, *all* respondents found the emotions *are* expressed through music, and 76% stated that this was *frequent* (Juslin & Laukka, 2004).

In the late 1990s, Steven Pinker (cognitive psychologist) infamously characterised music as "auditory cheesecake, an exquisite confection crafted to tickle the sensitive spots of … our mental faculties". He insinuated that music is akin to an enjoyable dessert, with no evolutionary substance, being simply a product of human language. In a less pessimistic interpretation of his statement, there lies some value. Music affects our brains in specific places, stimulating the production of chemicals that positively (and often negatively) affect our mood. Honing (2013) adds that, rather than music being a simple benign by-product of evolution, music/musicality is a characteristic that survived natural selection and developed to stimulate and advance our mental faculties.

A cohort of top scholars studying music and emotions has established the induction of emotion via music on a greater scope. Throughout "Musical Communication" (Miell et al., 2005), the authors conferred about archetypal studies, and gathered data from numerous research streams to demonstrate the strength of this concept. Several findings were revealed. First, that humans listen to specific kinds of music in hopes of promoting control, improvement and general emotional alteration (DeNora, 2001). Second, the study confirms scientific research concerning musical encounters: when we listen to music, we activate the various sections of the brain that are triggered in everyday emotional experience (subcortical and cortical portions) (Blood & Zatorre, 2001; Münte et al., 2002; Peretz, 2001). Third, researchers found that music can affect emotions that influence patterns of consumption, romantic attraction, and even potential disputes (Fried & Berkowitz, 1979; Hargreaves & North, 1997; Honeycutt & Eidenmuller, 2001; May & Hamilton, 1980; North et al., 2004).

1.2 Music Helps Us Feel *Better* – In Both Pathological And Non-Pathological Applications

The therapeutic value of music is an ageless concept. Chant therapy in ancient Egypt and ancient Greece was considered essential in practising healing. Philosophers Plato and Aristotle believed that music served to be cathartic, healing, was crucial in the development of faculties and intellect in early years of life, and was beneficial in overcoming emotional difficulty (Ferrari, 2019; Mary, 1978). In more recent psychoanalysis movements, there were notions that the efficacy of music as a means of sublimation (in which socially unacceptable impulses are changed into socially acceptable behaviours, ideally developing into a long-term adaptation of the original impulse) was extremely high, and that music provided a means of access to patients' subconscious (Konnikova, 2013).

Does music directly change our emotional state; is it a placebo, or something else? Music has been found to have many psychological and physiological effects. Kemper and Danhauer (2005) found in their studies that steady rhythms can regulate breathing, and "elicited increased activity in the temporal lobe" (a section of our brain that control sensory input). They found that classical music had significant effects on regulating heartrate, which in turn implicated its influence on stress levels and resilience. They also found that listening to ostensibly relaxing music lowered the body's levels of cortisol (the stress hormone). Overall, the paediatrician and psychologist's study showed that music directly and indirectly positively affected the moods of patients who had undergone any sort of medical procedure and patients with psychological impairments. It resulted in an actual change of emotional state – patients reported feeling happier, more relaxed and less apprehensive (Kemper & Danhauer, 2005).

Since the 2005 study by Kemper and Danhauer, music has since been used to assist patients undergoing treatments in hospital. In 2006, researchers showed that open-heart surgery patients could be enriched by musical mediation by listening to music prior to and following

surgery – they felt less anxious and needed an average of 200 minutes less oxygen-assistance (intubation) than patients who didn't undergo musical intervention. Similarly, it was found that musical intervention reduced depression in chronic pain sufferers at The Cleveland Clinic (Konnikova, 2013).

In Paris, an app is helping patients feel calm in hospital (American Hospital of Paris, 2018). Similarly to the research of Götell et al., a study through an app called MUSIC CARE at the American Hospital of Paris, uses musical intervention programmed by the patients themselves to help bring on a sense of calm before undergoing medical procedures. Practitioners consult their patients about what kind of music will calm them, and then use the MUSIC CARE app to create a playlist of music for each patient. The practitioner then interacts with the patient while on the operating table before the medical procedure, talks them through what they're going to do with the headpieces, and then administers the musical intervention. The results of this are:

- Reduced brain activity, "as if they are sedated" (American Hospital of Paris, 2018). However, by avoiding medical sedation, when the surgeon talks to the patient, "they are fully able to answer"(American Hospital of Paris, 2018). "They will really have an impression of having switched off, and they lose all sense of time" (American Hospital of Paris, 2018).
- Calmness in patients
- Calmness of the team and doctor as well: "when the patient is calm, the doctor is calm, the team is calm, and everything goes much better" (American Hospital of Paris, 2018)

Regarding music's ability to evoke specific emotions, recent research from Canada has demonstrated that music can also encourage euphoria. Music functions much like the reward system in our brain when we achieve something, involving the striatal dopaminergic system

resulting in dopamine release, especially with intense pleasure as a musical response. This is a key physical indicator of emotional experience (Honing, 2017; Salimpoor et al., 2011).

Our brains can rely on different memory systems for different aspects of meaning. There is no single “music centre” in the brain. The motor cortex of the brain is activated by listening to music, which is why we associate moving to music (Bengtsson et al., 2009). Clive Wearing is a man with the most severe case of amnesia ever known. He has a 30-second short term memory, after which he remembers nothing. He does, however, remember how to play the piano, read music, and conduct performers, which enhances his day to day wellness (Wilson & Wearing, 1995). The question arises: how does an abstract series of sounds manipulate our emotions so potently? As mentioned, emotions are often evoked through dopamine release in the striatal system (Salerian, 2015). Rhythmic music can become a template for organising series of movements (Pacchetti et al., 2000). It has been shown to effect improvements in bradykinesia also.

Music has been (and continues to be) prolifically used remedially to alter emotional state in the plight to assist the ageing generations. It has been used to help fight multiple diseases associated with ageing such as schizophrenia, Alzheimer’s and other forms of dementia, and Parkinson’s. Researchers from the National Taipei College of Nursing found that by playing background music during lunch, outbreaks of physical and verbal aggression from Alzheimer’s patients were considerably reduced (Konnikova, 2013). Using popular music as background music or sung by caregivers, Götell, Brown, and Eckman (2009) investigated whether familiar, upbeat music had the power to benefit both patient and caregiver experiences for geriatric dementia patients. In geriatric patients with dementia, emotional cognition can be negatively affected due to the deterioration of the salience network (a network that is involved in various cognitive processes, including attentional control, emotional processing, task switching, decision-making, and interpreting social cues (Uddin, 2016)), and aggressive behaviour is more

frequent (Götell et al., 2009; Rankin, 2020). Background music significantly improved the patients' mood and vitality compared to tasks carried out in silence during the usual morning routine. Carers and patients' interactions improved significantly after the aggressive outbursts of patients were reduced (Götell et al., 2009). Music has also been reported to assist in reducing anxiety in everyday applications in geriatric patients without dementia (Henry, 1995).

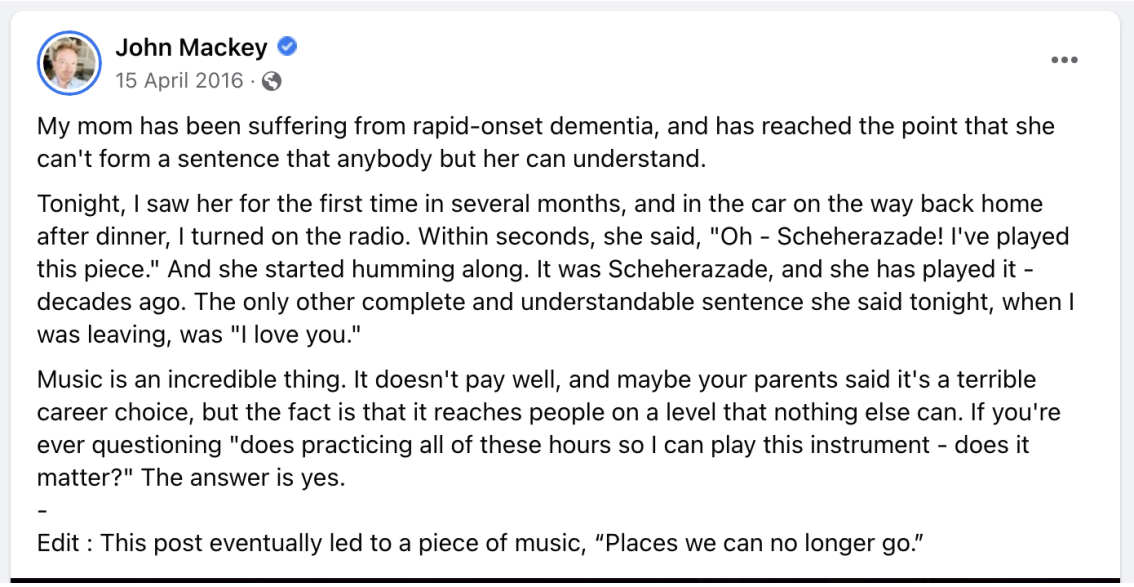
In Michael Rossato-Bennett's 2014 documentary *Alive Inside*, patients even in the later stages of dementia responded powerfully to music, in ways that were "nothing short of miraculous". He discovered that songs embedded deep in memory can ease pain and wake the fading minds of people suffering from Alzheimer's and dementia (Rossato-Bennett, 2014). In Alzheimer's disease, music memory encoding regions of the brain are well preserved, making musical memories unique compared to other memories. The medial prefrontal cortex (the region associated with planning behaviour, expressing one's personality, making decisions, retrieval of long term memory, and the moderation of social behaviour) is a crucial hub where music, memories and emotions are associated (Janata et al., 2002). It is also where autobiographical memory (ABM) resides, which is crucial to a feeling of continuity and social comfort. Music is often intertwined with the most seminal events from our past, and therefore when ABM is engaged through musical triggers, positive affect often ensues. In a study of Alzheimer's disease and music-evoked memory in 2017, music-evoked autobiographical memories overall had a positive effect on the patient's disposition, revealing a sense of self-identity that had survived the damage of "neural degeneration" (Cuddy et al., 2017). Patients with Alzheimer's also generated as many ABM responses to musical experience as other neurotypical control patients.

The overall benefits of using music as a remedial tool, when programmed carefully (and particularly during music-making), for dementia, Alzheimer's and amnesia, have been widely

studied and substantiated (Brancatisano et al., 2019; Särkämö, 2018; Bleibel et al., 2018). Some of these benefits are reported to be:

- Low cost
- Eliminates chemical intervention
- Transcends language
- Decreased:
    - Anxiety
    - Depression
    - Agitation
    - Wandering
- Increased:
    - Food intake
    - Social interaction
    - Recognition of music lyrics
    - Recognition of memories associated with programmed music
- Preserved musical memory
- Ability to learn new music (with/without previous training)

The composer John Mackey, for example, recounted an incident in which his mother, suffering from dementia, briefly recovered memory and intelligible speech on hearing an orchestral work she had performed in the past (Figure 2).



John Mackey
15 April 2016 ·

My mom has been suffering from rapid-onset dementia, and has reached the point that she can't form a sentence that anybody but her can understand.

Tonight, I saw her for the first time in several months, and in the car on the way back home after dinner, I turned on the radio. Within seconds, she said, "Oh - Scheherazade! I've played this piece." And she started humming along. It was Scheherazade, and she has played it - decades ago. The only other complete and understandable sentence she said tonight, when I was leaving, was "I love you."

Music is an incredible thing. It doesn't pay well, and maybe your parents said it's a terrible career choice, but the fact is that it reaches people on a level that nothing else can. If you're ever questioning "does practicing all of these hours so I can play this instrument - does it matter?" The answer is yes.

-

Edit : This post eventually led to a piece of music, "Places we can no longer go."

Figure 2: Facebook post by John Mackey re his mother's dementia (Mackey, 2016)

Blood pressure readings have been associated to a shift in emotional state (namely arousal – calmness versus excitement/stress). A study conducted by Do Amaral et al. (2015) assessed how music therapy might help lower blood pressure levels among patients with high blood pressure. Both a control group and a hypertensive group were tested, with the latter being shown ostensibly relaxing music between tests. Mood restfulness contributed to a lower systolic blood pressure in the hypertensive group. It may be caused by a process known as 'Rhythmic Entrainment' (Juslin and Sloboda, 2011), where the heartbeat locks in with a prominent rhythm in a piece of music and creates a "common periodicity ". After entraining the patient to the music, the heartrate of the patient will slow down, resulting in a restful state and ergo *specific* mood alteration. Musical emotional experience is not exclusive to the pathological patient. Researchers have also sampled healthy laypeople – college students in particular – to ascertain whether music has an effect on how adults are feeling in any given moment. This research relied on self-assessment, and had a focus on so-called musical emotions. Participants were prompted throughout their day over a two-week period, and were asked to report on how they were feeling. In 64% of the responses where participants were listening to music during the prompt, they indicated that music affected how they were

feeling. The emotions reported while listening to music were dominated by *happiness-elation* and *nostalgia-longing*, and conversely, in moments where music was not part of their experience, *anger-irritation, boredom-indifference*, and *anxiety-fea*r were prominent (Juslin et al., 2008).

McNair et al. (1981) collected mood variation data using a form of the Profile of Mood States (POMS), which observed mood states with a variety of subcategories (e.g., Mood Disturbance Index assessing a participant's propensity to mood disturbance). The POM states included both positive and negative valence moods (*anger, confusion, joy,* etc.). Researchers selected participants who ranked more susceptible to mood change (aka having 'adaptive personalities'), and questioned the group with ostensibly happy and sad music. Listening to sad music often exacerbated rather than alleviated the listener's depressive state, according to the study. In 2013, Garrido and Schubert also asserted that sad music often triggers and/or perpetuates negative valence emotions (sadness, depression, etc.).

This research demonstrates something unique: it supports the idea that music can alter emotions *specifically* rather than *generally*. McNair et al.'s research also seems to be one of the earliest studies that accounts for Schubert's "aptitude for mood disturbance" (2013) and Meyer's "inhibition of tendencies" (2008) — more recent research that represents a shift in the approach to contemporary music and emotions research to account for human variability.

It is important here to acknowledge music's propensity to negatively effect affective state. In many cases, individuals have reported a desire to feel negative affect from music listening, and the literature broadly frequently attests this to the purgation of repressed feelings that a listener was already experiencing and hence desired release from, or occasionally maladaptive emotional regulation behaviours (Garrido et al., 2011; Garrido, 2013; Schubert, 1996; Schubert, 2013). In other cases, unintentional (or intentional, which is often found in the case of music for film and television) negative affect occurs in listeners because of the technical

facets of music to equally convey negative valence affect as it does positive valence (Juslin et al., 2011). Music's ability to communicate emotions generally, means that there is a probability of communicating affect that resides on the left of the Circumplex Model. The circumplex model of emotions, as discussed in the introduction chapter, is a widely used framework in psychology that represents emotions as points on a circular map. The model suggests that emotions can be organised along two primary dimensions: valence and arousal. Valence refers to the positive or negative nature of emotion, while arousal refers to its intensity or activation level. On the circumplex model, emotions that are more positive in nature are located toward the right of the circle, while negative emotions are situated toward the left. Emotions with higher arousal are placed toward the top, while those with lower arousal are on the bottom. Acknowledging the potential negative effect of music on affect is crucial in regards to the complexity of emotions and their impact on mental health. While calmness is generally associated with positive wellbeing, low arousal states linked to sadness can indeed be problematic, leading to depressive states that require attention and support (Mizrahi et al., 2022). It is therefore important that musical intervention carefully accounts for valence when attempting to communicate calm. The studies in this dissertation aim to communicate positive valence calm specifically, by the end of a listener's exposure to the musical stimuli.

Moving away from a pathological context, composers throughout history, from Monteverdi to John Williams, have achieved remarkable success in crafting emotionally impactful music for centuries (Hubbard, 2022; He, 2023). They accomplished this by tapping into anecdotal insights, feedback-driven approaches, and intuitive decision-making related to compositional techniques that effectively convey emotions (Hubbard, 2022). Although earlier composers might not have been conscious of the psychological foundations behind these decisions, they effectively employed techniques aimed at eliciting emotions, which align with the mechanisms described by Juslin and colleagues.

Music has been and continues to be used for general remedial applications in a vast variety of settings: it is played in hospital waiting rooms in an effort to assist mood and wellbeing, in day spas to in an effort to calm clients, and for every locale in between. As individuals in an everyday context, we engage with music sequencers to program our lives: to boost adrenaline before a workout, to relax ourselves before bed, to feel catharsis in times of hurt, anger, and even heartache. Personalised music programming has become ubiquitous through apps like Spotify. These apps gauge our usage and program playlists based on our habit data. The idea of carefully creating music to evoke calm and/or catharsis influenced by psychological principles of emotional evocation, means the possibility of substantiating the personal music program beyond what's being done so far.

1.3 *How* Music Makes Us Feel Better – A Psychological Perspective and a Compositional Toolbox for Emotional Evocation

Music evokes emotional reactions through psychological functions. In the early 2000s, a group of key researchers in the emotion-and-music field set out to determine which specific psychological functions were catalysts for an emotional response. As part of their study Juslin et al. (2010) investigated the emotions felt when listening to music, as well as the possible causes of those emotions. Several experiments ensued, asking participants *what* they felt and *why* they felt the emotions they did, and researchers soon realised that having open-ended response options made the collection of data problematic. They were looking for nuance surrounding their understanding of affect via musical experience, but this resulted in a vastness of data that was unmanageable. From here, they considered well-established fundamental psychological principles of emotional experience, and based on these principles, outlined seven psychological mechanisms, that induce emotion through music listening. This became the framework for their response options for participants. In order to ensure they were not forcing a mechanism choice from participants, they also offered answer options including "I don't know", "lyrics" and "other". In years since, a newly adopted model outlines

eight mechanisms, in addition to the base mechanism of *cognitive appraisal.* The model is termed the BRECVEMA model (Juslin, 2013), and the eight mechanisms are: Brain Stem Reflex, Rhythmic Entrainment, Evaluative Conditioning, Contagion, Visual Imagery, Episodic Memory, Musical Expectancy, and Aesthetic Judgement. Recently prolific research by Volkner theorises that spreading activation is a premise for these mechanisms (Volkner, 2022). The fundamental theories behind each mechanism are outlined below:

1. Brain stem reflex – analogous to one's reaction to environmentally characteristic stimuli (e.g., loud bangs;)
2. Rhythmic entrainment – proprioceptive feedback induces a gradual alignment of internal body rhythms (e.g., heart rate, breathing) with a prominent external musical rhythm, thereby influencing the listener's emotions.
3. Evaluative conditioning – the frequent pairing of music with a stimulus that carries valence, eventuating in the music adopting said valence;
4. Contagion – contracting an emotional expression in music performance, typically expressed through prosodic features of the voice;
5. Visual imagery – associating music to imagery conceived in the listener's mind and their emotional association to said imagery;
6. Episodic memory – the musical features trigger memories that are unique to the listener, and by extension the emotions connected to them;
7. Music expectancy – emotion generated by the contradiction or confirmation of musical expectancy (predicated by the archetypal compositional sequences of one's cultural music);
8. Aesthetic Judgement – based on cognitive appraisal, the process of consciously aesthetically reviewing music to infer how it aligns or misaligns with one's personal beliefs, circumstances, or other.

Figure 3: Mechanisms of Emotional Induction (after Juslin et al., 2013)

These were the inaugural qualitative concepts devised surrounding the actual cognitive pathway from musical experience to emotional experience in the brain. Not only did the researchers show that emotional experience was a direct result of musical experience (which others had done before), they created a tangible structure for understanding *why* that

happens. The utilisation of these mechanisms to accompany music analysis and creation is a tool for the comprehension of music and emotions. It allows for an interdisciplinary and multifaceted enquiry into the powerful potential of music in an unprecedented way.

The literature to date has revealed a gap: as composers, can we utilise the data that researchers before us have collected surrounding emotional response to music – in general and specifically in relation to particular musical features – and create music to pointedly evoke *specific emotions*?

The experience of music can alter emotions, and particular music can result in a particular emotional response. In 2016–2018, I created a guideline for gauging and creating emotion through music in my Master's research, which was influenced by the development of 'Hypotheses for seven psychological mechanisms through which much might induce emotions in listeners' (Juslin et al., 2008), and other supporting research. This guideline is instrumental in this dissertation. It is a body of techniques used to both *analyse* emotional induction in music composition (of all genres), and *create* music that is specifically emotionally affective. The guideline has been revised and expanded upon in this thesis, accounting for more recent research (specifically Juslin's BRECVEMA model (2013)), more rigorous consideration of the framework, and utilising adjacent theories surrounding intervallic and contour emotive concepts. It has been applied to my own compositions in the form of the CTEE – influencing the way in which I attempt to convey emotions through my composition. The primary emotion and emotional experience that I aim to evoke are calm and catharsis.

The Toolbox comprises eight compositional mechanisms based on the BRECVEMA model. These are:

1. Rhythmic Unity
2. Response to Stimuli
3. Conditioned Response

4. Emotional Contagion
5. Visual Imagery
6. Episodic Memory Recall
7. Musical Expectancy
8. Intervallic and Contour Affect Theory

Details of the Compositional Toolbox for Emotional Evocation (CTEE) are as follows.

1.3.1 Rhythmic Unity

By interacting internally with the listener's bodily rhythm, the music's prevailing rhythm induces emotion. The heartbeat locks into a common frequency with a prevalent musical rhythm when oscillations naturally synchronise (Juslin & Sloboda, 2011). Through this, one can raise or lower a listener's heartrate and in turn affect arousal levels (associated with calm, excitement, etc.). Take for example the ability for certain songs to motivate a person to exercise – to run faster, lift heavier, or to seemingly slow our bodies and trigger deep breathing. Temporal influence plays a big part in these experiences. Rhythmic Unity is also optimised through syncopated rhythms (Witek et al., 2014).

1.3.2 Response to Stimuli

This mechanism is an intersection of Classical Conditioning and Involuntary Response. As a result of brain stem reflexes (Juslin & Sloboda, 2011; Juslin, 2013), Involuntary Response is concerned particularly with the ear's sensory characteristics. In one instance, it is a primal function where the induction of emotion occurs due to a spontaneous urgency musically depicted that parallels a natural counterpart (e.g., threat signals in nature – the boom of thunder and its imminent signal of the threat of lightning — can be emotionally evoked through a loud bass drum hit). Through Classical Conditioning, the brain associates the musical feature to the emotion felt through the conditioning of these events. In a second and similar instance, the brain interprets musical features that sound like their natural counterpoints, with

the associated response. For example, early morning birdsong functioned to alert animals of a new day, and is associated with mornings and awakening (Ten Cate, 2004). It is possible that a high pitched flute passage with similar articulative and contour features to bird song, might induce arousal, and the inclination to become alert, a heightening of general excitement.

1.3.3 Conditioned Response

Conditioned response is a duality process that pairs stimuli. It is founded on the principles of Pavlovian (or Classical) and Evaluative conditioning (Juslin & Sloboda, 2011; Juslin, 2013), and alters the musical emotional association — disassociating it from its compositional facets. In the context of the CTEE, a stimulus that arouses affect is paired with music. The emotional content of the 'unconditioned stimulus' (the music in this case) is altered to match that of the 'conditioned stimulus' after either repetition, or the conditioned stimulus' affect being particularly intense (De Houwer, 2012). An example of this could be found in the common stimulus pairing of music and the moving image – film. Unlike instances such as occurred in the 1960 film *Psycho* (Hitchcock, 1960), where the iconic shower-murder scene is articulated by scratch-timbred fortissimo high-register punctuations of the strings (which because of Response to Stimuli, the abrasive sounds simply further punctuate an already stressful scene), Conditioned Response is particularly identifiable when a piece of music is deemed a parodic or dramatically ironic comparatively to a visual. In the eighth episode of the fifth season of the series *Breaking Bad* (Gilligan et al., 2012), creators employed a terse reference to a climactic scene from *The Godfather* (Coppola, 1972). The protagonist is made godfather to a child as a string of brutal murders ensues in tandem – the dramatic irony of the paired music is recreated in *Breaking Bad*, where a montage of heinous murders in a prison is accompanied by the song "Pick Yourself Up" performed by Nat King Cole and George Shearing in 1950 – a jolly, major-tonality, big-band cruise-type song (Kern, 1936). Because of the prominence of the emotive content of the visuals, the associations with said song are likely to be associated with the stress and morbidity of the dramatic television series scene (a common film-music

technique). Another common example of conditioned response is that of the pairing of music to an opening credits scene of a TV show. A song that may have no or little associated emotive affect, after repetition, may take on the affect of the visual and one's association with that visual.

1.3.4 Emotional Contagion

The concept of Emotional Contagion is defined as a psychological phenomenon that deems another person's emotions contagious. It plays on our human propensity for empathy, and is frequently experienced in children (who have developed less resistance to emotions). The behavior can be compared to an infant crying and consequently causing other infants nearby to cry (Chakrabarti, 2014). Unlike 'cognitive empathy', in which we must grasp the rationale behind an emotion before feeling akin, these processes are innate and do not necessitate previous explanations. Emotional Contagion in musical experience is the interpretation of various musical facets similarly to prosodic features of speech (Frick, 1985). Suppose a piece of music sounded similar to a shouting voice (a static pitch contour accompanied by sharp surges and similar sharp changes in volume (Frick, 1985)), a listener might comprehend this as anger, and contract the emotion. From an instrumental perspective, if a cellist played an expressive solo, utilising the inherent fluctuations of volume and tempo that accompany expressive playing, the listener might feel sadness or at least, an intensity of emotion with a varied valence. This is due to their interpreting the musical features similarly to vocal prosodics. Simpler applications of this occur in music with vocals – where the singer projects and expresses emotional content through their timbral and inflection delivery – and listeners understand and 'contract' the intended emotions behind the vocal delivery. It is also possible that a listener can interpret force that is necessary to produce certain musical features – the physical demand on a singer singing in the extremities of their range, the muscular tension, precision and force it takes for a violinist to play notes in the uppermost part of their range etc. – , and contract the arousal that is being exhibited by the performer in an almost vicarious

manner (Juslin, 2001). Several studies have demonstrated that music that expresses certain emotions can evoke the same emotions in listeners (Barsade, 2002; Lundqvist et al., 2009; Ravaja et al., 2006).

1.3.5 Visual Imagery

Visual Imagery is the process of evoking emotional responses by associating audio with visual elements (Juslin & Sloboda, 2011). Percussive sounds resembling the roar of the ocean, ascending melodic contours conjuring images of rising waves, or a soaring flute solo piercing the dense orchestra 'sounding like' a seagull over an angry landscape, are all examples of this technique in use. Its weakness lies in the listener's volitional control. Researchers have found that a listener can ignore an evoked image voluntarily. Additionally, this device is not concerned with memory of visuals (this is Episodic Memory Recall), but is concerned with a connection between the visual organisation of the music (as represented by things such as pitch contours, articulations, volume changes) and the shape of the images. From an emotional evocation perspective, if the listener decides to cognitively sit with the induced image, then the emotions associated with that image (through Conditioned Response, Episodic Memory Recall, etc.) are evoked.

1.3.6 Episodic Memory Recall

Episodic Memory Recall describes emotions induced via the memory of an associated personal event, as opposed to semantic memory, which refers to common information that has no connection to individual experience (Zimmermann, 2014). With this mechanism, an individual will hear a piece of music and a personal memory will be triggered, in turn with the emotions associated with said memory. It is known, by J.B Davies (1978) (as referred to by Sloboda (1999)) as the “Darling, they’re playing our tune phenomenon”. The mechanism can also pertain to historical association, where, for example, the earliest and most prevalent associations of a sound triggers emotional response. A palpable example of this at play, is the

association of certain instruments to certain events. For example, the trumpet might remind one of the bugle, which was historically used in war to announce surrender or to assemble troops but is now a ceremonial tribute to soldiers (inducing a sense of nostalgia and sadness), or used in pop culture to announce royalty (inducing a sense of grandeur, importance, stoicism, etc.).

It feels pertinent to address the distinction between Episodic Memory Recall (EMR) and Conditioned Response (CR). In this dissertation, EMR concerns memory – conscious memory associated with an event, marked by a musical moment. EMR will conjure the memory of an event, and by extension, has the potential to arouse the emotions associated with said event. CR is subliminal, where sounds have the capacity to trigger a feeling in isolation of a memorable event. The clearest distinction is that CR is a duality pairing process – where one feels an emotion associated with a stimulus, and that stimulus is paired with music so the music takes on said emotion, whereas EMR doesn't rely specifically on two stimuli, but rather the music is the main stimulus and a more general event, person, place or thing that makes one feel a certain way, is associated with the musical stimulus.

1.3.7 Musical Expectancy

Musical Expectancy describes the emotional reaction in a listener when the melody, harmony, or other facets of a piece of music confirm or contradict expectations. Music and psychology scholars first began proving the connection between affect and a contradiction or violation of musical expectancy in 1991 (Juslin & Lindström, 2010). The CTEE takes that one step further and suggests that confirmation of expectancy can also elicit affect. Tillmann et al. (2014) also explored and supported this concept in their 2014 paper "The role of expectation in music: From the score to emotions and the brain". An example of this in Western Art Music might be when a listener hears a dominant in a concluding cadential phrase, they expect to hear the tonic following; if the composer instead follows V with chord vi, they contradict that

expectation, creating what's known as an interrupted/deceptive cadence. Composers can maintain attention through variables (MAV) by establishing musical patterns via ostinatos or similar repetitious ideas. Listeners process and acclimatise to the musical cells, until the composer utilises a small musical change. The small changes maintain sonic interest from the listener, keeping them attentive to the music. The technique is a vehicle for engagement and maintaining a certain level of attention and tension from the listener. In short, when music confirms a listener's expectations, arousal is lowered, and when music contradicts a listener's expectations, arousal is increased.

1.3.8 Intervallic and Contour Affect Theory

Analysts have theorised about the semiotics of intervals and their correlative emotive affect, and melodic contours and their correlative emotive affect since 1936 (Hevner, 1936). This has meant fleshing out the meanings of pitch, relative pitch, scale degree usage and the resulting phrase shaping of a melody and or accompanying material.

Amongst the various theories regarding why humans react in the way they do to certain intervals, is that suggested by Bowling et al. (2010), claiming that major intervals are more auditorily comparative to those exhibited in excited speech, as opposed to those exhibited in subdued speech through minor intervals. Their theories also subsequently support Emotional Contagion and the connection between affect we perceive through prosodic features of speech and its parallels to delivery in a musical melodic counterpart.

Another distinctive approach is outlined in Peter Eckman's "The Intonation Systems of Harry Partch" (Ekman, 2011). Partch classifies intervals into general categories:

Intervals of Power – 8ves, 5ths, 4ths

Intervals of Emotion – 3rds and 6ths

Intervals of Approach – 7ths and 2nds

Intervals of Suspense – 4ths and 5ths

His ideas of harmony and intonation revolve primarily around sound as a vibration – the concept of every pitch having a unique soundwave, and the higher the pitch, the quicker the vibration of the wave/the lower the pitch, the slower the vibration. Accordingly, he refers to pitches in their Hz form, and refers to just intonation in his theories.

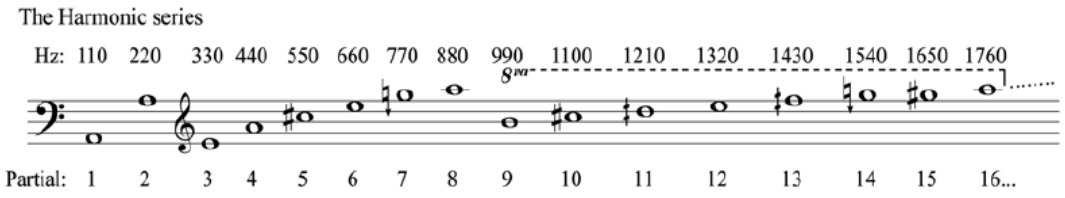


Figure 4: Harmonic series from A2

Regard the harmonic series for the note A2 (110 Hz) above. The first 6 partials form a major triad: A (A) E (A) C# (E)- henceforth the major tonic triad of the fundamental. Partch works with what he calls 'pitch ratios' – where once the partials are numbered, one can express any interval by its corresponding ratio. Take for example C#5 and A4 with their respective partials 5 and 4 – the pitch ratio becomes 5/4 (the higher note divided by the lower). Partch then asserts that the simpler the ratio (5/4, 2/3, 9/10, etc), the more consonant it sounds (paralleling the harmonic series itself: the octave – the most consonant interval – has the ratio 2/1= 2, the major third has the ratio 5/4, the minor third has the ratio 6/5, etc). No matter which two notes the interval falls on, the ratio will remain the same. For example; A and C#= 5/4, E and G#= 15/12, but 15/12=5/4. As is widely interpreted in Western cultural music, consonance elicits comfort and low arousal, and dissonance the opposite (Sammler et al., 2007). So, one can deduce that intervals that have the simplest ratios (the major third, perfect fourth, minor third, etc.) are more consonant and therefore comfortable (less arousing) than those with the more complex ratios (i.e., the tritone). Partch's theory is concerning specifically, arousal level, and is therefore related to experiencing calm and/or catharsis.

Dr. Michael Webb, Senior Lecturer, Music, presented his take on intervals and their correlative emotive affect in a tutorial for the subject 'Popular Music', where from Machin's paper on 'Analysing Popular Music' (2010), he deduced the following:

PITCH RANGE AND CONTOUR	**MEANING POTENTIAL**
High	= brightness, truth, transcendence
Low	= darkness, evil, bleakness, obscurity
Ascending Melody	= activation and optimism = a sense of picking up spirits; outward expression of emotions
Level Melody	= stasis or calmness
Descending Melody	= deactivation or pessimism = a falling of energy; incoming emotion

SCALE NOTE	**"VALUE"**
1	= anchoring, stable
2	= something in between, the promise of something else
Minor 3rd	= stable but sad or painful
3	= stable and happy
4	= building, creating space
5	= stable, like the 1st note
6	= generally happy, like the 3rd
7	= slightly thoughtful and longing
Minor 7	= pain, sadness

Machin's models, together with similar structures devised by various scholars (Costa et al., 2000; Curtis & Bharucha, 2010; Gosselin et al., 2015), can be summarised as follows for use in this CTEE (where intervals occur in both melodic and harmonic variations):

THE GENERAL NATURE OF INTERVALS AND THEIR CONSEQUENTIAL EMOTIONS	
Consonant intervals	= pleasant, positive
Dissonant intervals	= negative, strength, action

Major intervals	= brightness
Minor intervals	= sadness, sensitivity
Large intervals	= power
Small intervals	= weakness, smaller space atmosphere
SPECIFIC INTERVALS AND THEIR CONSEQUENTIAL EMOTIONS	
Minor 2nd	= darkness, displeasure
Major 2nd	= pleasure, neutrality, approach
Minor 3rd	= sadness, tragedy
Major 3rd	= joy, happiness, brightness, positive, stable
Perfect 4th	= neutral, powerful
Tritone	= danger, violence, tension
Perfect 5th	= stable, powerful
Minor 6th	= sadness
Major 6th	= charming, pleasure
Minor 7th	= unstable, the need to be resolved
Major 7th	= aspiration, approach
Octave	= stable, powerful

Ideally, through the utilisation of the eight mechanisms from the CTEE in conjunction with other widely acknowledged music and emotion concepts (again, such as minor tonality and its association to sadness in Western music (Gosselin et al., 2015), the discomfort of the tritone (Nagel, 2014), etc.), music can be more pointedly utilised as a tool to help calm and enhance lives. The CTEE also has potential for use as an analytical tool as well, to aid in creating a program of existing music for the use of enhancing a person's wellbeing. This is an alternative to other popular approaches such as the self-programmed approach (the individual picks existing music from popular culture to help ease them), which although has shown to be more effective than programmed playlists from external sources, poses potential issues such as the subconscious programming of music that despite being familiar to them (and hence comforting), could result in potentially undesirable physiological effects such as the raising of

one's heartrate. The self-selection of music for use in therapeutic contexts has been well documented as an effective means of emotional regulation, often moreso than that of externally programmed playlists (Batt-Rawden, 2010; Sedikides et al., 2022) . This author, however, believes that the aid of the CTEE as a tool can improve the efficacy of the externally programmed playlist for managing wellbeing, and there is a clear space for both approaches in the field.

This research project will be formative in contributing to the use of music as a tool for what I believe is an important function: the induction of calm and/or catharsis. I will argue that music can and should be created for emotional intent. The CTEE will become a tool for music creation and will be a record of my personal journey in utilising my skills as a composer to aid the laboured mind.

The composition of music with specific affective intent is an under-utilised tool for calming. The need for tailored programming in musical remedy is a conversation that's happening ubiquitously in the fields of neuroscience, psychology, physiology, design and music (i.e. the 'This Sound Like Science- Music and the Mind' series in August 2018 at City Recital Hall, hosted by Inspiring Australia). In these conversations, the overarching notion is that "Musical interventions must be personalised. We cannot apply a template and expect it to work for everyone." (Irish, 2018). My approach to combatting this issue, is to customise musical remedy from the root of the musical creation itself – to compose music with intent of specific emotional evocation, using new tools that will help shape the landscape of emotional content and composition, and defy or account for cultural, social, and personally preferential musical barriers.

This dissertation challenges the frequently expressed notion in music/psychology research that musical intervention cannot be programmed and created for an individual by another individual, and that people must program their musical experience themselves. It specifically

advocates for the creation of music for calming and emotional intervention over the utilisation of existing music in similar applications. This gives us the power as composers to 'program' the music itself from the conception of the work – enhancing its efficacy and countering the risk of using existing pieces of music that have potential 'triggering' effects on listeners (specifically, patients in pathological settings). Overall, this study will explore the efficacy of thoroughly researched, informed and innovative musical intervention for the everyday individual – via structured composition – with the view of this study becoming the basis for musical intervention running parallel to the treatment of various medical impairments going forward in healthcare settings.

1.4 The Need for Assistance with Calming – White Coat Anxiety and General Stress

"White coat hypertension/anxiety" describes the common state of raised blood pressure of a child or adult when at a hospital or doctor's practice, due to anxiety associated with a clinical context. Huizen (2018) explains: "Being upset or overwhelmed can cause a stress response, raising the heartrate … fear, an extreme form of stress, sparks an adrenaline response that increases the heartrate". A large portion – between 30 and 40% – of the hypertension experienced by children in clinics is attributed to white coat anxiety (Jurko et al., 2016).

In setting up and through the duration of this PhD, I have prospected many professionals in the field and attended and presented at conferences about music and the mind (presenting namely at the MARCS institute for Brain, Behaviour and Development in Milperra on Wednesday 15 August 2018, and in the Sydney Concepts Westmead series at The Huddle: WECC Level 1, Westmead Hospital on Friday 29 June 2018). At events such as the 'This Sounds like Science- Music and the Mind' series hosted by Inspiring Australia at City Recital Hall, I have met professors of design, neuroscience, biology, and music from The University of Sydney and Western Sydney University, and humbly solicited their advice on my pursuit of this research. Sessions like these truly exhibited the prevalence of emerging and past research in the field of

alternative therapies for wellbeing, and highlighted the growing need for them as well. Both anecdotal and formally presented observations presented to me have illuminated the prevalence of white-coat anxiety in pathological settings, and the increase in mental health decline in the Australian population at large. These talks informed allied professionals and researchers about my past and prospective research through this PhD with overwhelming reception. Health professionals working as surgeons, midwives, administrative staff, and others have advocated for my work in this area – demonstrating the urgency for and positive reception of work in this space. I have also inaugurated a new research node at the Charles Perkins Centre, titled *Health and Creativity*, that brings together researchers of science and music to create projects of impact. The ethos of this PhD is about reciprocity and interdisciplinary collaboration – joining the forces of professionals in their respective fields to create a better world.

1.5 Visuals and Calming – A Brief Framework for the Wellness Project

Colours have been associated with triggering associative memory responses, and in turn associated affects (Cernin et al., 2003; Farley et al., 1976). Similarly, patterns in images that are like those that occur in nature, can evoke a similar affect to their parallels in nature (Annerstedt et al., 2010; Henderson et al., 2017; Iheabunike, 2021).

Psychologists have found that city and urban residents living near parks report better mental health than those residents without said proximity (Levi, 2016; McCunn, 2020). Photographs and other imagery depicting nature and greenery have also proven effective in calming in similar applications. In 2012, psychologists studied the effects of plant and plant-imagery exposure on patients in hospital, and showed that these patients reported a calmer hospital experience than those who did not engage with natural imagery. In a similar study published in 2005, researchers found that corporate workers reported reduced stress levels after positioning their desks in a location that was exposed to plants and a window view. Research

has shown that most people spend a third of their time in the workplace – a commonly stress-inducing, fatiguing setting (Tattini et al., 1995). Tattini et al. compared natural and urban-themed content, and how the two affected participants' psychological state. Results showed that those who viewed natural imagery (whether through a window, an indoor pot plant, or a visual) felt markedly lower stress levels than participants who had little more to view than their desk (Tattini et al., 1995). As a general rule, natural imagery appeals more to those seeking respite from stress, according to Michael Merzenich, PhD, a neuroscientist at the University of California San Francisco: "When [the ocean is] landmark-free, it's naturally calming to us, much like closing your eyes is calming." (Levi, 2016)

Over the past decade, there has been an emergence of adult colouring books claiming to provide relief from stress. These fall into the category of "Art Therapy" (Barrett, 2015). This type of art therapy claims to use "calming subject matter created in intricate patterns" (Barrett, 2015), to engage adults in focused, creative output that is said to provide calm. Many of these books depict mandalas – an image that utilises repeated patterns that accumulate to form a larger image. A 2011 study found that "structured colouring of a reasonably complex geometric pattern may induce a meditative state that benefits individuals suffering from anxiety." (Curry & Kasser, 2005). Mandalas depict fractals – repetitive patterned imagery – similar to the patterns found in rock formations, shells, kinetic bodies of water, human fingerprints, flower petals, leaf veins, and other naturally occurring formations found in nature. Unsurprisingly, similar colouring books have emerged that use flowers and other plant amalgamations for their imagery. Scholars suggest that due to the fast urbanisation of society, humans find imagery that depicts nature (particularly in a restorative state), calming and similarly restorative for their headspace (Iheabunike, 2021). The calming effect of fractals is likely associated with an evolutionary predisposition in humans. In an email to Health.com, Richard Taylor, PhD, and director of the Materials Science Institute at the University of Oregon, wrote: "through evolution, our visual system has developed to efficiently process the visual

patterns of fractals that are prevalent in nature. This increased efficiency results in the observer becoming relaxed." (Levi, 2016; Taylor, 2021)

Another factor to consider in relation to Art Therapy is colour. How does colour affect/influence our emotions, and why?

> Are the effects of color on the human organism so extreme that our physical and mental hygiene depends on them? Could lack of color in our internal and external spaces not only cause ugliness and boredom but also be responsible for physiological discomfort or stress reactions? (Kueller and Mikellides, 1993)

Palmer and Schloss (2010) suggest a notion called Ecological Valence Theory. They studied colour and human association and found that we strongly prefer colours associated with things we like. More specifically, we tend to prefer colours that are associated with health in our environment (green for healthy plants, blue for clean water), and dislike colours that signify poor health and danger (brown for dirt, death, and faeces, etc.). Considerations of colour are made ubiquitously in our everyday lives, through the psychology of marketing in the graphics we consume all around us, and even in the attention to lighting in various commercial spaces (Kueller & Mikellides, 1993). It has been found that colours can be used to evoke a myriad of emotional (and subsequently physical) reactions. In particular, marketing agencies can use specific colours to calm their consumers, deceive their perception of waiting times, affect appetite, and increase feelings of happiness (Singh, 2006). There is a powerful semantic value associated with colours that influences the emotions evoked. Colours often carry symbolic and cultural associations that go beyond their physical properties of light wavelength and intensity. These associations can influence how colours are perceived and interpreted in various settings, such as art, design, branding, communication, and cultural practices, and a distinction should be noted between the triggered association from the colour, to the emotional response

brought on by said association. As in music, emotional responses to colours are evoked through both biological and cognitive mechanisms.

Among the most relaxing colours, according to psychologists at the University of Sussex and paper merchant G . F Smith, is navy blue. Other options include teal-like turquoise, and soft pastel pink hues (Levi, 2016). In 2017, the largest-ever colour survey was conducted, "The World's Favourite Colour Project", collecting data from just under 30,000 participants from over 100 countries. The survey asked participants what colours they liked and what emotional attributes they associated with various colours. The project found overall, that more saturated colours were associated with stimulation, excitement and emotional arousal, lighter colours were associated with calmness, relaxation and low states of arousal, and that blues and greens in particular are associated most with calmness and relaxation. The study also found that orange was the "happiest" colour, pink was the "sexiest", and white, purple, and orange were the colours most associated with luxury. This study supported the hypothesis of Ecological Variance theory of colour and associative meaning, and reinforced the notion that we as humans attribute emotional content to colours in the same way we would to their naturally occurring elements in nature.

1.6 An Approach to Measuring Emotional Response to Music

Expressing specific emotional experiences through language is a well-known and age-old challenge for humans (Suslow et al., 2000; Linsley & Carroll, 2011). Even more daunting is attempting to describe these emotions when they stem from non-linguistic activities, like music. Therefore, we must inquire: How can we obtain precise and meaningful descriptions of such experiences, considering the complexity of the task?

Emotional reporting in studies of music and emotions is a continuously contentious topic. Researchers have used eclectic emotion lists, dominance scales, valence and arousal scales, and shifted between physiological affect receptors and psychoanalytical affect measurement

systems in an attempt to reliably measure emotions in musical experience (Scherer, 2004). The variety of approaches has revealed further avenues for continuing enquiry. Over time, researchers have agreed that the physiological exhibitions of emotion, the evocation of emotion, and perceived emotion are all differentiated (Juslin & Sloboda, 2001). This dissertation being that of a composer cannot measure the physiological exhibition of emotions and will not attempt to. It also conflates/does not make a distinction between the evocation of emotion and perceptibly expressed emotion, focusing on whether music more generally communicates specific emotions or not for the scope of this PhD. Future studies would work to identify which components of the CTEE evoke and which express.

Self-reported emotional responses have the potential to carry issues of authenticity. In studies such as those in this dissertation that measure affect as a response to musical stimulation through self-reporting, how do we ensure we are not subconsciously influencing responses? For example, are we forcing a response to a question simply because the participant feels compelled to provide an answer where otherwise they might not feel an emotional reaction at all? How do we consider a participant's aptitude for mood disturbance? How do we choose what emotions to limit response options to, or which emotional reporting tool to use, in particular in pilot studies that engage small participant pools where too many responses would render no correlations at all? Study in this field has historically been littered with issues such as these, though have been partially alleviated by more recently generated and renowned tools such as the Circumplex Model of Affect, the Self-Assessment Mannikin, and others. It should be noted however that these issues persist in various ways, and researchers going forward should continue to endeavour to find solutions to combat barriers to emotional self-reporting.

Emotional self-reporting sees researchers relying on participants' acute sense of self-awareness for the accuracy of the data, and further to the issues discussed above, this is particularly problematic in two ways; for adults, the confrontation of emotional experience

might be overwhelming and counter-intuitive. It necessitates self-reflection that some may find undesirable (Suslow et al., 2000). Studies in this dissertation ask "how do you think this would make *someone* feel", rather than "how does this make *you* feel", in an attempt to side-step this issue and offer more reliable results. This also aims to mitigate previously discussed issues of accounting for a person's aptitude for mood disturbance, by framing the question in a hypothetical manner rather than in one that relies on the effect of the music on the participants themselves. For children, the very fact that self-reported emotional response relies on self-awareness can be the biggest issue. Self-awareness and reflection is a matured skill (Michalson & Lewis, 1985). For this purpose, studies in this dissertation conducted interviews with child participants, in order to gauge nuance around their answers, and hoping, through thematic analysis, to reach a higher level of accuracy in the data.

The simplification of the emotional options for the studies in this dissertation is crucial to find indicative or even statistically significant results in their use of small to moderate sized recruitment pools. The pilot studies in this dissertation revert to the building blocks of emotional experience to do this: valence and arousal (Irrazabal & Burin, 2021). Future studies with large recruitment pools would utilise comprehensive emotion lists to allow for subtlety in emotional reporting. The studies in this dissertation utilise a modified version of the Self-Assessment Mannikin, otherwise known as the SAM scale. The SAM measurement system is and has been widely used in the field of psychological research for decades. It is a Likert-type scale that has emerged as one of the most reliable measurement systems for self-assessed emotional reporting. This graphic evaluation technique measures a person's pleasure (a.k.a valence), arousal, and dominance in response to a range of stimuli. The two leading scales are pleasure and arousal. The third scale is dominance, which describes the prevalence of the affect (Morris, 1995). It is possible that the dominance scale may exhibit information regarding a participant's aptitude for mood disturbance, but it is equally possible that it reflects the saturation of emotional evocation from the stimulus itself. Again, a person's aptitude for mood

disturbance is one element that this research could not reliably measure. Similarly, the saturation of affect has not been theorised from a musicological perspective in the CTEE. For these reasons, the dominance scale was omitted from the studies in this dissertation. Nonetheless, the use of the modified SAM scale promotes an otherwise reliable (or at least well-established) emotional reporting system, and this dissertation will draw conclusions surrounding the emotional experiences of calm and catharsis, based on scores from the modified SAM reporting system.

Chapter 2:
The Wellness Project – Music for Calm and/or Catharsis: A Study

2.1 Introduction

The Wellness Project is a study that utilised Natalie Nicolas' CTEE to ascertain how 10 pieces of music written using the CTEE, portrayed perceived calm and/or catharsis in listeners. The CTEE comprises eight compositional mechanisms derived from 'Hypotheses for seven psychological mechanisms through which music might induce emotions in listeners' (Juslin et al., 2008; Juslin 2013) and other theories surrounding intervallic and contour emotive affect. The pieces of music were paired with music-reactive visuals, and participants rated from 1-5 on a modified SAM scale how excited/calm (arousal) and happy/sad (valence/pleasure) they think each sample might make someone feel. The use of the terms happy/sad instead of positive/negative was an attempt at making the language more accessible to participants. It should be noted that calm and catharsis can be concurrent with pleasure or displeasure and the two are not mutually exclusive. In this study, I was interested in finding correlations between perceived arousal and pleasure, and each piece (sample) was written with an aimed pleasure and arousal rating. The study also included four control experiences.

2.1.1 Research Questions

The research questions that guided this study were: Are pieces created with the CTEE more pleasurable and calmer than those created without the CTEE? Do the aims of a composer using the CTEE to evoke specific levels of arousal and pleasure match the perceived levels of arousal and pleasure by listeners? Does the music composed using the CTEE communicate emotionally with listeners? What observations can we make regarding the perceived relationship between arousal and pleasure by listeners?

2.2 Background and Method for the Music Creation – The CTEE

2.2.1 Literature

> "(You can) use colours to increase or decrease appetite, enhance mood, calm down customers, and, reduce perception of waiting time, among others." (Singh, 2006).

Ecological Valence Theory is just one model of colour-affect theorem, coined by Palmer and Schloss (2010). It supports the notion that humans prefer colours that occur naturally in healthy, flourishing depictions of nature. Other research has found that colours that are more saturated elicit a sense of excitement, and colours that are softer and lighter elicit a sense of calm and relaxation. Orange has been most often associated with happiness, and "many studies have found that blue and green are also associated with calmness and relaxation (fewer studies find no association)" (Hale, 2019).

Similarly, visuals that utilise abstract fractals have been shown to induce calm, relaxation and are the most mesmerising over other visuals. This is due to the association of fractals to patterns that repeat that are replete in nature: in shells, flowers, leaves, snowflakes. Taylor says that "The calming effect of fractals may have to do with our how brains have evolved to interpret them. The idea is that, through evolution, our visual system has developed to efficiently process the visual patterns of fractals that are prevalent in nature." (Taylor, 2021).

Visual storytelling is also an effective means of emotional alteration. Visuals depicting what would typically be considered a 'soothing' environment can induce peace and catharsis for viewers (Ahmadpour et al., 2019). Pairing calming imagery that uses abstract fractals and soft colours with music written especially for calm and/or catharsis is how this study aimed to help participants most effectively engage with the provided samples, and minimise distraction from other sensors, as an attempt at multi-sensory control. Studies that have paired music and visuals have proved effective in altering psychological wellbeing for the better (Gimeno, 2010).

Arousal and pleasure are distinguishable in the following ways: pleasure pertains to valence (positive/negative), and arousal pertains to arousal levels. Measuring pleasure (aka valence) and arousal was key in this study, in attempting to understand the degree to which the samples used could evoke feelings of calm and/or catharsis.

On the modified SAM scale, 'calmness' is used to describe low arousal on the 'arousal' scale. Calm coexists with positivity and negativity, hence the inclusion of the pleasure scale alongside to provide further insight to any experiences of perceiving various arousal states by participants. For the purpose of this study and aligning with earlier definitions in this thesis, I deemed that catharsis is an initial sense of excitement, followed by a resultant level of calm. I also deemed that catharsis exists alongside happiness or sadness (positivity or negativity more specifically in relation to valence), and similarly to arousal, was observing any perception of valence to these pieces. It should be noted that levels of resultant calm via cathartic experience are presumed to be higher on the arousal scale than for those samples that aim to evoke calm throughout. The pieces that were written to lead to an end result of catharsis, aimed to journey the listener from excitement through to calm, hence the expected higher arousal levels than other samples.

There is substantial evidence that supports music's ability to alter emotional state. Researchers have been demonstrating this connection since the early 1960s and have found evidence of music's ability to alter *general* mood (Götell et al., 2009; Kemper & Danhauer, 2005; Konnikova, 2013; Salerian, 2015), and the ability for music to alter *specific* mood (aka emotion) (McNair et al., 1981).

As mentioned in the previous chapter, various technical musical facets are associated with emotional experience. Certain intervals can elicit specific feelings (Costa et al., 2000; Curtis & Bharucha, 2010; Gosselin et al., 2015), major and minor tonality are evocative of the respective notions of happiness and sadness in Western tonality (Gosselin et al., 2015), and

pitch contours in melodic, countermelodic and accompaniment lines can elicit emotional reaction connected to the prosodic features of speech embedded in their cultural dialect (Frick, 1985). Musical features used deliberately in the samples created for this study were utilised through the CTEE, which draws on data from said researchers and alike upon which to base its premises.

2.2.2 Method for Music Creation – The CTEE

There are some particularly recurrent emotions that occur through musical experience in general. For the purpose of this study, I aimed to evoke perceived calm and catharsis as an aid to pathological and everyday stresses on the human mind.

Emotions are prone to influence through music listening. As a result of "Hypotheses for seven psychological mechanisms through which much might induce emotions in listeners" (Juslin et al., 2008), the BRECVEMA model (Juslin, 2013), and other theories surrounding pitch contour, intervallic emotive content, and more, the Compositional Toolbox for Emotional Evocation was developed.

The Compositional Toolbox for Emotional Evocation (CTEE) comprises eight compositional mechanisms, inaugurated in Nicolas' (my) 2018 Master's dissertation, and further developed in this thesis. The mechanisms are as follows:

1. Rhythmic Unity
2. Response to Stimuli
3. Conditioned Response
4. Emotional Contagion
5. Visual Imagery
6. Episodic Memory Recall
7. Musical Expectancy
8. Intervallic and Contour Affect Theory

Further details regarding the CTEE can be found in the Background section of this dissertation (Chapter 1.3).

2.3 Aims/Objectives

There is limited data proving the efficacy of music written *specifically* to induce emotions. Research to date has identified various technical facets of music that can induce certain emotions, investigated what occurs psychologically during musical and tandem emotional experience, and even verified that music can and does change specific emotional state. It has not, however, specifically examined music written using a formulaic approach, or the efficacy of that music in affecting emotional state. Previous enquiry has utilised non-specific music, or music written for film to enhance a given visual. My CTEE is an amalgamation of the aforementioned insights into the relationship between music and emotions from the specific perspective of music-making. This study tests the efficacy of the CTEE, and further, the efficacy of the visuals used in the production of the game created for this and further studies.

2.4 Method

I recruited participants from the age of 15 and over, via email and Facebook, to participate in the study titled 'The Wellness Project'. The study was run via a website. Participants followed a provided link and were directed to a home page that describes the aims of the study, and the background research. They then clicked through to the 'study' page, which redirected participants to the RedCap data collection platform, hosted on the University of Sydney server. They filled out their details in the participant consent form and continued to the study itself.

The methods of feedback and data collection were chosen to be appropriate for adults of most ages – participants engaged with basic, accessible technology, and a simple numerical feedback system through engagement with the modified SAM scale.

The SAM scale (Self Assessment Manikin) is a pictographic Likert-type scale, and is widely considered an efficient self-measurement of emotional response. Its straightforward approach gives it the ability to transcend cultural and language barriers (Morris, 1995). My modification of the SAM was minimal, and reduced the nine-point system to five points, for more streamlined response options that aligned with calm and/or catharsis. The scale was as such:

- Arousal: 1 – very calm, 2 – calm, 3 – neutral, 4 – excited, 5 – very excited
- Pleasure: 1 – very sad, 2 – sad, 3 – neutral, 4 – happy, 5 – very happy

A widely unaccounted for variable in the measurement of affect is an individual's "aptitude for mood disturbance" (Garrido & Schubert, 2013). To take into consideration that self-emotional assessment doesn't allow for considerations of a person's mood prior to engaging with the study, nor one's "aptitude for mood disturbance", I asked participants how they think the experiences might make "someone" feel, rather than how it made them feel. This meant that participants were not necessarily immediately attributing the emotional communication to the music/video, but attributing the perception of affective phenomena to said stimulus. It aimed to minimise the requirement to consider the passage of time in the observation of perceived affect adjustment along the course of the study.

Participants engaged with 14 excerpts in total: 14 pieces of music paired with abstract, ostensibly calm/neutral visuals that are programmed to be music-reactive. I created the visuals specifically for the study, based on research into colours and their associated arousal and pleasure (valence). The visuals depicted mandalas, fractals, and other non-specific imagery that aimed to parallel patterns found in nature, which have been proven to have calming effects on individuals (Taylor, 2021). They were created using Adobe Creative Suite platforms,

and turned into visuals that were music-reactive using video editing software. The paired music-reactive visuals created for this study aimed to minimise distraction from other stimuli. They used ostensibly emotionally-calm/neutral colours such as green, navy blue, teal/turquoise, soft pastel pink and others that correlate to various human colour preference theories such as Ecological Valence Theory (Palmer & Schloss, 2010).

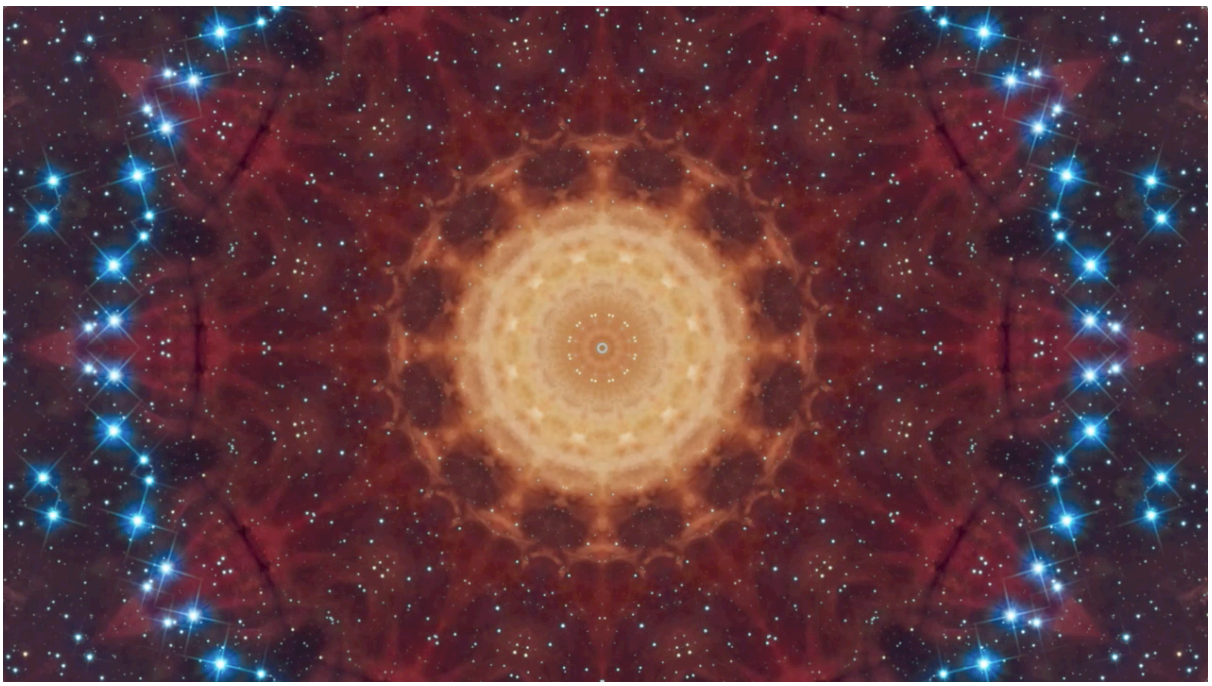


Figure 5: Still image of a scene in *Eight* depicting fractal-like imagery

The music created has been written in what was aimed to be a harmonically, rhythmically and instrumentally accessible manner for adults (including young adults) that would be participating in my study. I utilised the piano trio (an ensemble that appears ubiquitously in arts, film and classical music and dates back to the Classical period (Cîrlejan, 2012)), Western harmonies, and textural treatment that is paradigmatic for contemporary art music, film music, and the like.

The four control excerpts were created without using the CTEE and with no strategic videographic 'matching' to the key features of the music. Instead, they were chosen from a library of music written by the same composer (myself), where the instruments and harmonic

language were similar to the 10 specifically programmed pieces. This was to minimise a participant's potential distinction between hearing a control or non-control work. The control works were included to distinguish whether participants were perceiving communication from the musical experience in general, or the pieces specifically.

The participants listened to the audio using headphones or speakers, and watched the paired video via a laptop, mobile phone, desktop, TV, or other device. The study was conducted in the homes of the participants, in a quiet space, or wherever participants felt safe to engage with it. After engaging with each example, they picked a point on the two aforementioned pleasure and arousal scales that best described how they believed each example might make someone feel.

The COVID-19 pandemic limited expected participant recruitment to 25 participants. Being a pilot study, and a mixed method approach that included qualitative analysis, I did not necessarily need a large number of responses (research indicates lower numbers are needed for qualitative analysis, and as little as 10 participants are needed for a pilot study (Herzog, 2008)), but I welcomed as many participants as were willing to cooperate with the study. The resulting participant pool was in fact 79, with 859 responses to the samples overall. This exceeded expectation.

The age group of 15+ was relevant as I was aiming to use the data to best inform as to how to assist the layperson in emotional self-management for future projects, via experiencing specifically composed music for said purpose. The study itself requires a developed emotional maturity and self-awareness that comes with mid-teens to adulthood (Bhattacharjee, 2016).

The CTEE is a new instrument for emotion-inducing composition, and this pilot study stands as an efficacy investigation for composing music with the CTEE for perceived calm and/or cathartic nature. The research has the potential to facilitate further applications of music for

general wellness, and/or use in healthcare settings to help combat white coat anxiety, assist the practitioner to self-manage psychological wellbeing, or for family and friends in waiting rooms. The last of these is of particular interest for me, due to an increasing rate of pharmacological intervention for the treatment of mental unhealth in the population at large (Stephenson et al., 2013). Music used in such contexts to date has been largely pre-existing music rather than specifically composed pieces.

A quantitative data collection method, in the form of an online survey, was adopted for this study. Participants visited a website, and when the study began, listened to 14 excerpts of music paired with distraction analgesia videos, reporting how each excerpt might make someone feel in terms of arousal and pleasure. Participants then listened to and watched four excerpts of music and video paired together, reporting on each in the same way. Participants were informed that they were helping researchers understand more about how music could make someone feel.

The types of analysis used in this study were descriptive analysis and deductive analysis. In terms of study design, survey research was the overarching approach.

Table of participants' ages

There were N=79 participants, with ages between 15 and 71. The mean age was 35 with a standard deviation of 12.6 (and the median was 31 with an inter-quartile range of 41.5 – 28 = 13.5). Three participants did not give their age.

Total Count (N)	Missing*	Unique	Min	Max	Mean	StDev	Sum	Percentile						
								0.05	0.10	0.25	0.50 Median	0.75	0.90	0.95
79	3 (3.7%)	35	15	71	34.96	12.62	2,762	16.90	21	28	31	41.50	54	59.30

Lowest values: 15, 15, 16, 16, 17
Highest values: 59, 62, 63, 68, 71

2.5 Analysis of the Wellness Project Compositions – Where are the Tools/Mechanisms Present?

It is hypothesised that the eight mechanisms of the CTEE can be used in conjunction with theories of tonality and affect to *create* music associated with specific affects. The music written for this dissertation has aimed to evoke primarily calm and/or catharsis, combined with a range of emotions on the pleasure scale. Catharsis in this context is regarded as a process of first exciting/arousing a listener to encourage energy use, then calming them again by the end of the work.

The following will comprise a short analysis of the 10 pieces encompassing the album *Music for Calm and Catharsis* used in this study. The analysis of each work will touch on some of the many techniques utilised from the CTEE, and decisions regarding tonality. Each work was written with the aim of evoking calm and/or catharsis during various parts of the individual work, with a resultant overall emotional state after listening. The pieces were of two to three minutes duration – a length that offered the composer the potential of cycling through multiple emotional states. Details of these assignments accompany each analysis, and in the results section of this chapter, the composer's own intentions for each sample (relative to the two SAM scales 'arousal' and 'pleasure') are provided as a comparison to the most frequent responses from the 79 participants. All works in this album aimed to evoke positivity on the pleasure/valence scale (4/5). To relate the various intended arousal levels to a score on the SAM scale, a system was derived by the composer (myself). No track was intended to evoke a 5/5 (very excited) on the SAM arousal scale, as overall the pieces were intended to evoke calm either in entirety, or through the avenue of catharsis, however catharsis (as is deemed in this dissertation) is a process of purgation of emotion to calm, ending in calm – and the less

calming movements that accompany the work, the higher the expected resultant arousal level will be. The following percentages represent the portion of the piece that was comprised of music designed to build arousal levels in order to facilitate possible catharsis:

- 75–100% catharsis = 4/5 (excited) arousal
- 50–75% catharsis = 3/5 (neutral) arousal
- 25–50% catharsis = 2/5 (calm) arousal
- 0–25% catharsis = 1/5 (very calm) arousal

Participants were asked to identify how, at the end of listening to the whole piece, it may make someone feel. For accompanying listening reference and score perusal, audio recordings and full scores of these pieces can all be found in Volume Two of this dissertation.

2.5.1 *One*

0:00 to 1:39 catharsis (building and moving away from excitement)	1:39 to end calm	Overall: Happy (4/5), Excited (4/5)

One aims to build gently and incrementally from calm to excited, ending in calm in the second half of the two-minute work. It encompasses 81% of catharsis, and the remainder calm, in intended arousal. Overall, the affect is aimed at calm, through the process of the purgation of emotions that is catharsis. It is expected to be one of the top scoring tracks on the arousal scale, due to the cathartic avenue for calm and the length of time proportionate to the track that builds arousal.

Rhythmic Unity

It is through Rhythmic Unity that this track aims to entrain a listener's pulse and adjust their arousal levels throughout the work. Syncopation in an ostinato established at the start of this work creates rhythmic drive from the onset – to interlock with a listener's heartbeat through sensorimotor synchronisation. Most pieces of the album utilise ostinato as a vehicle for

Rhythmic Unity in order to affect a listener's heartrate, and due to the composer's compositional style, this is an overarching theme of the collection of works. The tempo is marked at 100bpm, at the upper end of the average resting heartrate of an adult (60–100bpm (Franklin & Chaddha, 2018)), and promotes arousal excitement and uplift.

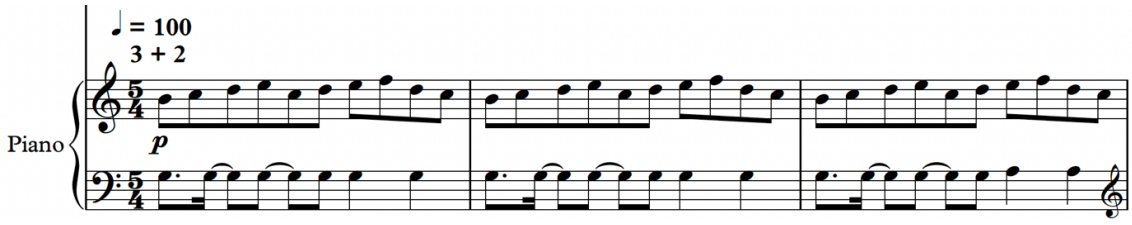


Figure 6: Piano (b) bb. 1–3 syncopation in *One*

Episodic Memory Recall

This work is in the key of G mixolydian – a major-oriented mode. The use of major tonality is traditionally associated with positivity in Western music (Gosselin et al., 2015). Also, the instrumentation choice of strings – a feature of all 10 pieces on this album – has been shown in various studies to emanate positivity, uplift and a sense of joy due to the association via Episodic Memory Recall of stringed instruments to celebrations established historically in their earliest uses in societal undertakings of the 1600s (Areni & Kim, 1993).

Musical Expectancy (specifically MAV)

By the halfway mark of this piece, Musical Expectancy through MAV is utilised in order to renew listener attention – deemed necessary due to the repetitious nature of the ostinato – and to increase tension and arousal through the sublimation of expectancy. The passage below exhibits the harmonic contradiction of a listener's expectations. In bar 17, instead of moving to where the harmony ordinarily would – as is dictated by Western harmony practice and the harmonic progression of this passage that the piece has setup insofar (chord VII to I), we have the use of a minor i (parallel minor) – a short modulation, and this variable encourages the

listener to maintain concentration while still keeping a sense of tonal centre through the unchanged tonic (G).

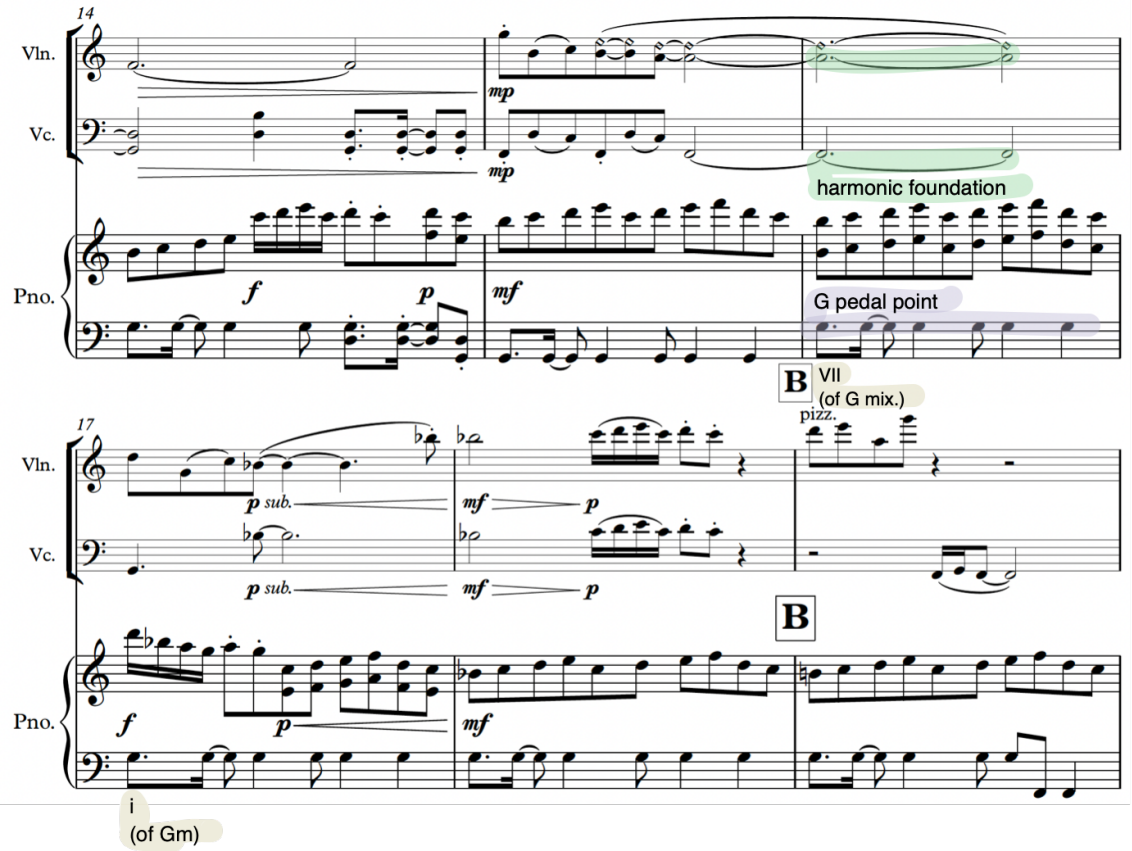


Figure 7: b. 14–19 *One*

Intervallic Affect Theory

Throughout this work, intervals of power, stability, pleasure and positivity have been utilised frequently, to parallel the intended arousal narrative. This is in both harmonic (vertical) and melodic (horizontal) capacities in the pitch material.

The downbeat of the ostinato set up in this piece from the onset of the work utilises the interval of a major third – responsible for eliciting feelings of positivity and stability. The ostinato, as its purpose deems it, runs throughout this work in the accompanying line – reiterating this intervallic emotive affect underpinning the melody (Figure 6). Although the

work encourages various arousal levels, it aims to maintain a sense of happiness concurrently, throughout.

The piece frequently uses intervals of an octave, 6th, perfect 4th and 5th in passages where melodies particularly stand out from the surrounding texture (through registral and dynamic manipulation), and in the orchestration of the accompanying ostinato. These intervals represent emotions we associated with calm and catharsis including stability, power, and pleasure. In the figure below, the ostinato of the work is developed in the middle of the piece, now harmonised in octaves and 6ths. Octaves are the most powerful intervals of our classification, and the combination of major and minor 6ths (determined by the tonality of the work and which 6th variation is diatonic to the key—which in the context of the surrounding harmony has no bearing on emotive valence despite minor 6ths and their association with sadness).

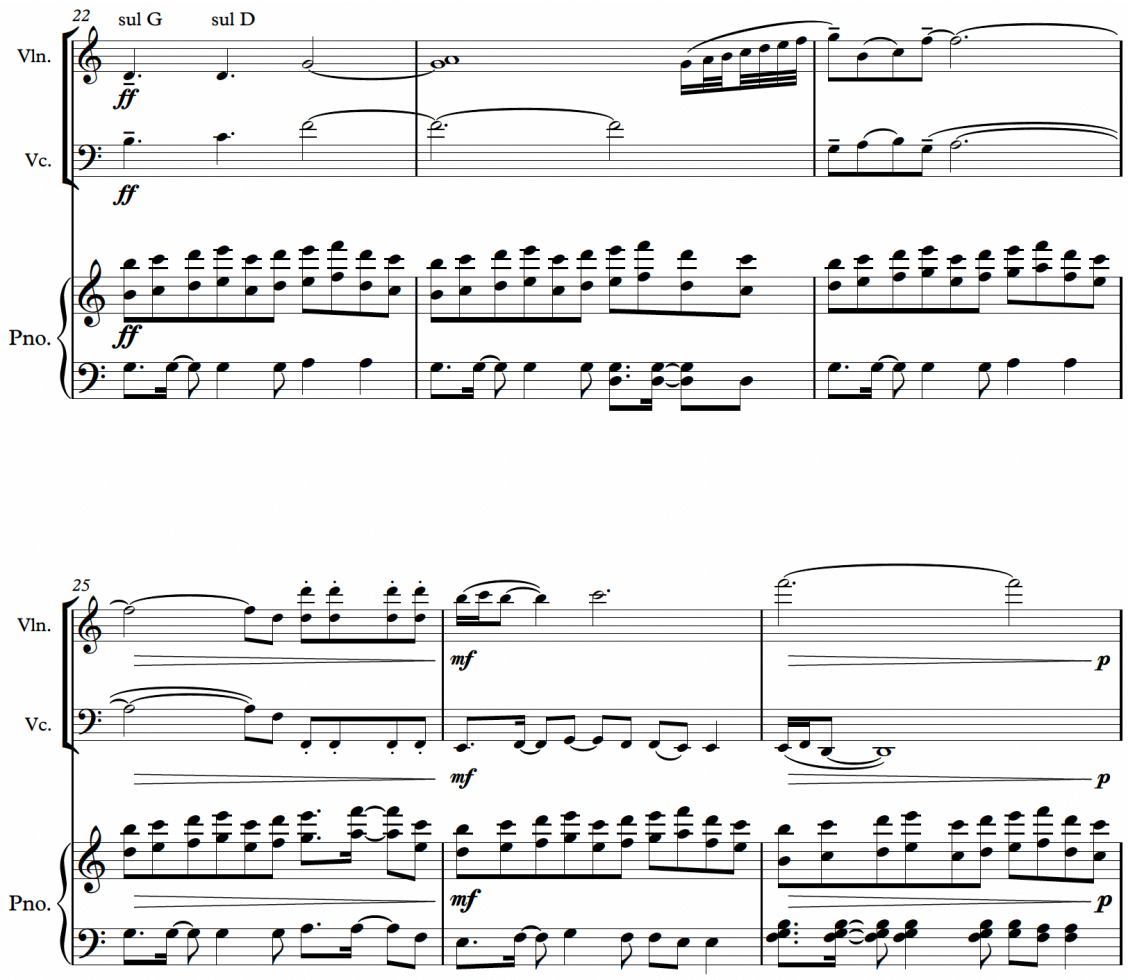


Figure 8: b. 22–27 piano, ostinato harmonisation in 8ves and 6ths in *One*

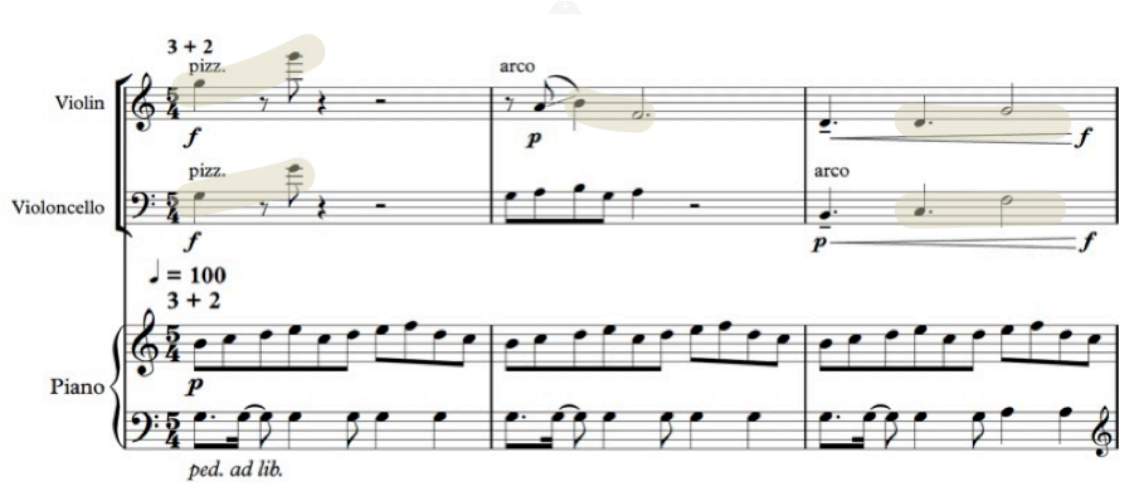


Figure 9: b. 1–3 violin and cello melodic octave interval leaps (b. 1) and perfect fourth interval leaps (b. 3) in opening of *One* emphasised by held notes, registral exclusivity, and *forte* versus *piano* accompaniment dynamics.

2.5.2 *Two*

0:00 to 0:35 calm	0:35 to 1:05 catharsis (building excitement)	1:05 to end calm	Overall: Happy (4/5), Calm (2/5)

Two aims for a somewhat similar emotive narrative as *One*, however utilises an extra calming movement at the start of the work. *Two* aims to be an overall calmer piece than *One*, with only around 25 seconds of the work (25%) that builds arousal for cathartic purpose.

Rhythmic Unity

The opening of *Two* sets up an ostinato, much like many of the tracks do in this album, to form a vehicle for Rhythmic Unity via heartrate entrainment. The tempo of the work is marked at dotted crotchet = 50 – about ten points lower than the average resting heartrate of an adult (60–100bpm (Vega, 2017)). This supports the calming emotive narrative of the first 35 seconds. Although the ostinato subdivides the main countable beats into quavers and semiquavers – which has the potential to result in a perceived tempo of 100 or 150bpm – later this is balanced out by long, sustained notes in the accompanying strings.

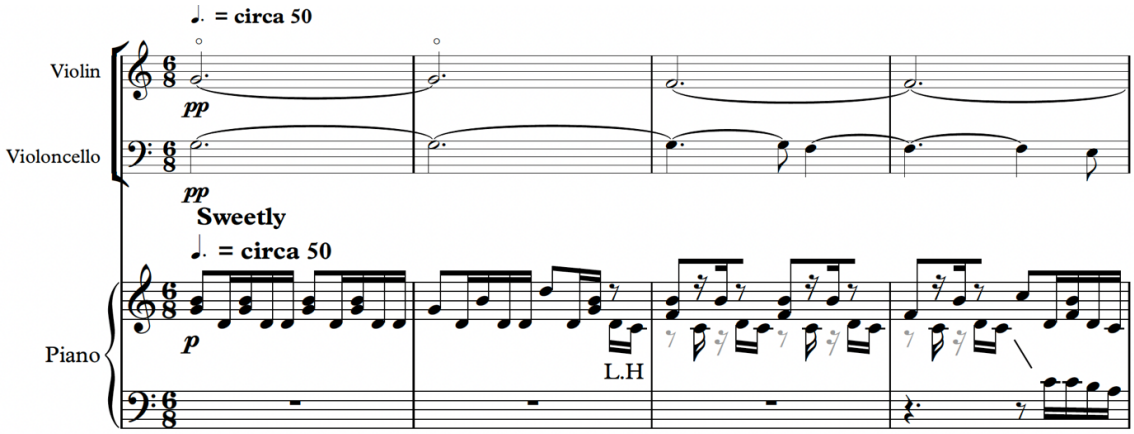


Figure 10: bb. 1–4, ostinato in piano in semiquavers and quavers, supported by long notes in strings in *Two*

In the cathartic movement of the work, the tempo of the piece is increased (via *accelerando*) to 88bpm, and the ostinato is accompanied by syncopated notes in the left-hand piano accompaniment and in the strings. The syncopation firstly acts as a supporting means of Rhythmic Unity (heartrate entrainment is optimised through syncopation (Witek et al., 2014)), and secondly, the nature of the accompanying notes is also functioning in a way that determines where the perceived pulse is. The ostinato (which has now changed incidentally to a second ostinato) is dominated by semiquaver subdivisions whose pattern emphasises the first note of every crotchet beat (scale degrees 5, 6, 7 and 8/1 make up the repetition, where 5 and 8/1 are the most stable notes of the key and feel grounded in the harmony). This means that the right hand of the piano ostinato accentuates the crotchet beat (which is at 88bpm). The accompanying syncopated notes in the left-hand piano and cello are dotted quavers, offering a faster tempo than the right-hand piano (around 110bpm). However the violin's accompanying syncopated notes are dominated by dotted crotchets, balancing the dotted quavers, and solidifying the pulse at the crotchet = 88bpm. This pulse is maintained until the one-minute mark, where we have molto ritenuto paired with a dynamic drop to piano, and a pause, before resuming 'tempo primo' (crotchet = 50bpm) at the beginning of the final calm movement of the work. The final movement from the one-minute mark, utilises the same

rhythmic devices as the first, in a quasi-ternary form, retaining the 50bpm pulse, and eventually slowing even further in the final bars, paired with a volume decrease to pianissimo and rhythmic augmentation of the ostinato, to a calm end.

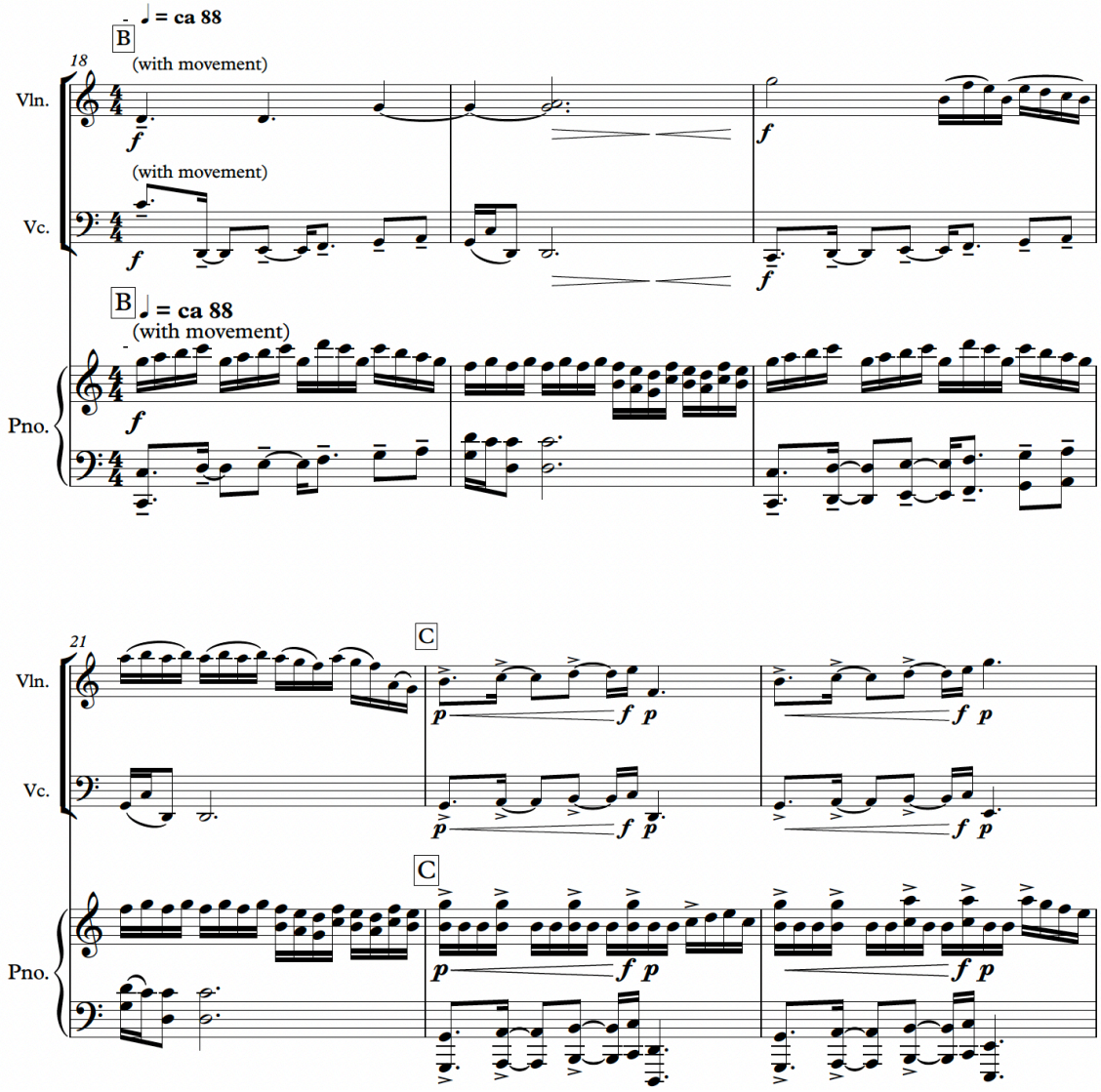


Figure 11: All instruments bb. 18–23 climax of *Two*

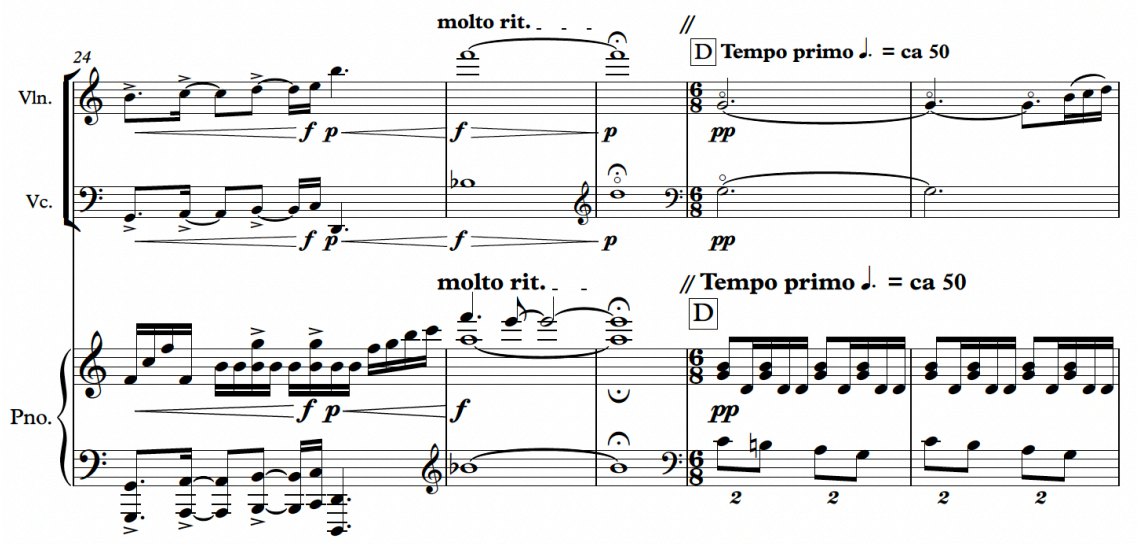


Figure 12: All instruments slow to the second half of the work, in *Two*

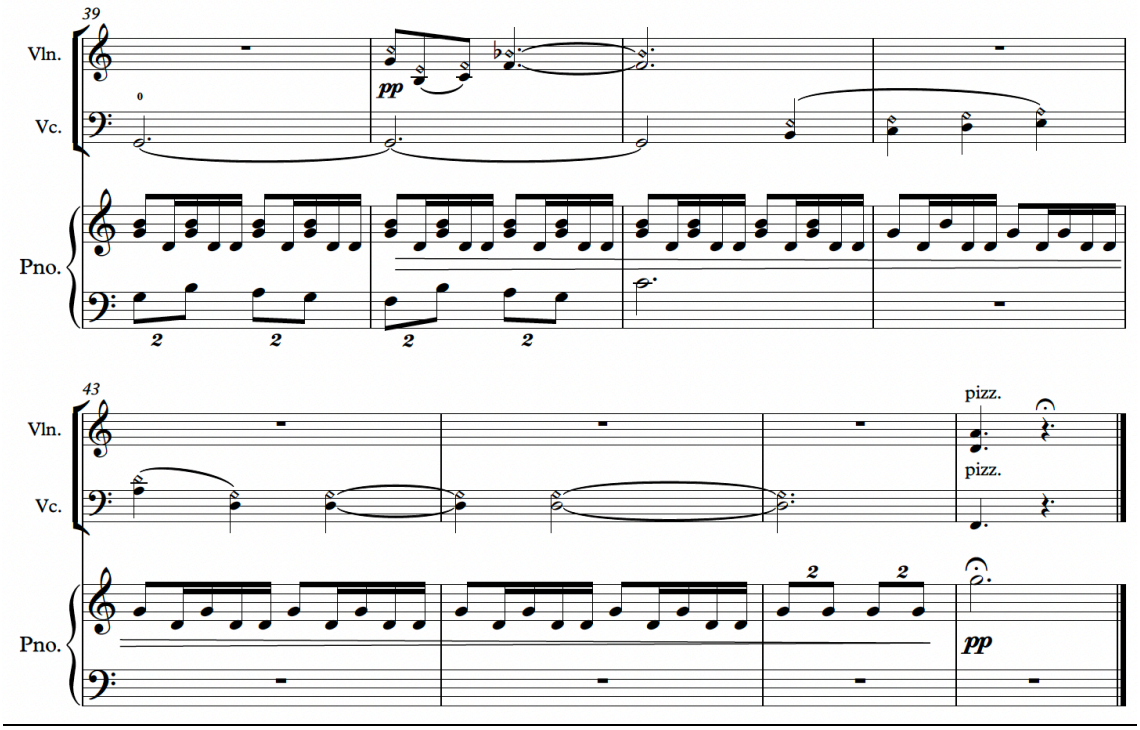


Figure 13: Augmenting final bars of *Two* to a calm end

Musical Expectancy

The ostinatos used in this work engage Rhythmic Unity in the listener, however the repetitious nature of an ostinato might encourage adaptation of the ear. From the pattern established in bar 1, listeners might expect this intervallic and rhythmic configuration to continue, however it

is subverted immediately using MAV in bar 2 by the removal of the harmonising notes and augmentation (or expansion) of the interval on the second beat. Furthermore, the ostinato is developed in various ways, such as the addition of a countermelody-like line (see bar 4 left hand), further intervallic expansion (see bar 3 right hand's vertical range with retained contour and rhythmic pattern), and other subtle aberrations. To maintain attention of the listener, this pattern of subversion continues throughout the piece.

Intervallic and Contour Affect Theory

Use of leaping, skipping and stepping intervals in an ascending direction in particular – major 2nd, 3rds, perfect 5ths, perfect 4ths – aim to evoke pleasure, neutrality, approach and power. They are utilised throughout the piece, including at the beginning of the work, but aim to be particularly effective in the middle section of the work in order to build arousal alongside a continued positive valence.

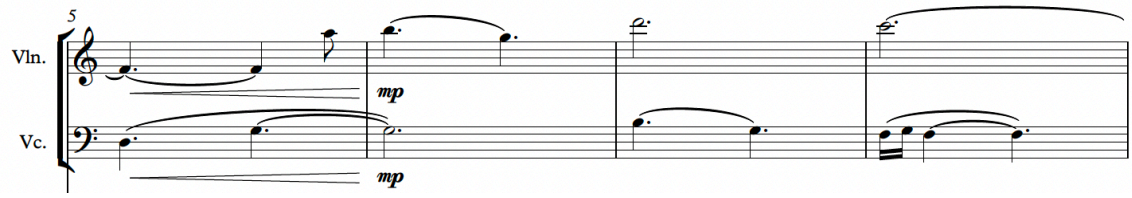


Figure 14: Violin and cello bb. 5–8 skips and leaping intervals of pleasure and stability in an ascending fashion in the first movement of *Two*

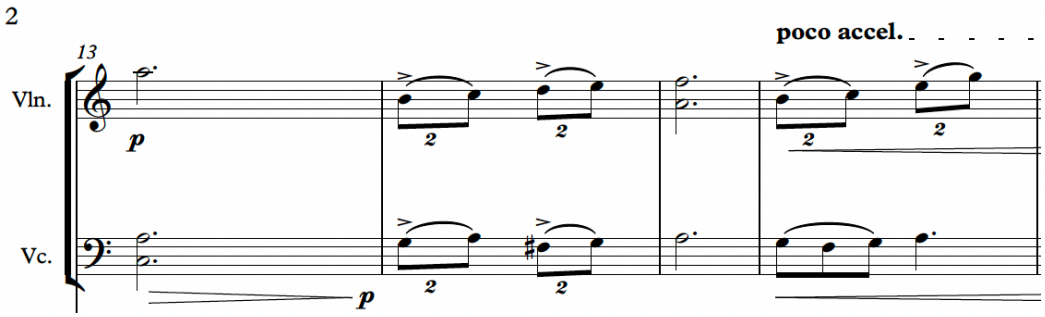


Figure 15: Violin and cello bb. 13–16 ascending stepwise motion and melodic intervals of approach leading to climactic second movement of *Two*

Both ostinatos of the piece are optimised through Contour Affect Theory to support their aimed arousal narrative. The level contour of the first ostinato established in the first movement and continued in the final movement of the work aims to evoke stasis and stability, whereas the ostinato in the middle section (that builds arousal for catharsis) utilises an ascending pattern, which aims to evoke approach, a sense of picking up spirits, and optimism. The latter is also closely linked to Visual Imagery, where the ascending contour of the cells depict ascent, soaring, flying, and so on – all positive valence imagery (Pictet et al., 2011).

In the final movement of the work, harmonic octaves are utilised in low voices in the piano left hand – a standard technique used for centuries to reinforce the bass notes of the harmony, but that which in turn aims to emanate power and stability through Intervallic Affect Theory, and to release the tension built in the work and lead the listener from excitement to calmness, the contours of the musical content are reversed, generally descending throughout this movement. The descent here represents deactivation and a falling of energy. The pairing of the descent with melodic intervals of a major 2nd, major 3rd, perfect 4th and perfect 5th (intervals that emanate approach, power, stability), ensures the descent retains a positive emotive framework.

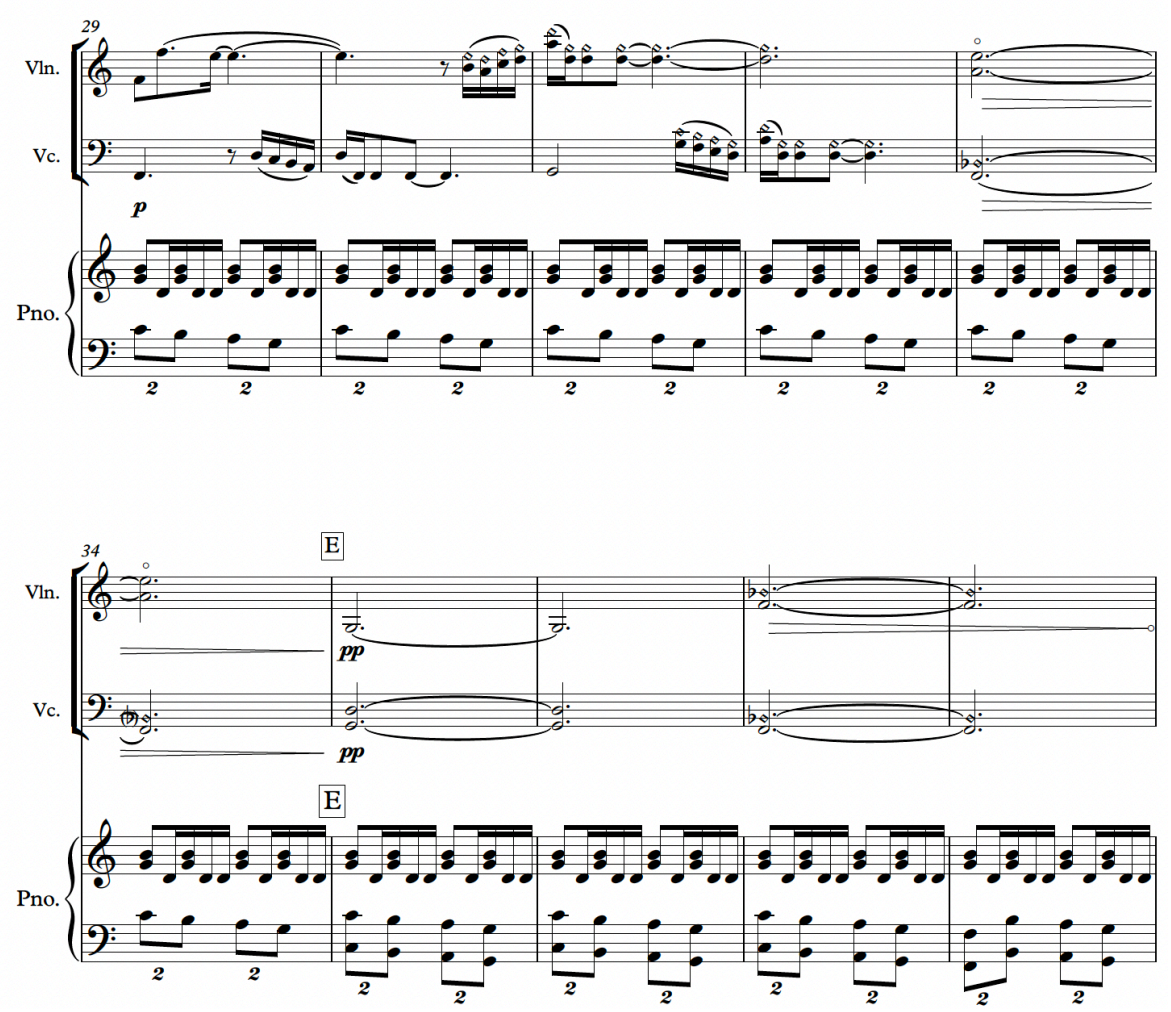


Figure 16: All instruments bb. 29–36 final bars of *Two*

2.5.3 *Three*

0:00 to 0:25: calm	0:25 to 0:55: catharsis (building excitement)	0:55 to 1:07: calm	1:07 to 1:15: catharsis (building excitement)	1:15 to 1:48: calm (less so than following excerpt/movement)	1:48 to end: calm	Overall: Happy (4/5), Calm (2/5)

Three aims to be slightly dominated by calm arousal levels. In its 2:20 minutes duration, 1:20 (about 60%) aims to evoke calm, and the other 40% of the work aims to evoke building arousal to achieve catharsis.

Rhythmic Unity

As is commonplace amongst the works of this album, an ostinato is established in the piano from the onset of the work. The tempo is marked at 144bpm, but the consistent use of minims and semibreves in the material surrounding the ostinato promotes a pulse effect of 77bpm (in the range of the resting heartrate of an adult (Vega, 2009)).

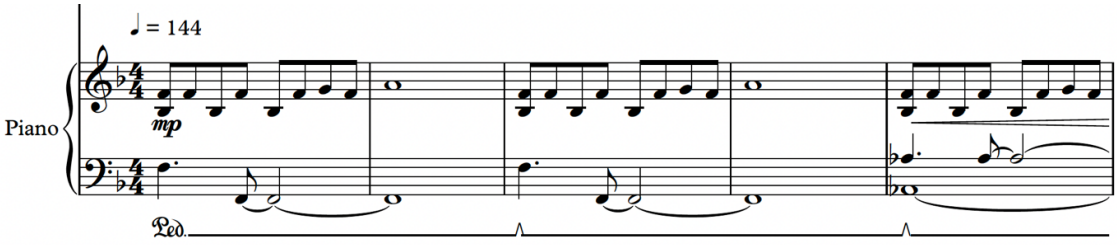


Figure 17: Piano bb. 1–6 ostinato in *Three*

The work utilises the same principles as *One* and *Two* in its manipulation of tempo (supported by manipulations of dynamics and Intervallic Contour Affect Theory) to raise and lower the listener's heartrate throughout the work, to match the intended arousal narrative.

This work introduces a 'poco rallentando', marked over the ostinato – the same one established at the onset – in its final bars. This becomes commonplace amongst the works in the album. The aim is, at this point of the work, through continued heartrate entrainment, to slow the listener's heartrate back down to leave them with feelings of calm release.

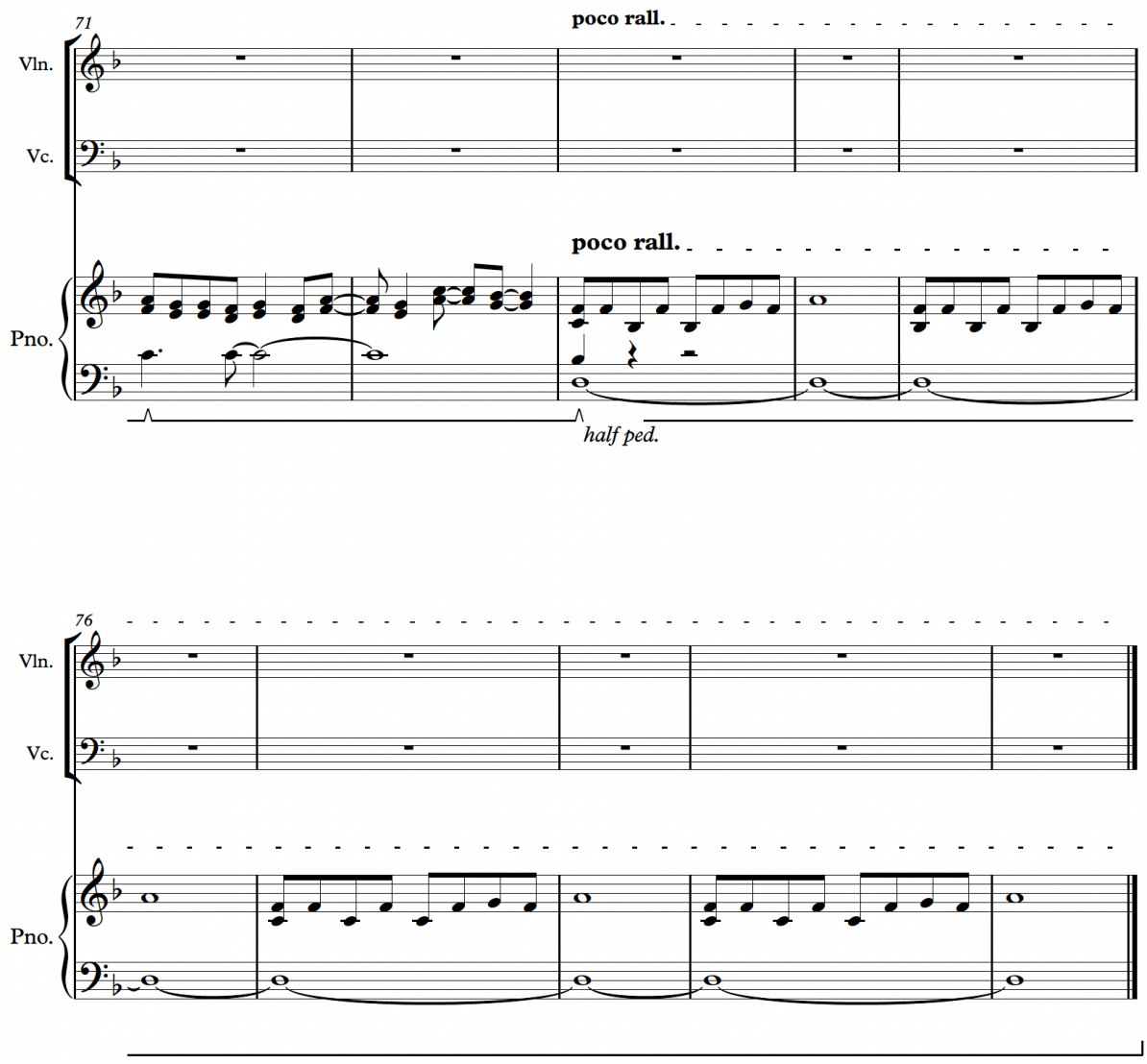


Figure 18: b. 71 to the end, *rallentando* over ostinato in *Three*

Intervallic and Contour Affect Theory

Intervals of power, approach and stability dominate the ostensibly cathartic and high-arousal movements of this work in order to support the intended emotive narrative. The musical content in these moments are dominated by perfect 4ths, 5ths and octaves, and are specifically highlighted through various textural, registral and dynamic choices.

As the tension builds in the work in figure A – the first intended cathartic movement of the piece (circa 0:25-0:55, from b.17), intervallic expansion is applied to the piano ostinato with

harmonic octave doublings, supported by continuous said doubling in the left-hand accompaniment.

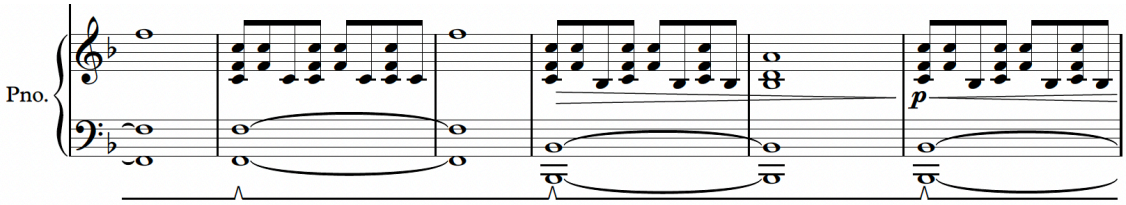


Figure 19: Piano b. 18–23, figure A octave use in the ostinato in *Three*

Bars 27 onwards aim to drop the arousal (tension) and encourage the listener back to calm. melodic contours are dominated by descent (only subverted occasionally to return the instrument to their optimum tessitura) – represent a falling of energy (rather than pessimism due to being paired with the major tonality of the excerpt). There is also a reduction of octave-doublings to neutralise the ostensible effect of power, and instead a prevalence of intervals of stability (4ths and 5ths) in both melodic and harmonic manners is used.

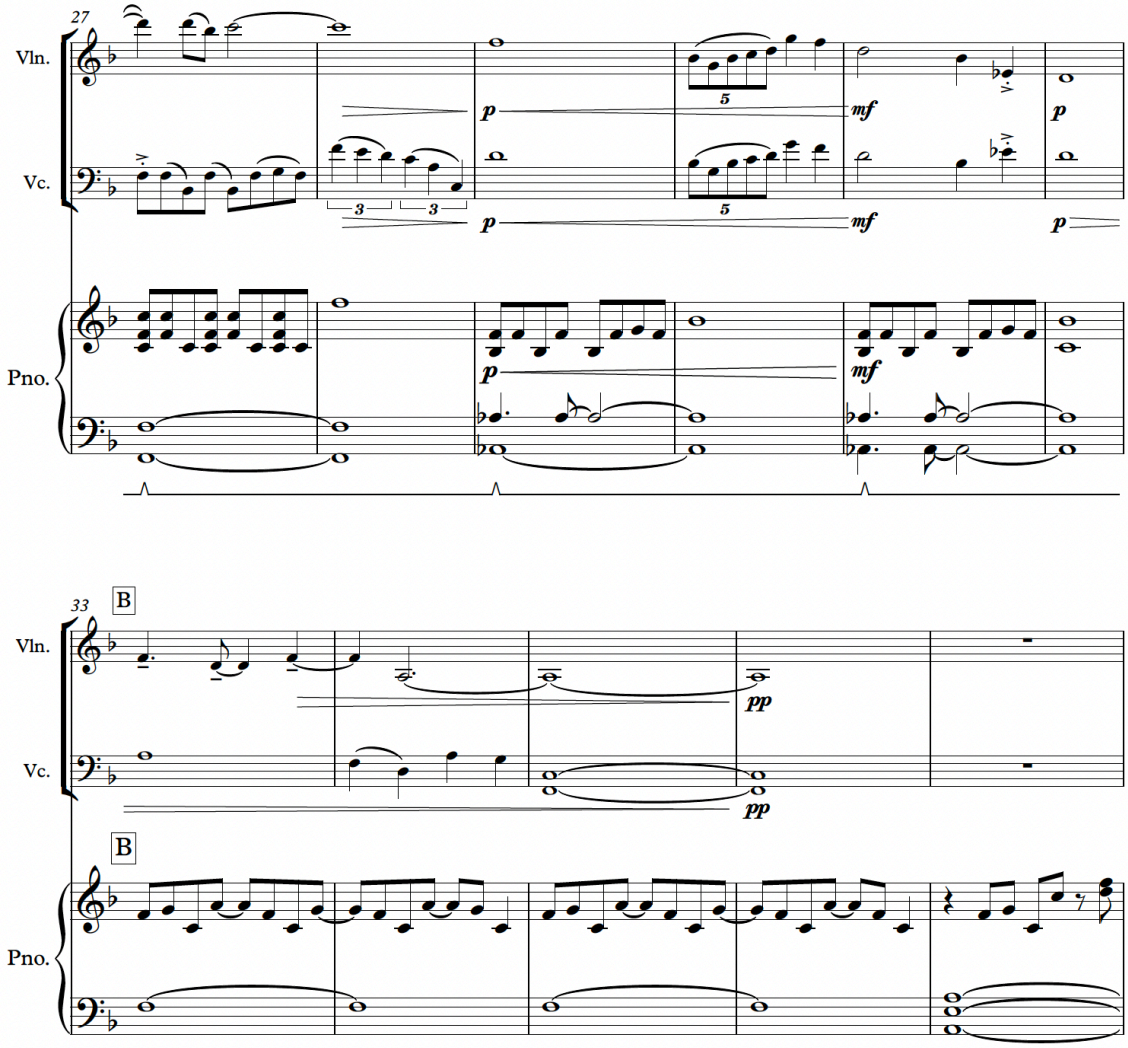


Figure 20: All instruments bb. 27–37 descending contours in *Three*

Emotional Contagion and Intervallic and Contour Affect Theory

The register and dynamic marked in the ascending melodic passage in b.24-26 in violin (paired with the portamento slide) marks the highest registral point of the piece so far, and takes effort from the player to achieve due to its residing beyond the player's average comfortable tessitura. This translates through the tone of the instrument, and can be likened to the human voice when attempting a high and loud vocal passage (note the violin's forte marking). The strain arising from a loud execution of this high note is intended to be emotionally contagious. The emotion that aims to be depicted is embedded in the tonal and intervallic content of the

passage: Major tonality suggests positivity (Gosselin et al., 2015), and major 3rds and perfect octaves suggest power, positivity, stability.

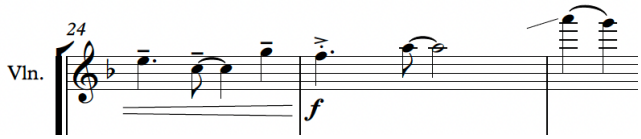


Figure 21: violin bb. 24–26, ascending melodic passage in *Three*

Musical Expectancy

In the later stages of this piece, Musical Expectancy through MAV is utilised to re-engage the potentially disengaged conscious listening of the participant. The use of the F minor chord in the figure below (the parallel minor to the key of the work) contradicts a listener's expectations. After the tonic key, listeners might expect another pre-dominant chord or dominant function chord, but this is subverted momentarily while still maintaining harmonic relevance through the retained tonic note and modally-altered tonic key.

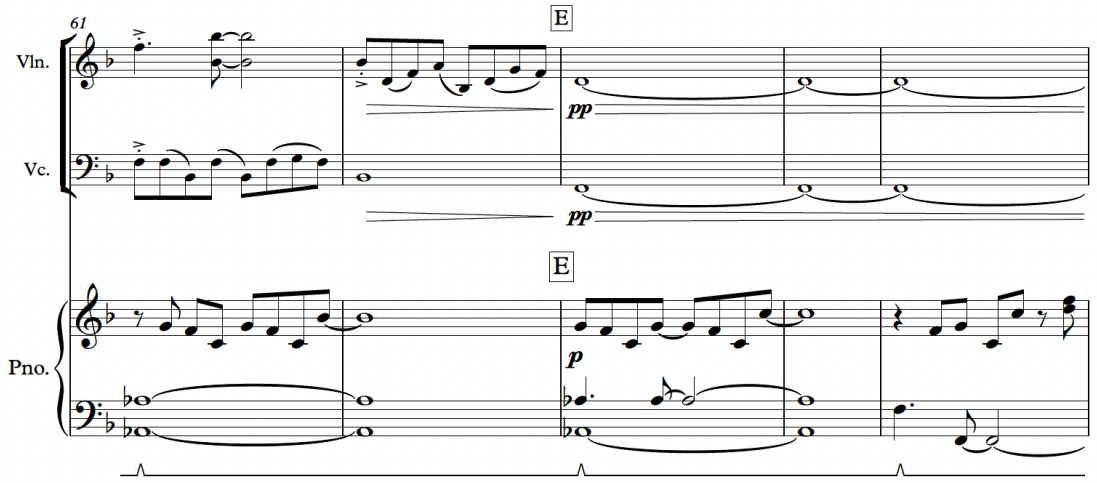


Figure 22: All instruments bb. 61–65 exhibition of F minor parallel minor to the tonic key in *Three*

2.5.4 *Four*

Whole track: catharsis	Overall: Happy (4/5), Excited (4/5)

This track aims to illicit a sense of catharsis throughout, building in arousal and ending only in the last moments of the work, at calm.

Rhythmic Unity

Like many works in this album, an ostinato is set up from the onset of the work that engages the listener into rhythmic unity. The tempo is set at 60bpm – within the range of the average resting heartrate of an adult (Vega, 2009), however the semiquaver subdivision challenges the perception of this pulse. The accent marked on every dotted crotchet beat aims to balance the semiquaver subdivision out, but it is expected that the two pulse suggestions are in constant competition. There is a certain energy to the piece created by said semiquavers which the end of the work aims to dissemble once the emotional journey has been had.

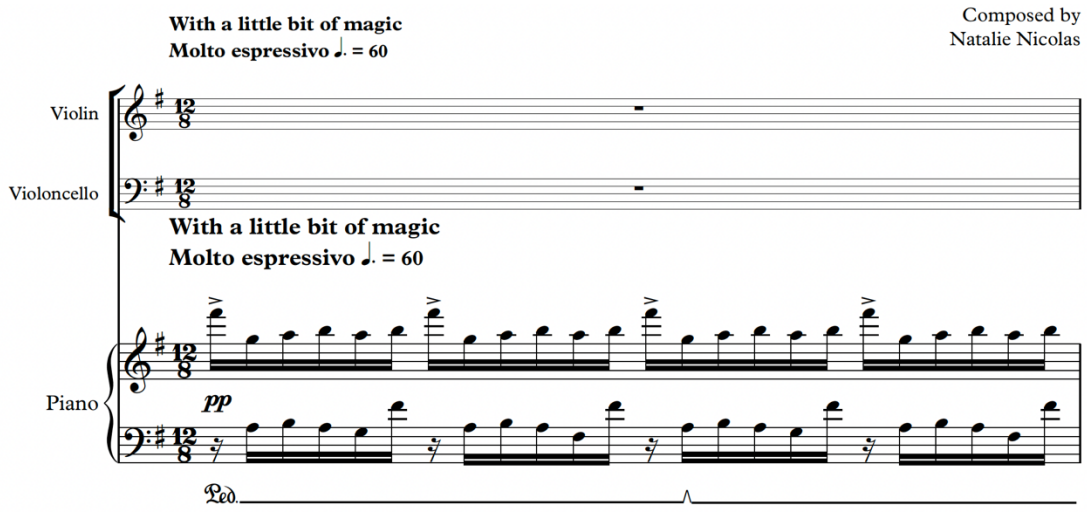


Figure 23: All instruments bb. 1 ostinato in piano *Four*

Rhythmic augmentation of the ostinato in the two bars of the end of the work aims to elicit a short moment of a slower pulse, and encourages the heartrate to slow into a calm, rested state, appropriate to the ending of the piece.

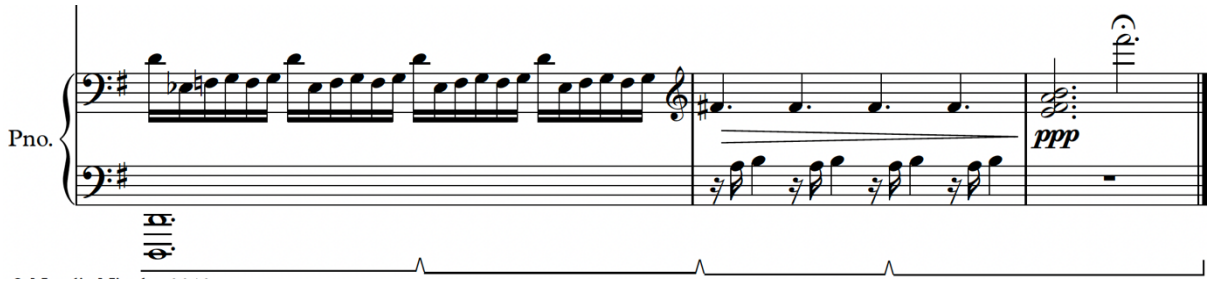


Figure 24: Piano ostinato, b. 28 to end, rhythmic augmentation *Four*

Musical Expectancy

The chord progressions used in this work deviate from common Western music traditions. The introduction of the ostinato in the piano (see above figure) utilises a chromatically descending pattern of chords. Bar 1 uses chord I (G major), b.2 then uses bVII (F major – modal interchange from G mixolydian), b.3 uses VII (F# major – spelt enharmonically here for the purposes of readability), and so on. This was selected as a non-diatonic chord progression to create harmonic interest, and therefore maintains the listener's attention throughout the work despite the continuity and simplicity of the rhythmic component of the ostinato (semiquavers).

Contour Affect Theory and Rhythmic Unity

This work utilises Contour Affect Theory in conjunction with Rhythmic Unity, particularly as a means of releasing tension momentarily to create space for further arousal build. For example at Letter E of the work, the tempo is reduced slightly (from 60bpm to 52bpm), and this is paired with a descent of contour in all parts to very slightly release emotion and arousal and create space for an increase shortly thereafter. The composer intended that the duration and intensity of the arousal was not quite enough to emanate calm, but just enough to create interest and opportunity for musical intensity.

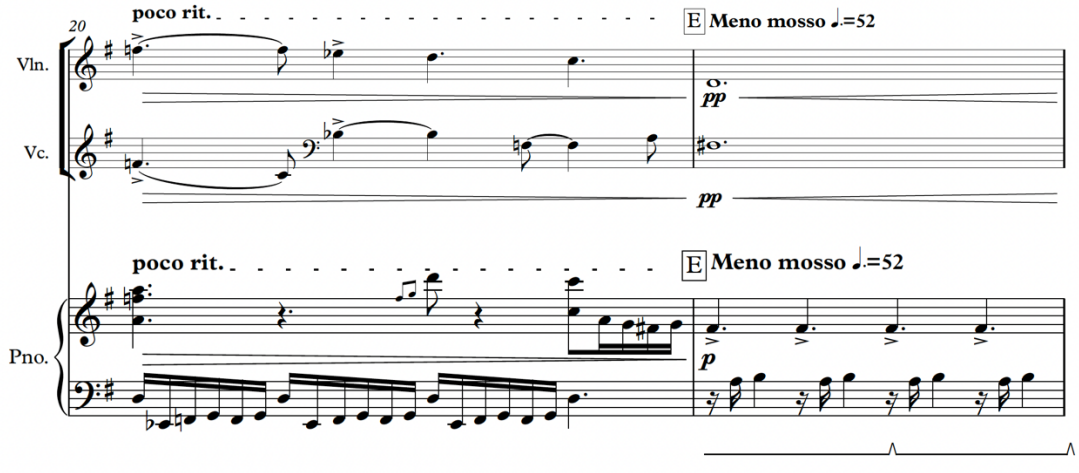


Figure 25: bb. 20–23 descending contours to figure E in *Four*

The cathartic nature of the work means that it aims to maintain arousal build to, almost, the end of the piece. Bars leading to the end of the work utilise an ascending melodic and harmonic contour with the aim of leaving the listener with a sense of optimism, expectancy, and positivity.

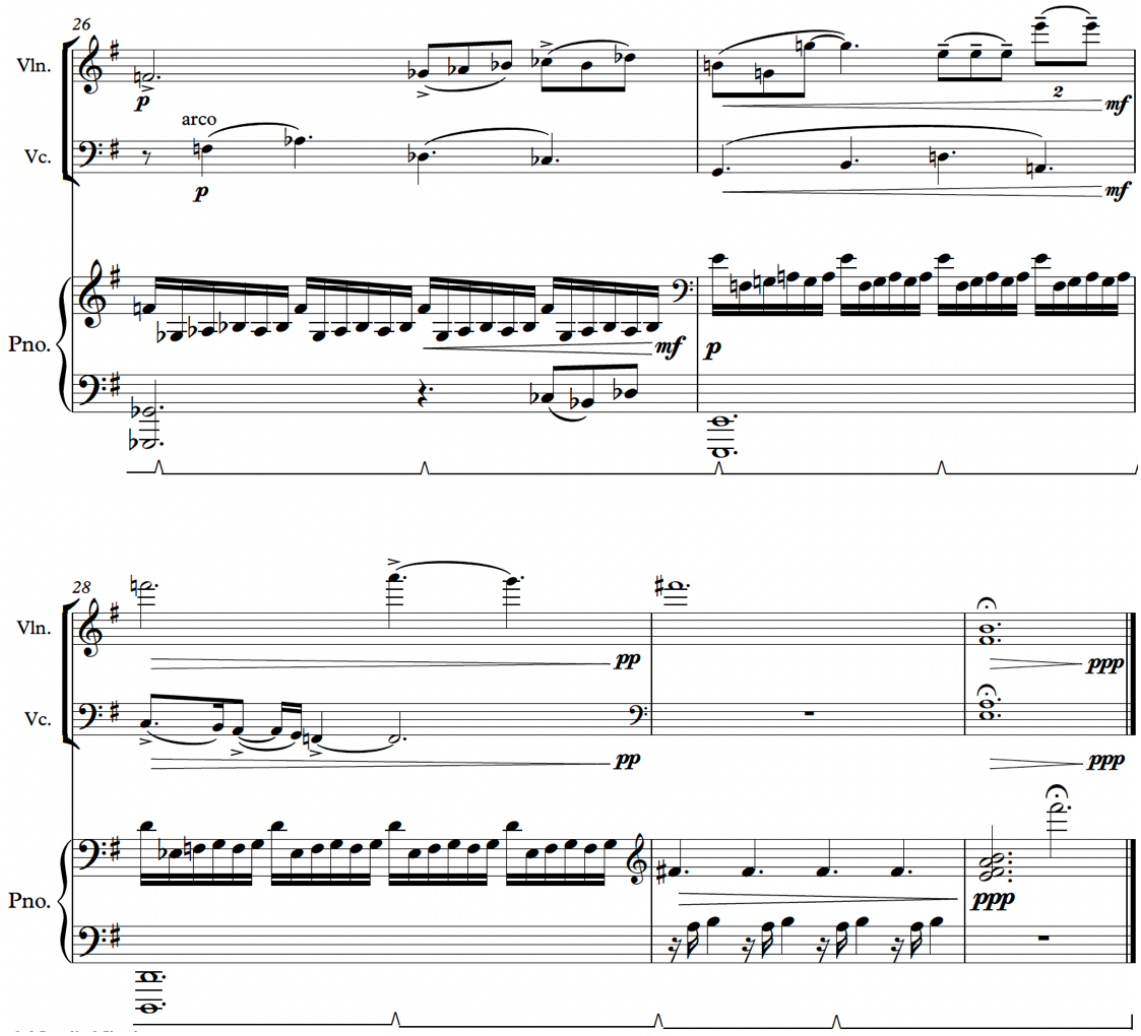


Figure 26: All instruments ascending contour in the conclusion of *Four*

Episodic Memory Recall

The harmonic progressions utilised in this work (as mentioned earlier), are drawn from those heard in whimsical, adolescent fairytale film music. Film music depicting fantasy and which is targeted towards children frequently utilises chordal movement that shifts in a stepwise motion (be it chromatically, diatonically, or through a whole-tone pattern). For example, Disney composer Alan Menken's scores for *Beauty and the Beast* (1991) often use a stepwise chord progression or voice-leading as a means of moving between unexpected chords. These movements can be observed in a piano arrangement of the *Beauty and the Beast Overture* that he wrote for the 2017 adaptation of the original film (Figure 27). Menken utilises mediant relationships to achieve common-note modulations in quick succession. This results in an

overall chord progression that is not diatonic, often uses stepwise motion from chord to chord, or stepwise voice-leading to prepare unexpected chords. Although *Four* does not utilise the mediant relationship to result in the stepwise chordal movement, the result is very similar.

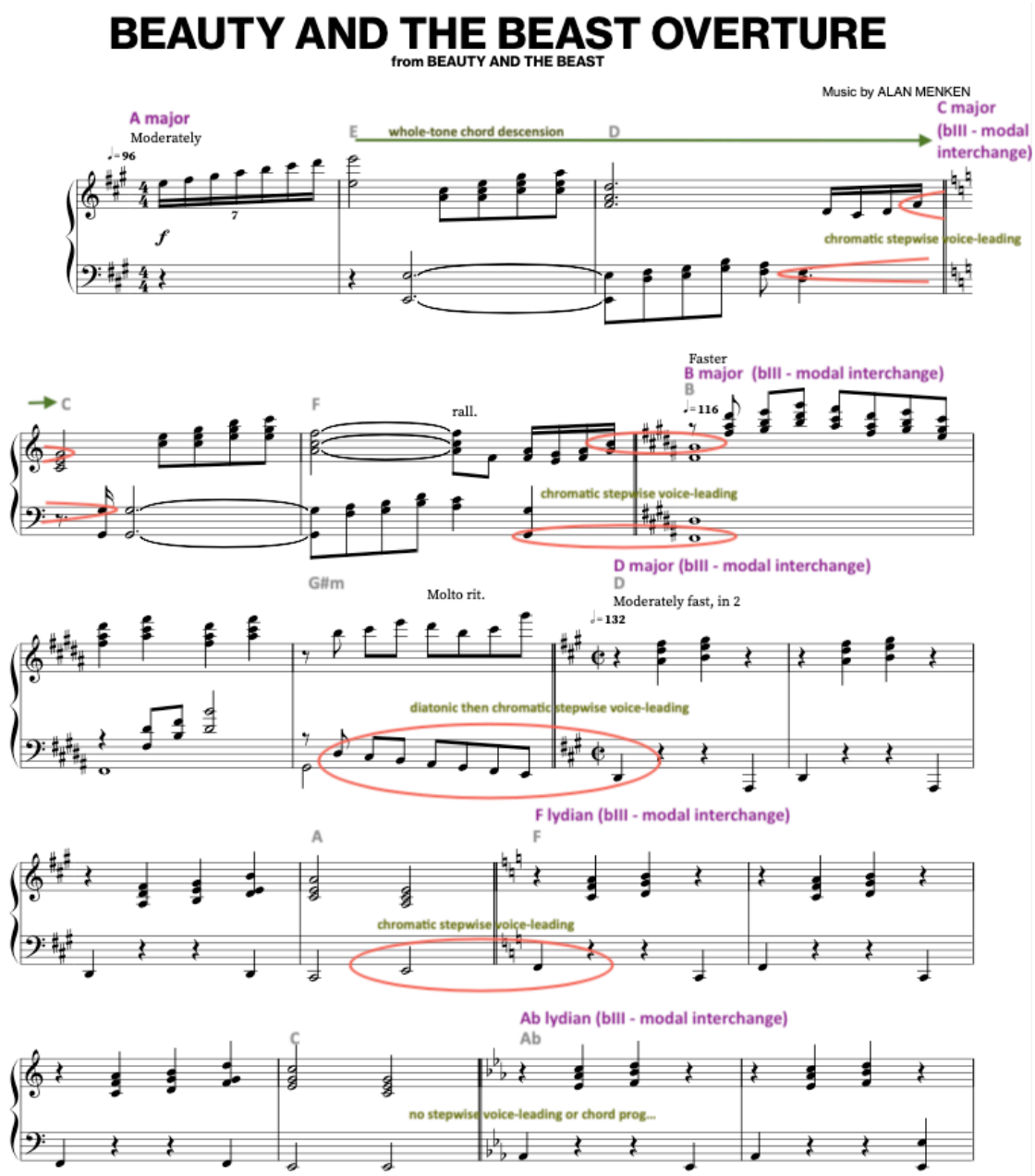


Figure 27: Piano arrangement of Alan Menken's *Beauty and the Beast Overture* using chromatic chordal movement (Menken & Leclere, 2017)

2.5.5 *Five*

0:00 to 0:37 calm	0:37 to 1:00 catharsis (building excitement)	1:00 – 1:43 calm	1:43-end catharsis (building away from excitement to calm)	Overall: Happy (4/5), Calm (2/5)

Five is a track that navigates calm and catharsis in four almost-evenly-sized movements (with aimed proportions of 42% cathartic content and 58% calm content). The two segments that aim to evoke a cathartic process do so in mirroring fashions: building up to a climactic moment, and building away from one. Although the final cathartic movement is less arousing than the initial cathartic movement, it continues to utilise similar musical content and rhythmic drive. This portion aims to relieve the arousal and begin to release tension, though not completely, remaining firmly still in the cathartic category.

Rhythmic Unity, Contour Affect Theory, and Musical Expectancy

Again, an ostinato underpins this work. It is established at the start of the piece and is pointedly rhythmically driven at a tempo of crotchet = 90bpm (within the range of the average resting heartrate of an adult (Vega, 2017)). This drive encourages a common periodicity lock-in with its listener's heartrates, engaging rhythmic unity to promote calm. Throughout the work, small aberrations to the ostinato pattern (ornamentations) aim to ensure the listener is kept engaged with the musical material through MAV, whilst remaining in entrainment with the pulse of the ostinato (see b. 3 beat 3–4 semiquavers (where otherwise we would normally have a held dotted crotchet or dotted crotchet rest)). In a similar fashion, the contradiction of Musical Expectancy is utilised throughout the work through intermittent, small harmonic shifts that are atypical to their classical-ballad-pop stylisation (see bb. 3–5 bassline of the piano

part — F sharp, F natural, and E accompanying a D major, D minor and E major chord progression). Ordinarily, the confirmation or contradiction of Musical Expectancy is used in this album in a way that affects arousal: the confirmation releasing arousal, and the contradiction building arousal.

Adjacent to the ostinato, the melodic material of the first movement is dominated by descending contours (with the occasional ascent to return the instrument to an appropriate tessitura). This is to depict emotional deactivation and a falling of energy – paralleling the arousal narrative of the section. In a similar fashion, as the music leads to the first ostensibly cathartic movement, the melodic material is dominated by ascensions – aiming to activate and pick up spirits.

In bb. 18–22, leading into the first cathartic movement of the work, the left hand of the piano ostinato is altered gradually through rhythmic diminution. The diminution aims to create a suggestion of a tempo increase without an actual bpm change, and the rhythms utilised here are considerably syncopated – a device that significantly assists in engagement with sensorimotor synchronisation and hence Rhythmic Unity. Paired with these devices is again, the contradiction of Musical Expectancy in a rhythmic fashion (with the sudden use of a 2/4 bar, leaving the pattern short of two beats). The variation of the diminished accompaniment maintains listeners' attention through MAV, and the combination of these techniques from the CTEE aims to build arousal and engagement leading into the cathartic section to follow. The

remainder of the piece utilises these tools in a similar fashion.

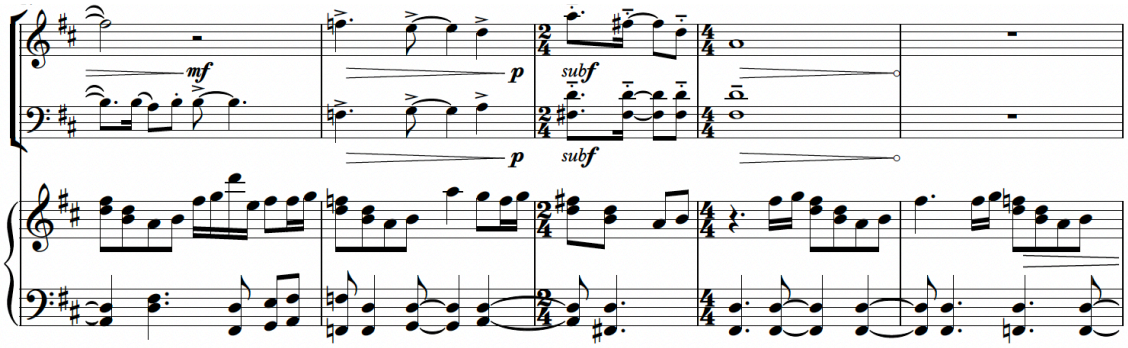


Figure 28: bb. 17–21 rhythmically diminished ostinato and 2/4 bar in *Five*

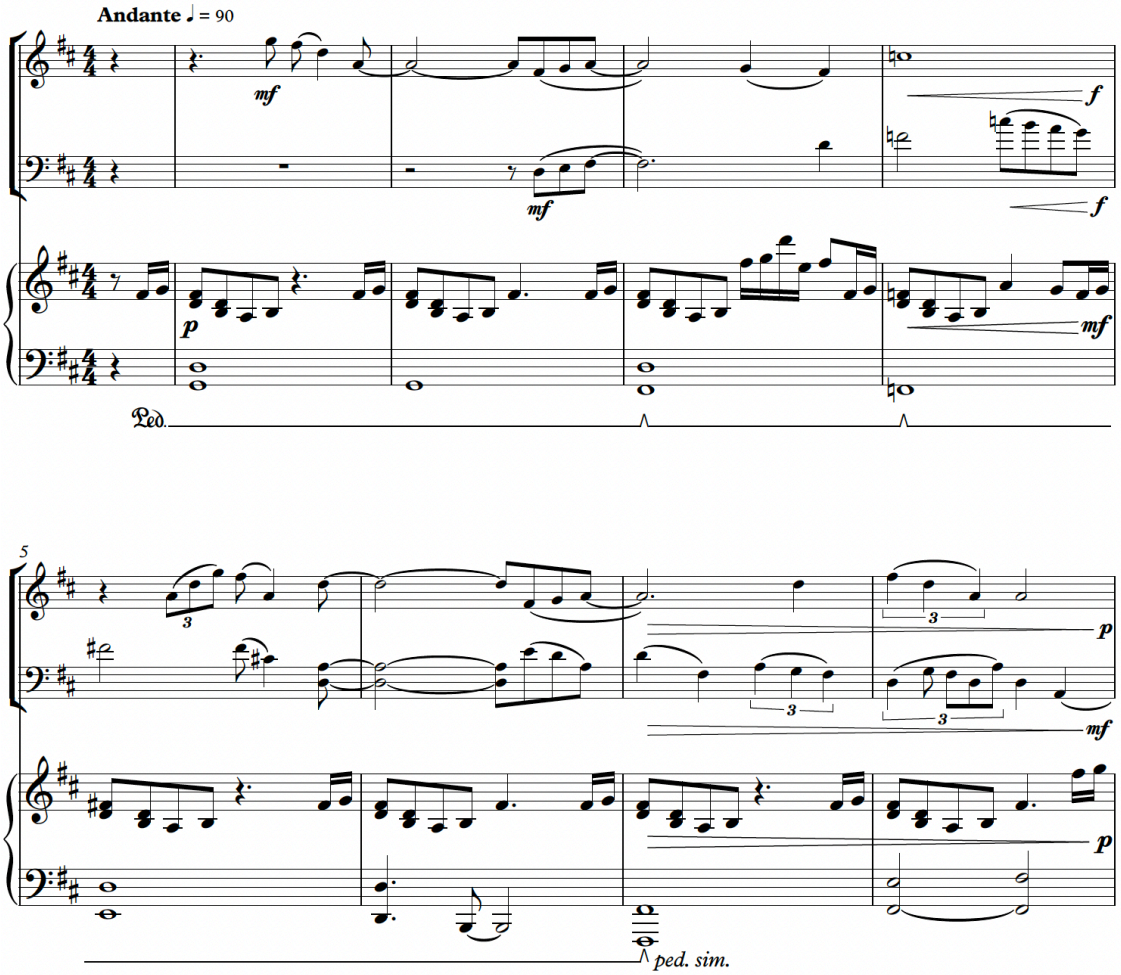


Figure 29: Ostinato in piano, and descending melodic material in strings, in the opening of *Five*

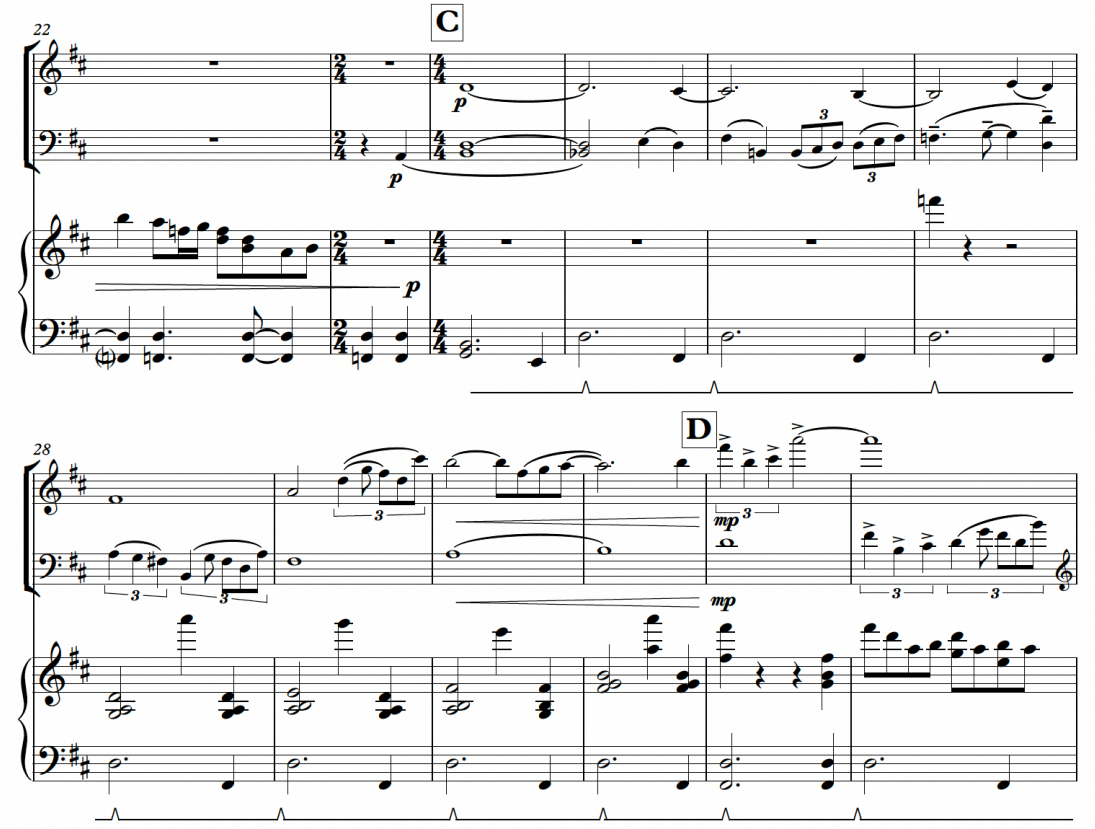


Figure 30: Ascending melodic material in cathartic movement of *Five*

Intervallic and Contour Affect Theory

Pointed use of stable perfect 4ths and 5ths, and major intervals in standout moments of melody in the work, aim to stabilise the emotional content of the piece. This is especially apparent in the early movement, such as in the strings in b. 5. Again, this section is aiming for calm, stability, and minimal tension. Intervals of stability and power emphasise this tension contour and major intervals allude to positivity, in order to parallel the emotional arousal journey of the work.

Rhythmic Unity

In stark contrast to the rest of the work and the diminution of the earlier material, figure C now significantly augments the rhythms of the ostinato. This aims to lead to a perception of an almost half-time tempo and allows the listeners' heartrate to slow through entrainment.

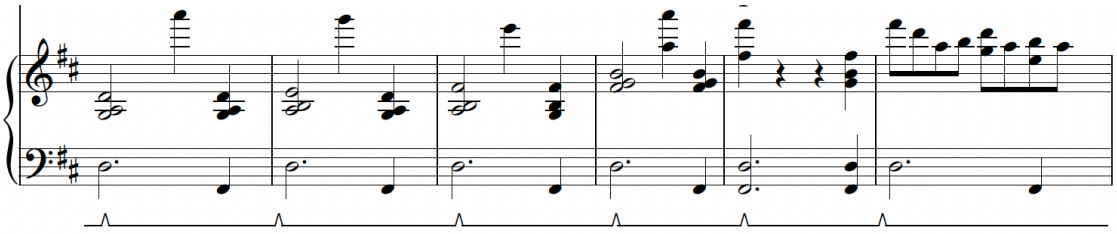


Figure 31: Piano figure C ostinato rhythmic augmentation in *Five*

Finally, the textural sparsity of the conclusion (piano solo) gives emphasis to the material that remains. The piano plays a developed version of the ostinato, with shimmering, high-pitched semiquavers and contrasting long notes in the left hand. The piece temporally slows to the end through a ritenuto, and the use of the rhythmically driven ostinato in conjunction with the ritenuto aims to slow the listener's heartbeat to a state of calm. The end of the work rounds out the cathartic middle, aiming to leave the listener relaxed and emotionally purged.

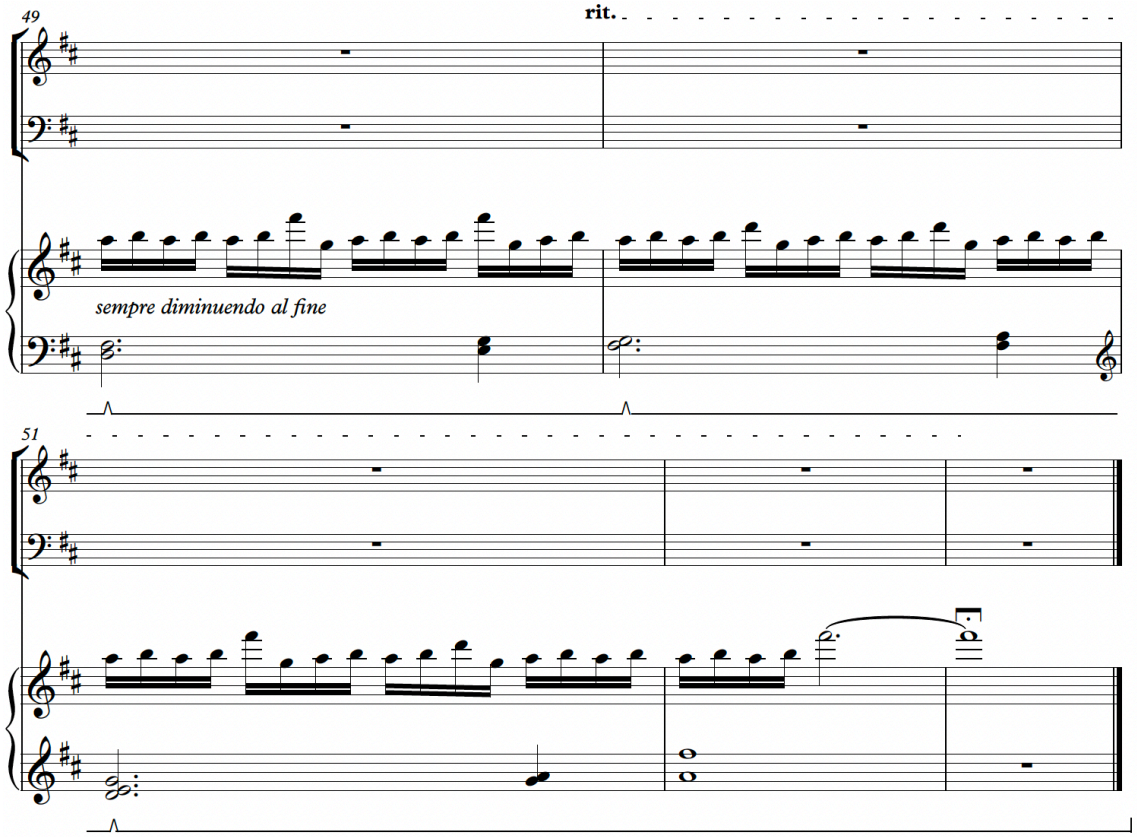


Figure 32: All instruments bb. 48–end, outro ostinato material in *Five*

2.5.6 *Six*

Whole track: calm	Overall: Happy (4/5), Very Calm (1/5)

Rhythmic Unity, Intervallic Affect Theory:

This work aims to be the calmest of the album. Again, like most of the pieces in the Wellness Project album, this piece utilises an ostinato that entrains the listener into the pulse. The pulse of this work is 66 bpm – again within the range of the average resting heartrate of an adult (Vega, 2017). The textural sparsity of the opening aims to draw the listener's attention to the ostinato, optimising heartrate entrainment.

Intervals of power and stability intentionally frequent the ostinato particularly in the left hand of the piano in harmony. Here, we see the exclusive use of perfect 4ths and 5ths. This aims to strategically establish a sense of certainty and stability from the onset of the work. It is surmised that stability is associated with low arousal, and henceforth calm.

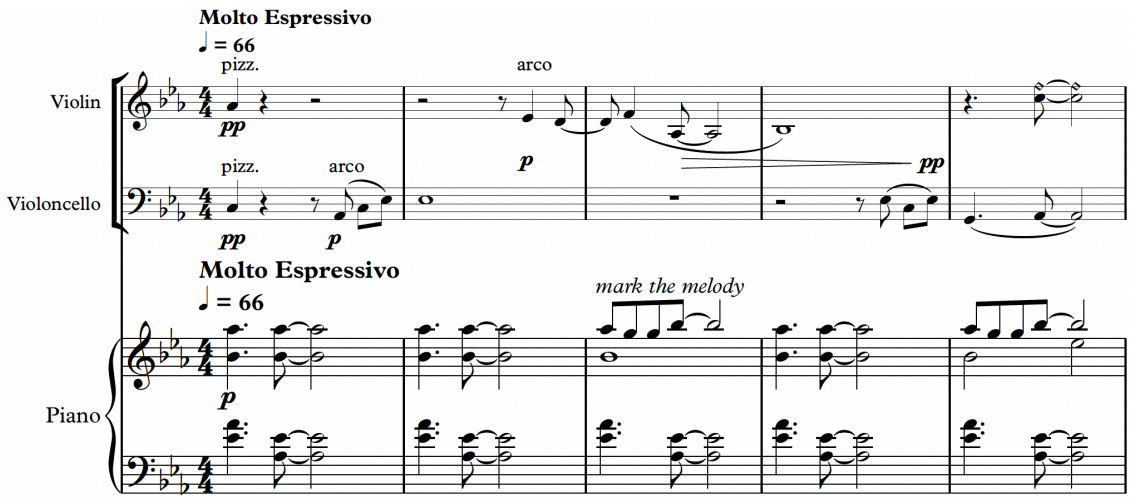


Figure 33: Ostinato in piano, opening of *Six*

Musical Expectancy

Although the piece is in E flat major, it utilises the occasional flat third (G flat) in lines of the melody and the G flat major chord in the harmony to subvert the listener's expectations and

encourage attentive, active listening. This is deemed necessary in this work as due to the ostensibly calm musical content, the piece is relatively sparse and un-ornamented.

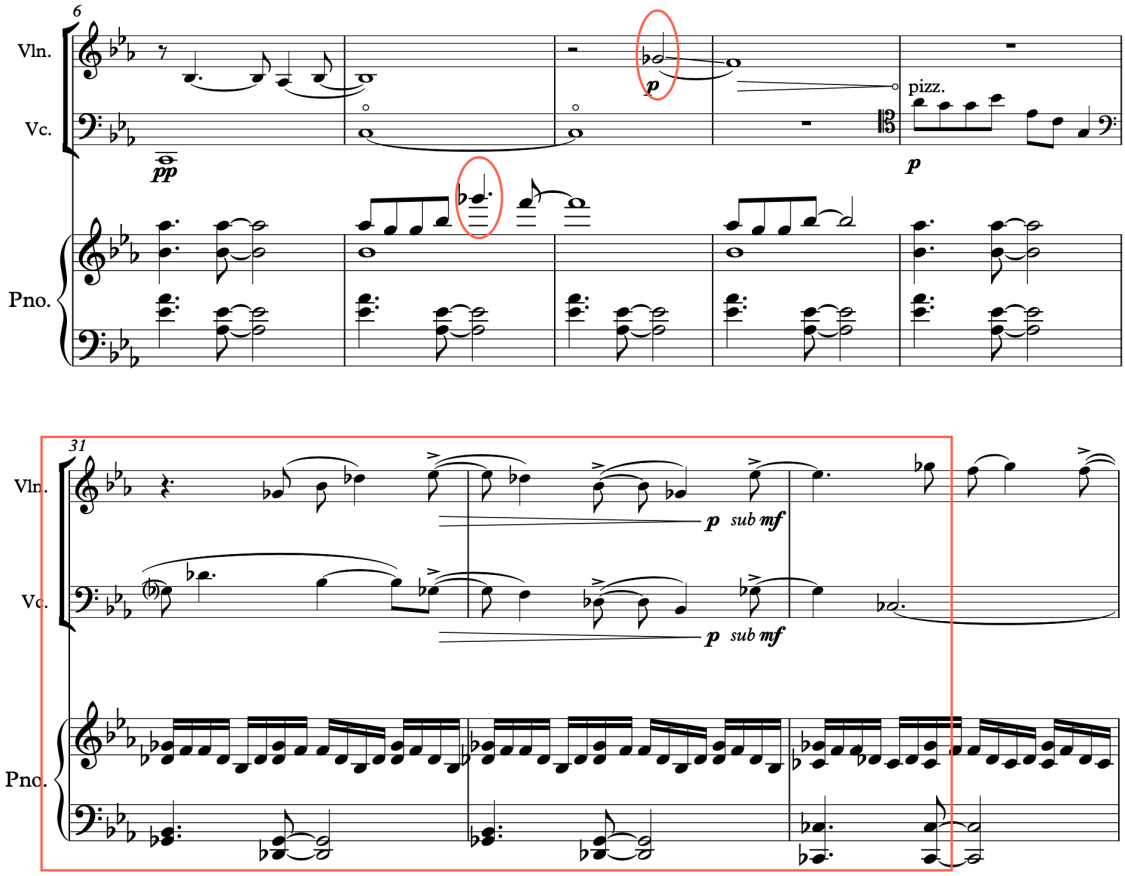


Figure 34: Various use of G flat and G flat major in *Six*

As the piece evolves, the harmony shifts to a short modulation to G flat major. It is a direct modulation without pivots, interchanges or substitutions. Such modulations aim to subvert the listener's expectations and produce a shift in the energy and arousal component of the piece. This happens again at the climax of the work at Letter C, where the piece reverts to the original key of E flat major. Although the modulations affect arousal, it should be noted that it is not so drastically so, as to change the overall effect of the music (a generally calming piece). The contradiction of Musical Expectancy here aims to function in a way to renew listener interest at key moments in the work through minor increases in arousal (MAV). This is paralleled by the rhythmic diminution of the ostinato. Ordinarily, the diminutions would

typically begin to trigger a lift in energy (arousal). However, when accompanied with the long notes in the LH of the piano (and in strings), such diminutions continue to entrain with the listener due to the prominence of the rhythmic pattern without encouraging heightened excitement. In this way, the Rhythmic Unity mechanism is used not to change arousal levels, but create interest and maintain listener attention.

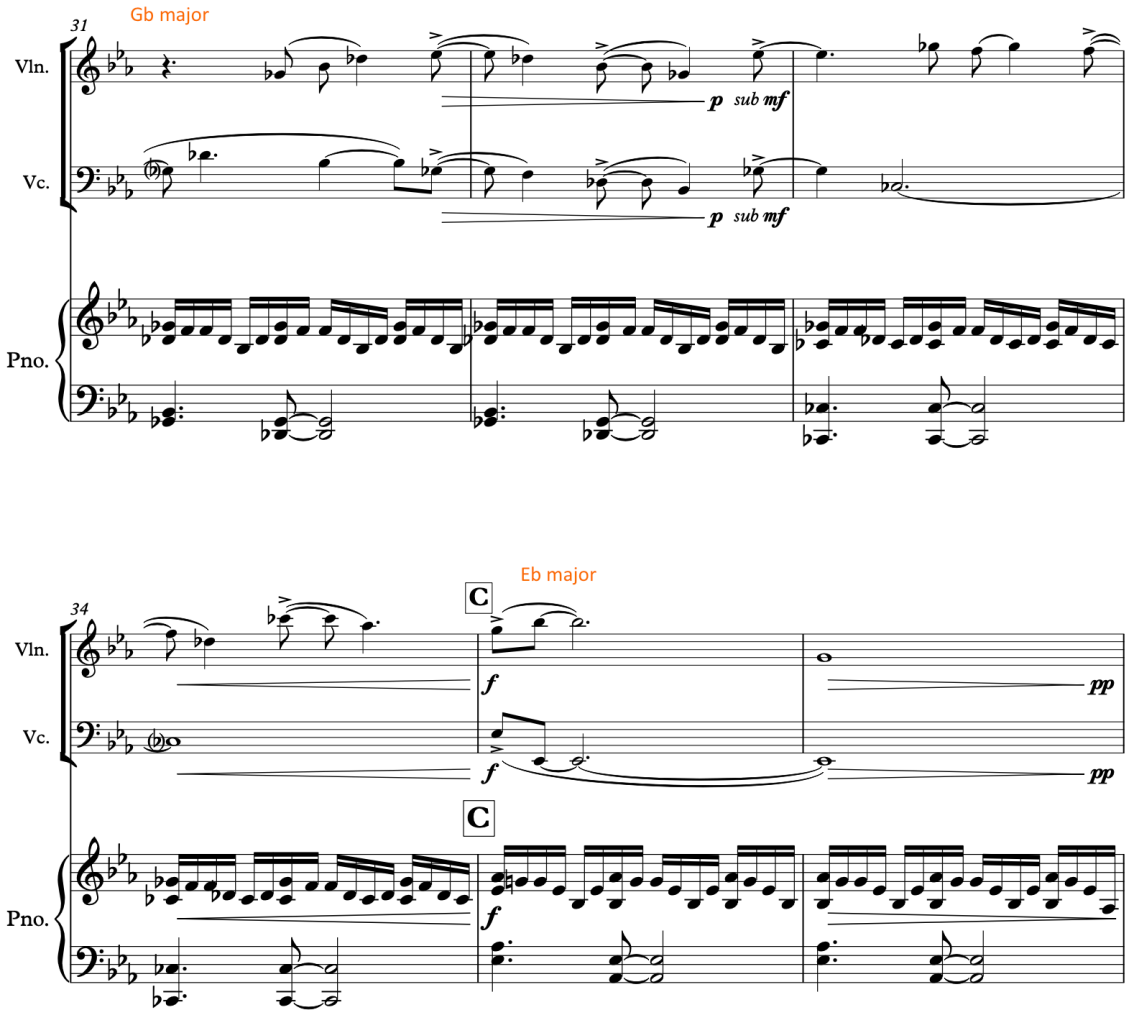


Figure 35: bb. 31–36 modulation to G flat major in *Six*

Rhythmic Unity

Much like *Five*, the end of this work uses a sparse texture and a rhythmic augmentation of the ostinato. It also utilises a *ritardando*, meaning the work literally slows in pulse, but also seems

to slow even further due to said augmentation. This aims to reinforce and extend upon the sense of calm that the piece has explored, ending with a definitively calm arousal portrayal.

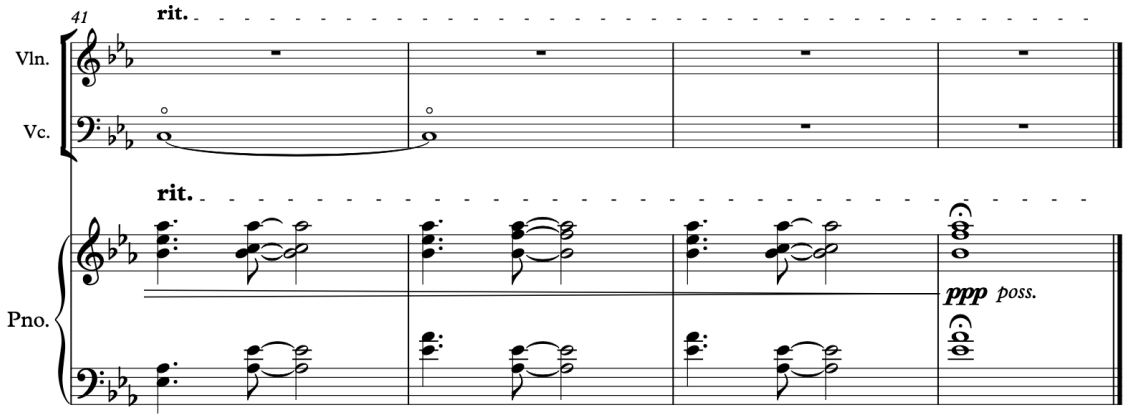


Figure 36: Ending of *Six*

2.5.7 *Seven*

0:00-1:07 calm (building incrementally to catharsis)	1:07-2:00 catharsis	2:00-2:25 calm (calmer than first movement)	Overall: Happy (4/5), Calm (2/5)

This track aims to predominantly evoke calm, with only circa 36% of the work deemed to evoke catharsis. It utilises a quasi-ternary form, with repeating musical material in both ostensibly calm movements.

Rhythmic Unity

As the other pieces in the album have also done, this work starts with a rhythmically driven ostinato. It is underpinned by a syncopated rhythm, and is played at 126 bpm however, due to the left-hand note lengths, the pulse effects 63bpm, which is within the range of the average resting heartrate of an adult (Vega, 2017). This invites entrainment with the listener's pulse. Also again, the texture of the opening is sparse to promote listener focus on the ostinato.

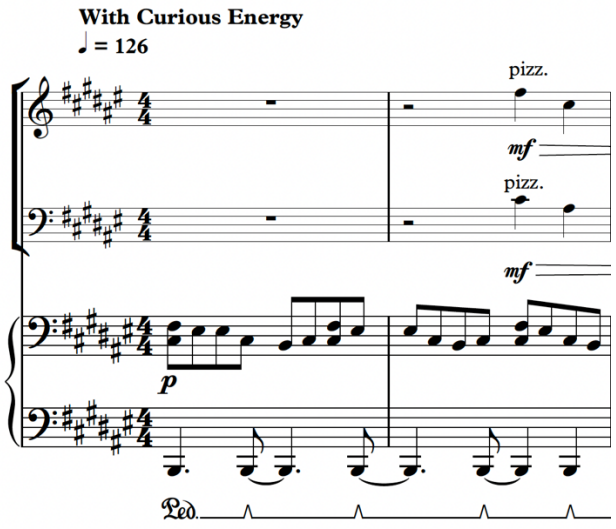


Figure 37: All instruments, bb. 1–3, ostinato in opening of *Seven* with sparse texture

Musical Expectancy

This piece, similarly to the others, uses harmonic shifts that subvert the listeners' expectations, as a means of utilising Musical Expectancy through MAV. In the below excerpt, the piece is in F sharp major (dominant), but here moves to E major, which is a tertiary dominant to the C sharp major chord of the bar before – a diatonic chord of the F sharp major key. The harmonic shift is unexpected (uncommon in Western harmonic conventions). This variable triggered by contradicting musical expectancy aims to help keep the listener engaged with the work. These sorts of shifts are typical in this piece (see also figure 39, shift from E major to G major — the flat Picardy third/mediant).

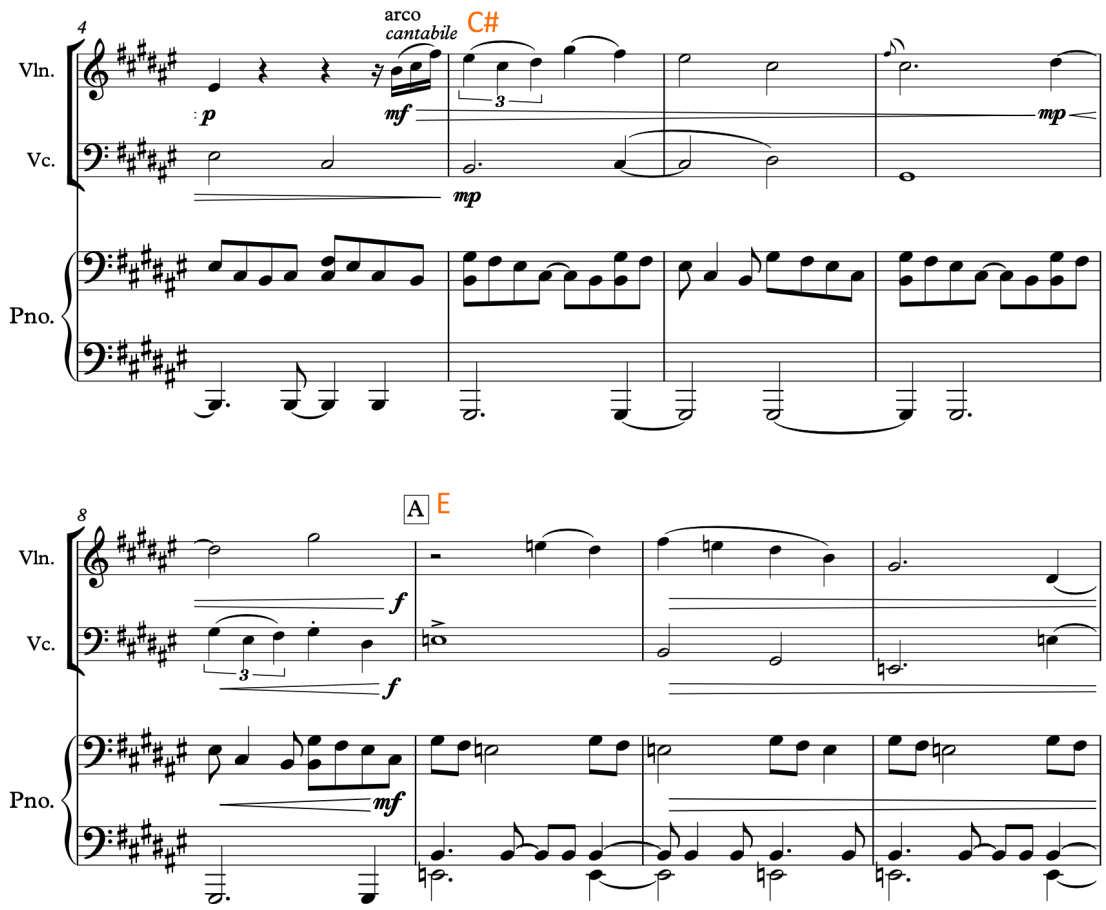


Figure 38: All instruments bb. 5–14, harmonic shift at A in *Seven*

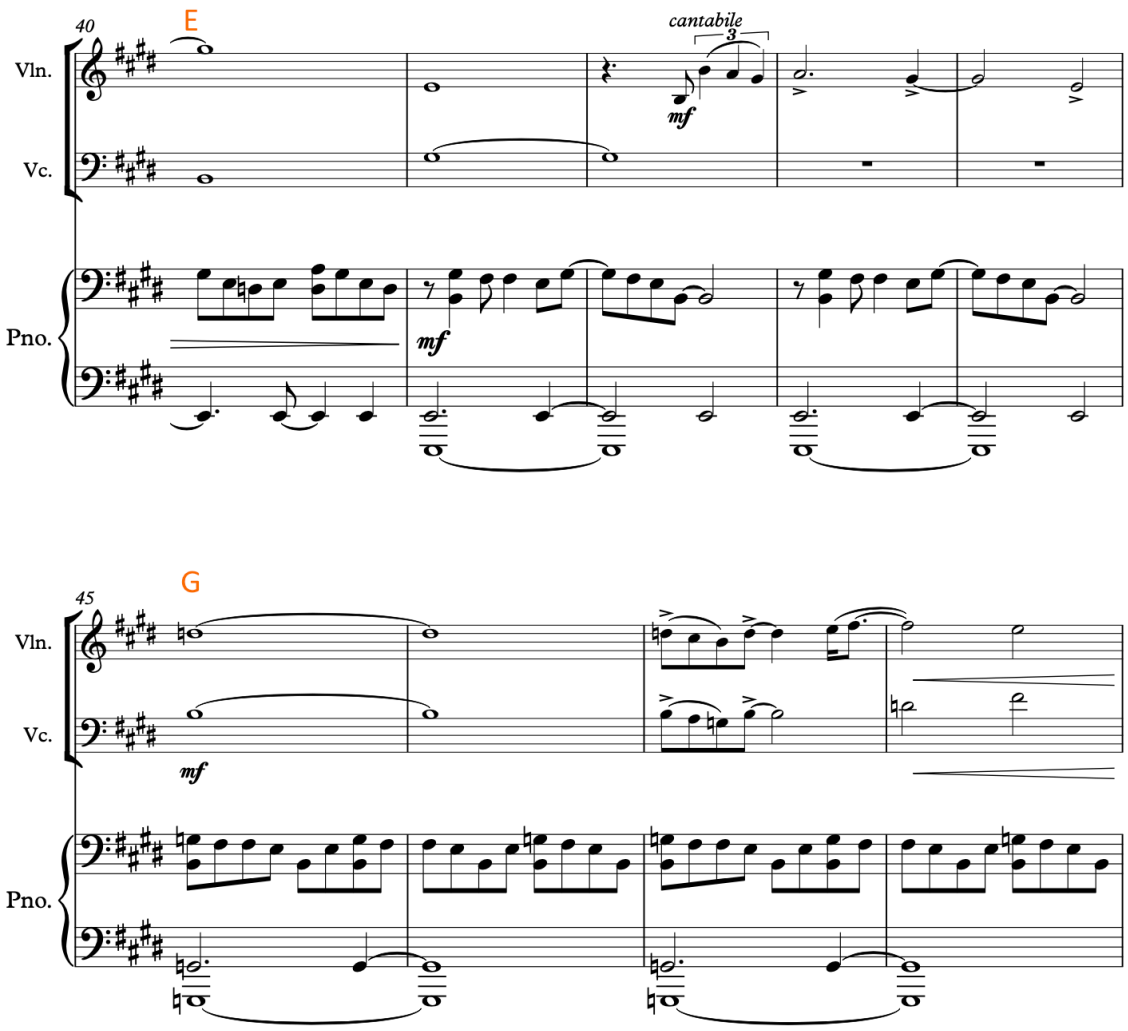


Figure 39: All instruments bb. 44–46 harmonic shift in *Seven*

Contour Affect Theory and Musical Expectancy

At Letter B, the work aims to deactivate arousal momentarily through a generally descending contour in the melody and ostinato development. This is to foreshadow the forthcoming section. Section C encompasses what is aimed to depict an almost mournful, specifically nostalgic musical palette (although not one that affects arousal, but rather pleasure – if just for a short moment). Section B also depicts a modulation to the dominant key (C sharp mixolydian – modal variation of the major dominant), which aims to maintain a listener's attention through the harmonic shift.

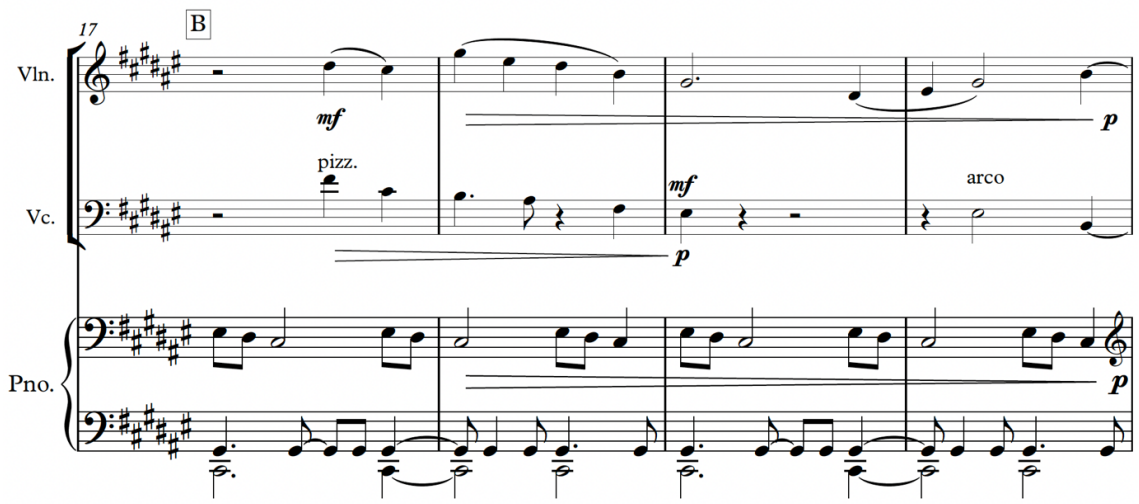


Figure 40: Descending contours and modulation to C sharp mixolydian in *Seven*

Musical Expectancy and Historical Association

After the release of energy of Letter B, the work engages with a series of chord shifts to gradually modulate to a minor key at C. At C, we are in E minor (the relative minor of the C# mixolydian (major mode) modulation in B).

Minor keys can evoke sadness, nostalgia, longing, and in the context of this work aims to do just that. The premise is that by provoking a sad nostalgia, there is the creation of room to lift the listener's pleasure profile to happiness in the successive section of the work. This is the first piece of the album that utilises minor tonality as a means of encouraging the purging of specifically sad emotions. Despite all pieces of the album aiming to overall evoke happiness by the end of their musical journey, this particular work delves into alternate affect territory to get there.

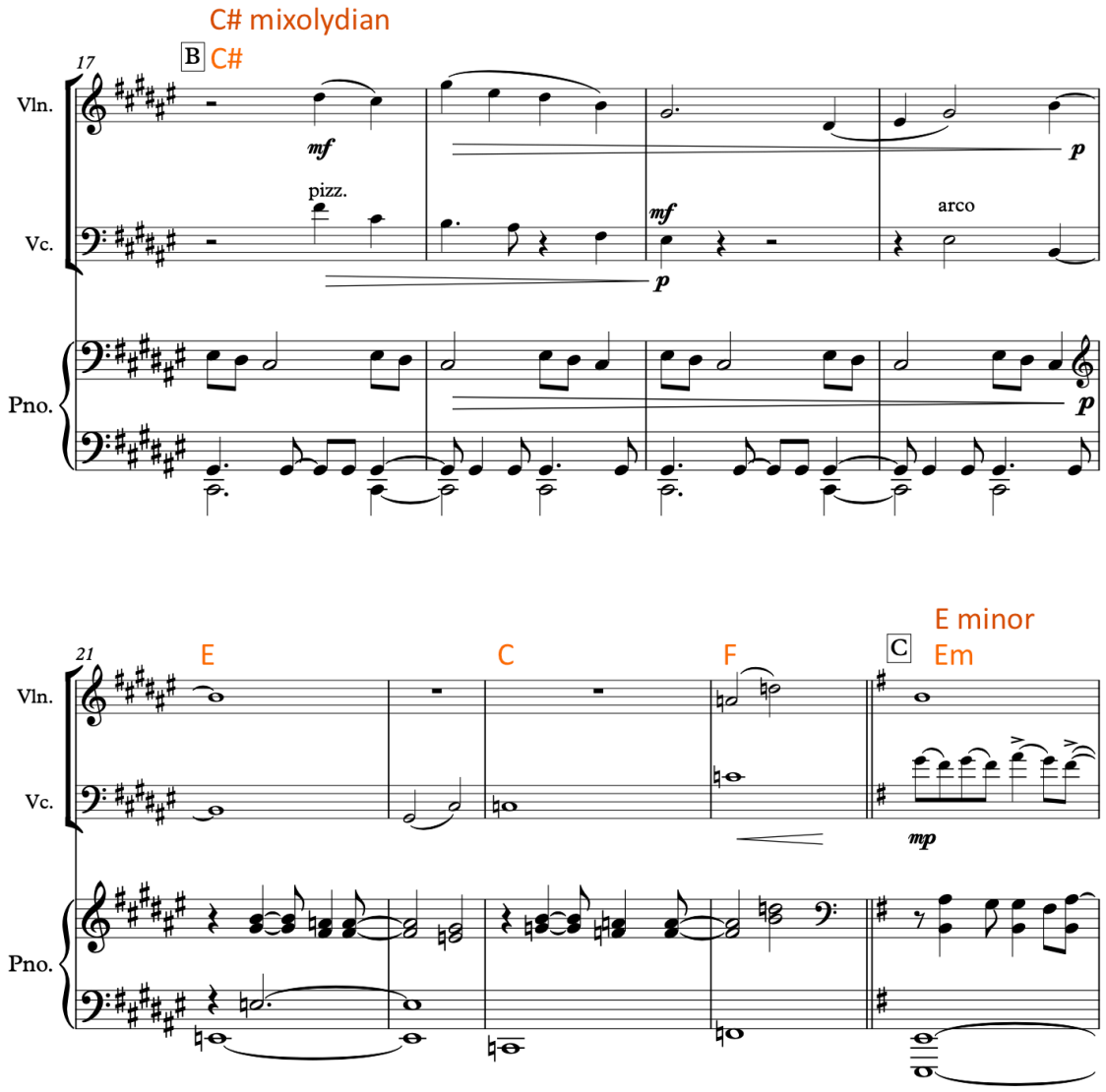


Figure 41: bb. 21–25, modulation to minor key in *Seven*

Musical Expectancy

Letter D brings a final modulation in the work. After a brief 11 bar minor harmonic palette, the piece lands firmly in E mixolydian: a key that listeners might now consider familiar via its use as a tertiary dominant established earlier in the work. The major modality releases the darkness and nostalgia of section C and aims to contrast the emotional palette with catharsis and positivity. The positivity is evoked through the tonality, and the catharsis is through the diminution of the right-hand of the ostinato in the piano again (that actually results in its depiction in prime form), to evoke a faster pulse. This key and pattern remains for much of the duration of the work.

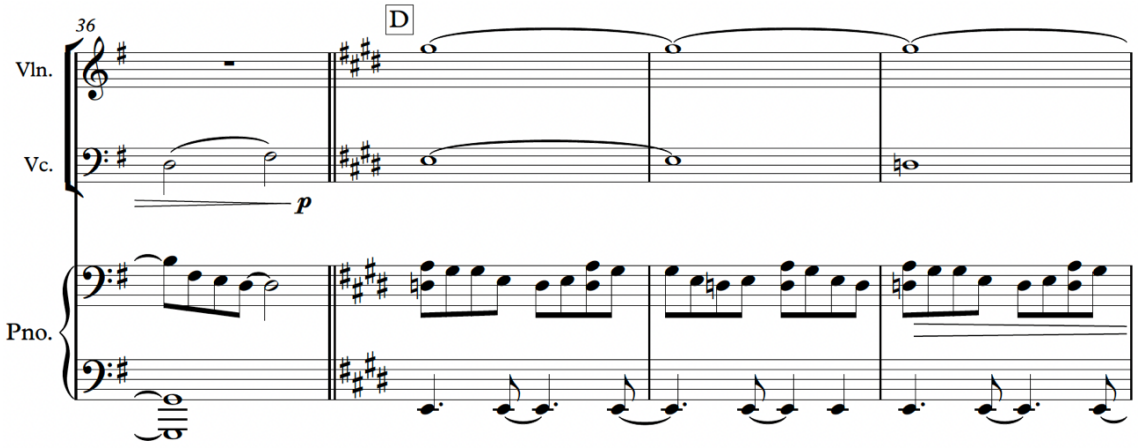


Figure 42: bb. 36–39, modulation to E mixolydian in *Seven*

Rhythmic Unity

Rhythmically augmented developments of the ostinato frequent the end of all the pieces on this album, and this piece is no exception. This gives the illusion of a slower tempo, highlighted by the sparse texture of the work. The end of the work employs a ritenuto which then quite literally slows the piece down, aiming to slow a listener's heartrate via a common periodicity that was entrained from the onset of the work, and end arousal state in calmness.

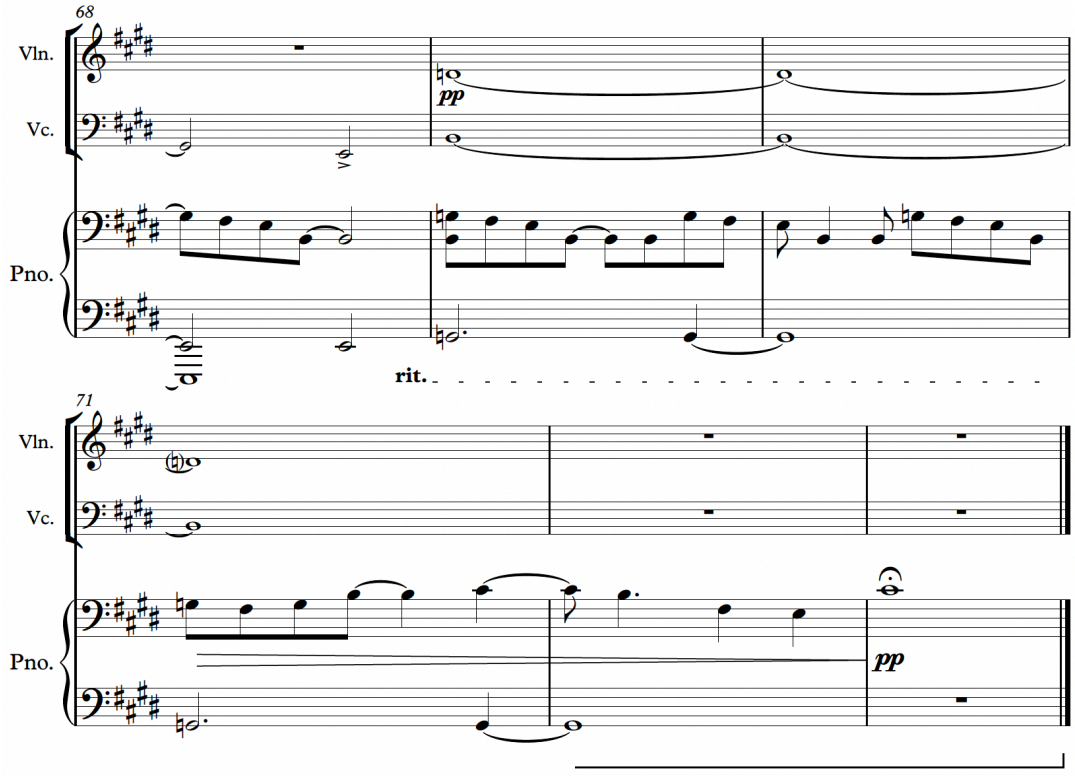


Figure 43: bb. 68 to end, augmented ostinato and slowing pulse in Seven

2.5.8 *Eight*

Whole track: Catharsis	Overall: Happy (4/5), Excited (4/5)

Eight builds arousal incrementally throughout. It utilises a series of small climactic moments that immediately drop tension thereafter as a means of creating space for further arousal build. Overall, the tension (arousal) journey is a steady ascent, with a short, comparatively released moment right at the end of the work. Because of the prevalence of arousal build in the main body of the work, the final release is comparatively calm against the previous material, but not released enough to be deemed a calm movement were it to stand alone.

Rhythmic Unity

The bpm of this work is set at 120. However the primary beat division of crotchets and crotchets followed by crotchet rests (resulting in a minim feel) in the strings encourages perception of a 60 bpm pulse (again, within the resting heartrate range of an adult (Vega, 2017)). This is underpinned by an ostinato in the piano that aims to helps engage the listener into a common periodicity.

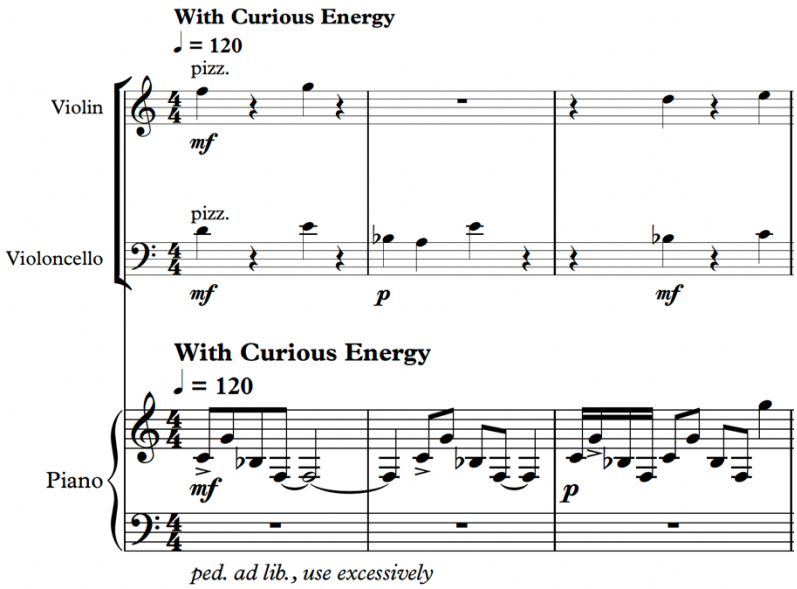


Figure 44: Opening of *Eight*

Rhythmic Unity, Intervallic and Contour Affect Theory, and Musical Expectancy

By Letter A – the start of the second quarter of the piece – the work is markedly aiming to evoke a higher sense of arousal. The contour of the pitches in the strings at Letter A rises, and this is accompanied by a crescendo to forte. The ostinato in the piano is now rhythmically diminished, promoting the feel of a faster pulse and more rhythmic drive.

The first climax of the work appears at b. 14. This is articulated by the intentional use of intervals of power (octaves) in the piano left hand to strengthen the arousal of this moment. This climax represents the loudest point of the work so far. To emphasise the drop of tension away from this climactic point, the softest part of the work is introduced (*ppp*) to contrast, aiming to contradict a listener's expectations and renew their interest in the piece (the dynamics are not linear as may be expected), while creating space for continuing tension and arousal build. To complement this, the registral content of the music here is the lowest it has been in the string instruments so far.

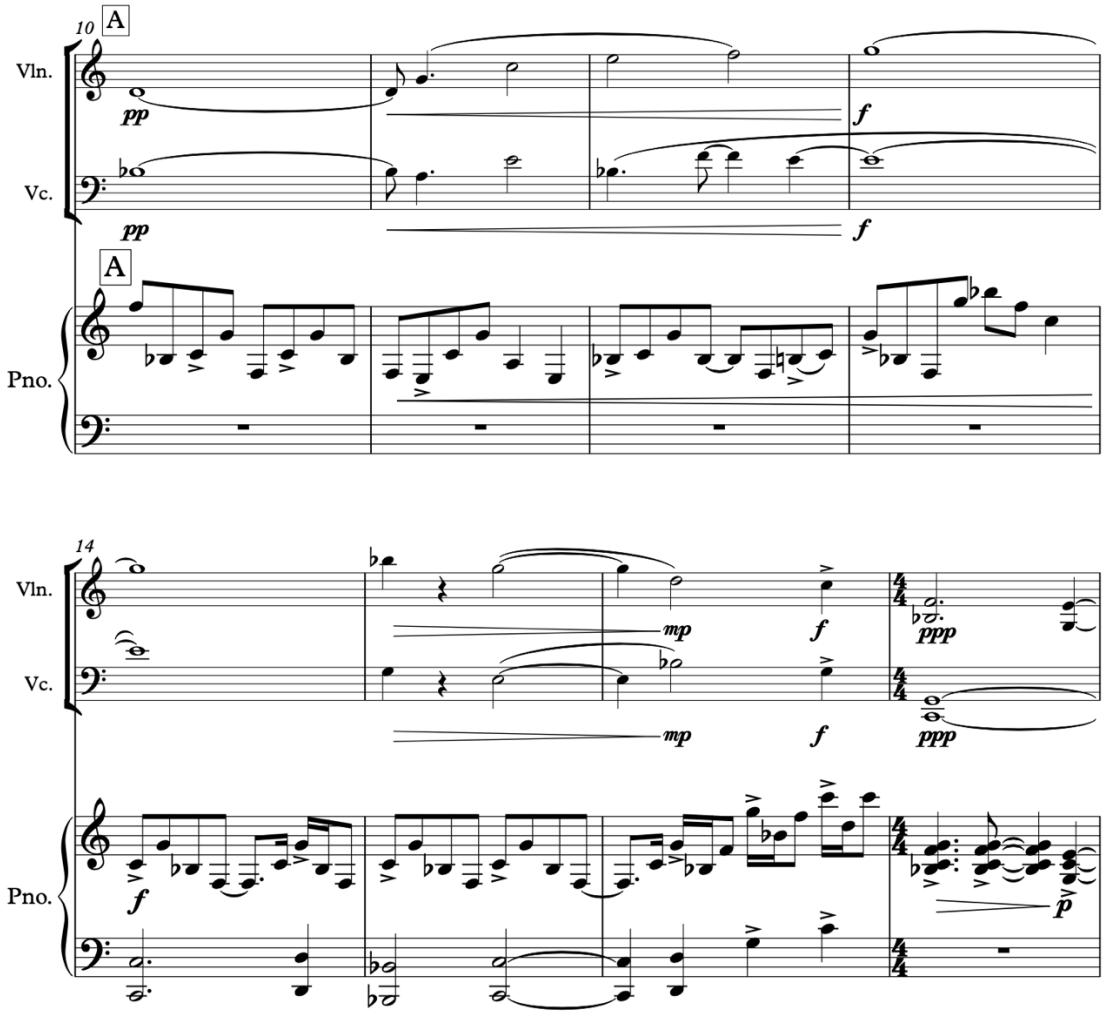


Figure 45: Figure A in *Eight*

Intervallic Affect Theory and Historical Association

Moving forward to the final section of the work, the strings dominate the accompaniment through sustained, long notes in harmony with each other. These harmonies have been written with the prevailing use of intervals of power, stability and neutrality in order to try and include an element of calm to the end of the piece (calm being associated with stability and neutrality, power being associated with the catharsis of the material insofar). In the excerpt below, the strings hold a vertical interval of a perfect 5th. This is followed by short iterations of a major 6th, an octave, and a major 2nd, but we imminently resolve back to the perfect 5th. The major intervals aim to depict pleasure, providing some emotive content to accompany the arousal. The low notes (bb. 44–46 utilise the lowest possible notes of the violin and cello) aim

trigger a sense of power and intensity due to the historical association of low, full-bodied pitches to their natural powerful counterpoint: thunder (Machin, 2011).

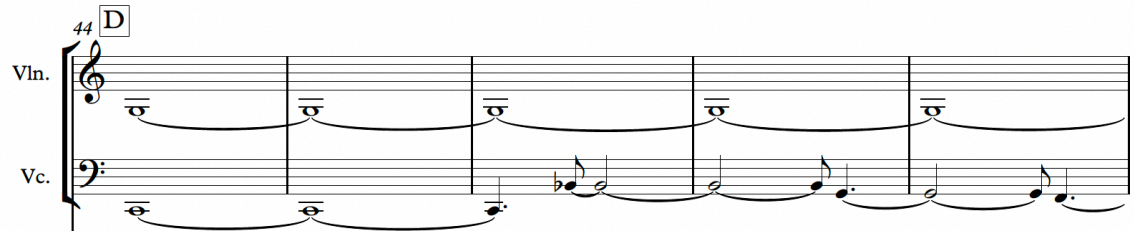


Figure 46: Violin and cello bb. 44–48 intervals of power and pleasure in *Eight*

Rhythmic Unity

Eight, like the seven others previously discussed, uses a sparse texture at its conclusion that exposes the piano ostinato. This ostinato slightly rhythmically augments and eventually literally slows down also via a rallentando, to bring the listener's entrained heartrate to a slower pace encouraging a calmer state of being than the majority of the piece's material.

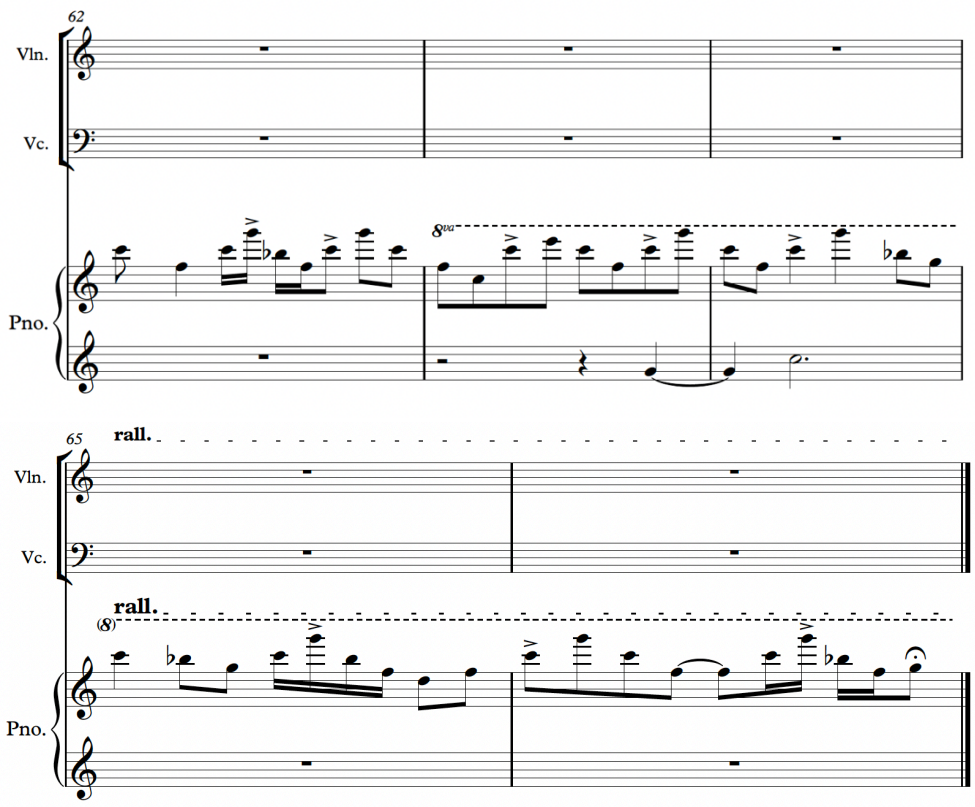


Figure 47: Ending bars of *Eight*

2.5.9 *Nine*

0:00 to 0:27 calm	0:27 to 0:53 catharsis	0:53 to 1:35 calm	1:35 to end catharsis (building towards and away from)	Overall: Happy (4/5), Calm (2/5)

Nine encompasses four sections that aim to evoke an almost exactly even division of catharsis and calm (49%/51%). It is the first work that aims to very nearly stimulate a completely neutral arousal level, and therefore is surmised to be interpreted as either calm or neutral by listeners.

Rhythmic Unity and Musical Expectancy

This work's ostinato serves to entrain with the listener's heartrate from the onset. The tempo of the piece is set at crotchet = 92bpm – within the average resting heartrate of an adult. This is circa 30bpm faster than other pieces (most which start at around 60bpm (Vega, 2017)). The right hand ostinato itself in the piano is dominated by quaver and semiquaver subdivisions, however the left-hand accompanying durations utilise notes of a minimum crotchet length, spanning up to semibreves. This has the effect of 'balancing out' the quaver and semiquaver perceptively faster tempo. This said, this work still begins with more energy than some previous pieces.

The ostinato utilises a 4/4 to 3/8 time signature pattern. This meter shift is likely to be unusual for the layperson to hear, and aims to contradict Musical Expectancy from the onset of the ostinato. Paired with the tonal ambiguity (C major or F Lydian), the ostinato itself utilises various musical facets that serve to create a moderate arousal level from the very beginning of the work.

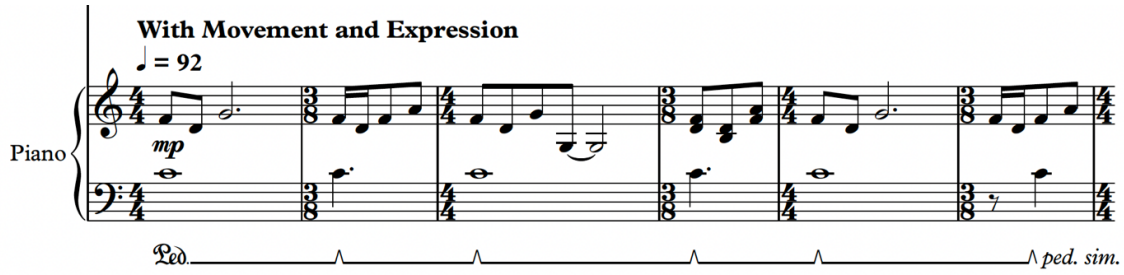


Figure 48: bb. 1–7, piano ostinato in *Nine*

Musical Expectancy

The first cathartic section of *Nine* utilises Musical Expectancy (specifically MAV) to begin to arouse energy. No sooner than the ostinato is set up in the entrance, it is dissembled and varied in the piano in b.9-13. When it returns in bar 14, it does so in a rhythmically altered form where it sits comfortably in 3/4 time. These variables paired with the continuity of the

use of the original motif (stated in the strings before the below excerpt), serve to maintain a listener's attention, without subverting it completely to a new, unfamiliar idea. The aim is for interest to be retained and arousal to be piqued, but for pleasure valence to be unchanged.

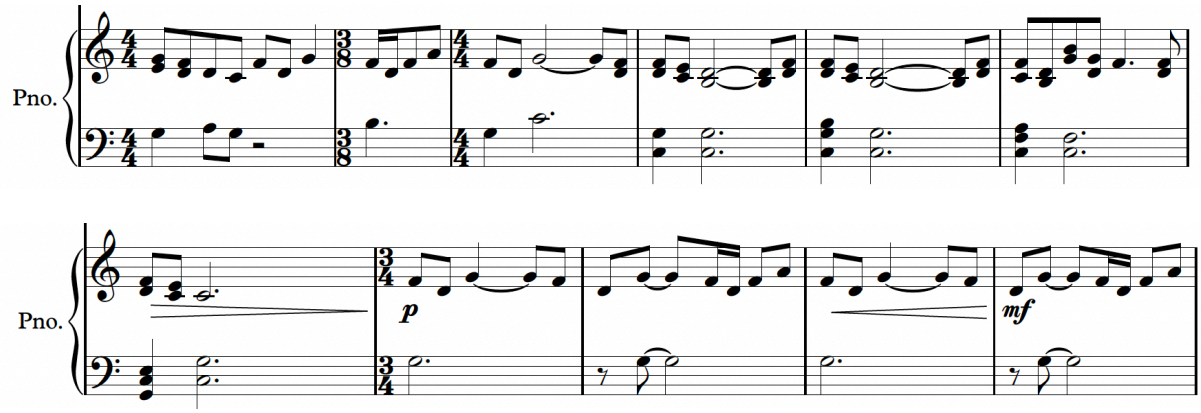


Figure 49: Piano bb. 9–13, disassembling the ostinato in *Nine*

Contour Affect Theory

In the second passage of the work (that which is deemed cathartic), the violin is playing in a moderately high part of its range in a louder dynamic than the accompaniment, and is highlighted through registral and orchestrative manipulation as foreground material. This aims to be moderately intense and arousing. The entrance of the violin line also utilises a semiquaver ascending lead-in ornamental cell to engage attention, and the ascension aims to, through Contour Affect Theory, evoke activation and optimism.

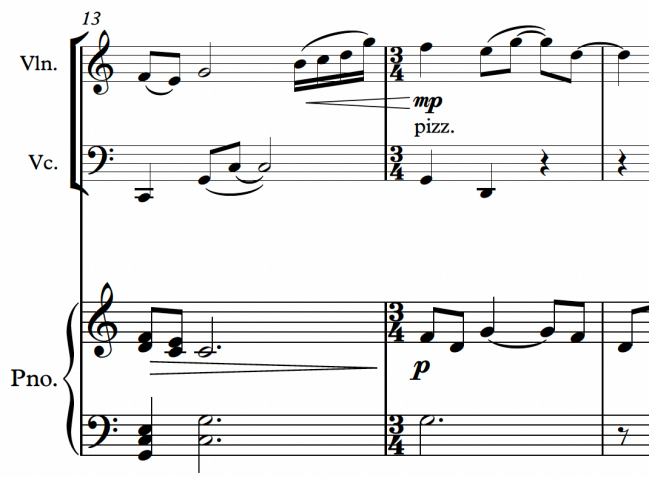


Figure 50: Violin's leading melody, b. 13 onwards in cathartic section of *Nine*

Rhythmic Unity and Musical Expectancy

Letter A signifies the next section, which aims to evoke calmness. The ostinato appears developed here in the piano, displaced by a quaver, augmented, and utilising constant syncopation against the pulse. The syncopation aims to help to continue to entrain the listener, and the development itself aims to maintains interest in the repetitious material. The augmented rhythms of the ostinato also work to slow the perceived pulse of the work, and the cello and piano right-hand state the ostinato in a development that actually creates melodic material out of it (in a call and response manner). This shift in orchestrational order is a second means of Musical Expectancy in maintaining listener interest.

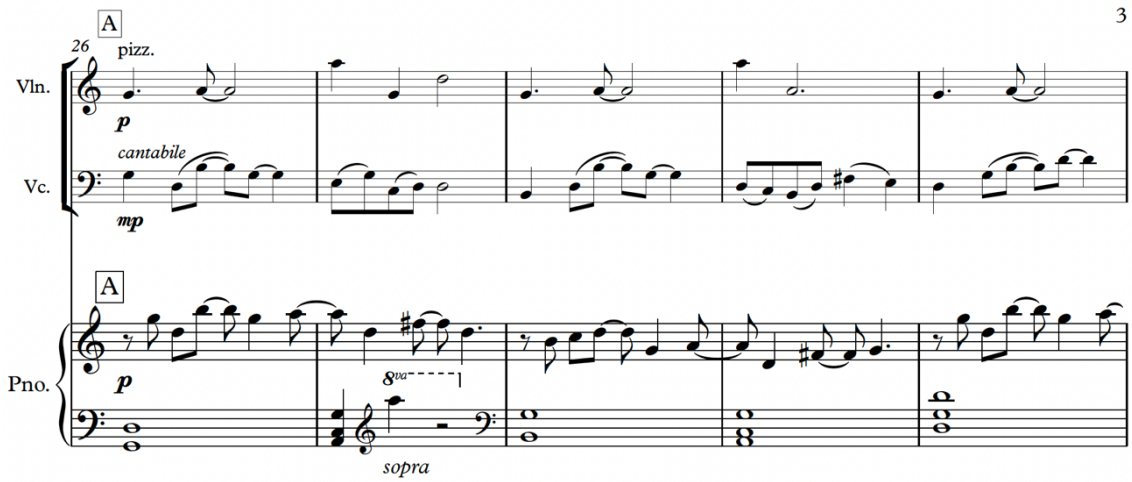


Figure 51: Figure A, ostinato development in calm section of Nine

Musical Expectancy

Letter A established a G major tonality, and utilised an uncomplicated chord progression that moves between chords I, IV and ii for the 8 bars. Bar 33 (bar 8 of the section) uses chord IV, and one might expect a plagal cadence and return to/repeat of the harmony from the first bar of the section (chord I), but instead the harmony returns to the introductory material in F Lydian (or C major), and moves into Letter B. Letter B contradicts a listener's expectations, aiming to foreshadow a lift of momentum again (the cathartic section to follow) where otherwise one might expect a full tension release.

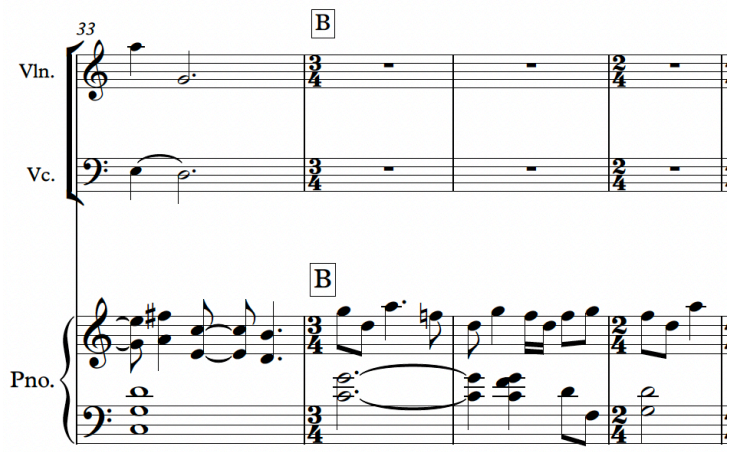


Figure 52: bb. 33–36 contradiction of harmonic expectation in *Nine*

Rhythmic Unity

Letter C marks the start of the final section, which is aimed at evoking catharsis. The tempo is increased by 10bpm – a fairly small increase, but the piano rhythmically diminishes the ostinato with a predominant semiquaver subdivision. This has the potential effect of indicating a half-time pulse. The left-hand notes seek to add stability and predictability to the ostinato pattern: it grounds it within a four-beat framework against which the quasi-polyrhythmic and syncopated semiquaver patterns are placed, but overall, there is a distinct lift in energy. The ostinato remains rhythmically driven and the subdivisions and tempo increase aim to effect a small lift in heartrate in the listener and a rise in tension/arousal for the opening of the final cathartic section.

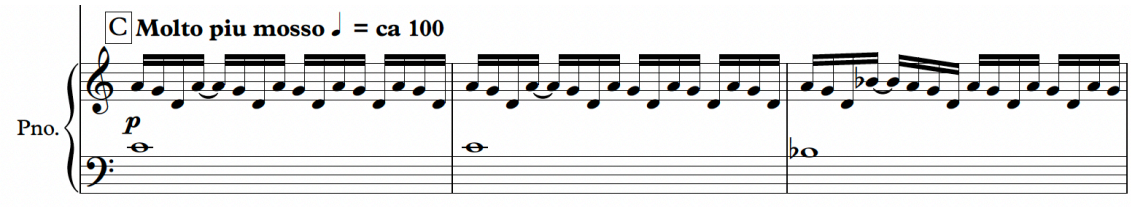


Figure 53: Figure C piano, rhythmically diminished ostinato and tempo increase in final section of *Nine*

Intervallic and Contour Affect Theory

As Letter C builds arousal for catharsis, a rising melodic contour in the strings paired with a crescendo to forte (the loudest point of the piece so far) is utilised to effect emotional activation and optimism. These bars anticipate the climax of the work at b. 52.

The climax of *Nine* is dictated by intervals of power in all parts, particularly in the piano with the use of octaves in the right hand and perfect fifths in the left hand. Intervals of power paired with the loudest dynamic point of the work, are a means of highlighting the climax. The tonality here is still in a major mode, so the positive valence of the tonality grouped with the powerful intervals and loud dynamics gives this moment in the work the potential for cathartic effect.

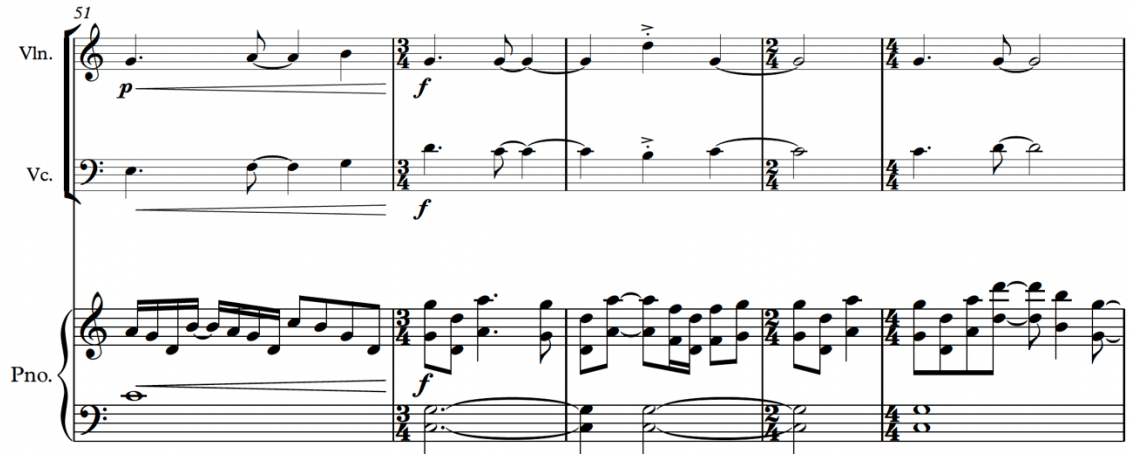


Figure 54: Climax of *Nine*

Rhythmic Unity

As the climactic, high-arousal final section of the work ends, there is a short reprieve of tension (as is commonly depicted in the works of this album that utilise catharsis for their final sections) via the use of a molto ritenuto. The final bars of the work aim to comparatively lower listener arousal (as is deemed throughout this dissertation a necessary component of the process of catharsis), and utilises the piece's thematic ostinato in its prime form again as a vehicle of Rhythmic Unity to maintain heartrate entrainment and lower arousal to state of relative, moderate calm.

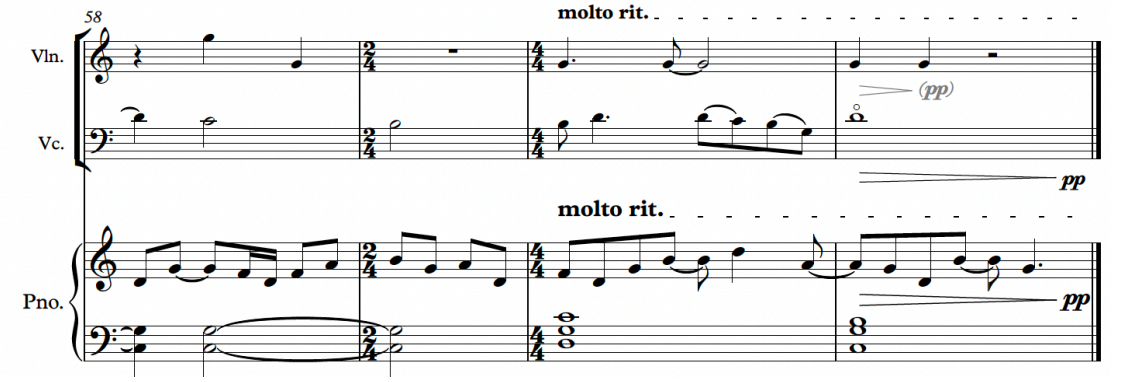


Figure 55: All instruments b. 57–end *Nine*

2.5.10 *Ten*

0:00 to 0:36 calm	0:36 to 1:17 catharsis	1:17 to 2:07 catharsis (less so than previous excerpt)	2:07 to 2:30 catharsis (climax, most exciting)	2:30 to 3:14 catharsis (building away)	3:14 to end calm	Overall: Happy (4/5), Neutral (3/5)

Ten is dominated by cathartic emotive affect. It begins and ends with what are intended as calm sections, and through the middle, cycles through ebbs and flows of increasing and decreasing arousal, with a climax around the middle of the work. The entry is the slowest material used so far in this album, using long, sustained notes in the strings which return (albeit momentarily) in the final seconds of the work.

Historical Association and Visual Imagery

This work aims for a 72% cathartic emotive affect, resulting in a "neutral" and borderline "excited" arousal level. The opening of *Ten* references chant – a type of therapeutic, spiritual singing that is associated with centredness and calmness. The strings utilise sustained notes in close diatonic cluster chords with staggered entries, that aim to closely parallel the Om chant, drawing listeners into a state of relaxation through their early associations with the sound (Vanjari et al., 2019).

For the first time in the set of pieces, visual imagery is utilised intentionally in the opening of *Ten*. The piano plays single notes at ostensibly random points in the bar, surrounded by the pad of sustained notes in the voices adjacent. These piano notes, often high in register, aim to

sound like raindrops hitting a rooftop: one or two to begin with – then exceedingly more until the momentum builds. The build of notes is paired with a crescendo in all parts, to imitate the inevitable volume build of an onsetting rain shower. This image painting is a way to compositionally move from calm 'chant-like' material, to the cathartic, pulsing material of the second section (and generally cathartic middle sections) of the piece.

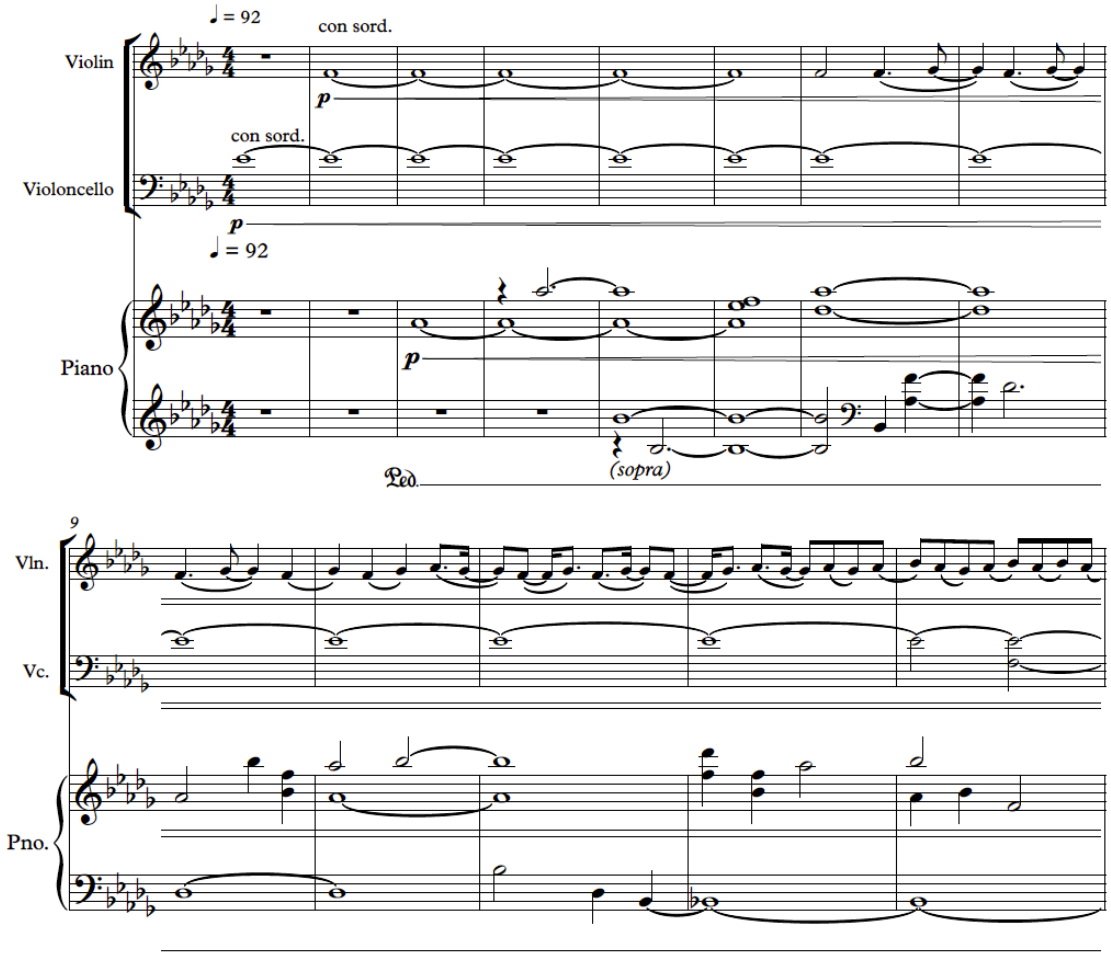


Figure 56: Om chanting, Visual Imagery and pulse introduction in opening of *Ten*

Rhythmic Unity and Contour Affect Theory

This work utilises an ostinato as a vehicle for Rhythmic Unity. It is introduced at bar 7 in a rhythmically augmented variation in the violin. The augmentation covertly pushes the undercurrent of the work along, introducing a pulse to the material where initially there was none. The gradual diminution aims to first entrain with the listener's heartbeat and then raise

it to a state of moderate excitement (arousal) in preparation for catharsis. It directly follows the 'raindrop' notes of the piano and serves to take over the momentum build from the piano by the end of the section. The building material from the beginning of the work is paired with a slow crescendo, aiming to parallel the arousal and pulse build (and again, articulate the increase of volume that would ensue through gradually increasing rainfall).

The violin's melody rises in contour somewhat rapidly over the course of this section, and in partnership with the dynamic crescendo, aims to propel anticipation for a tension climax (which ensues at A).

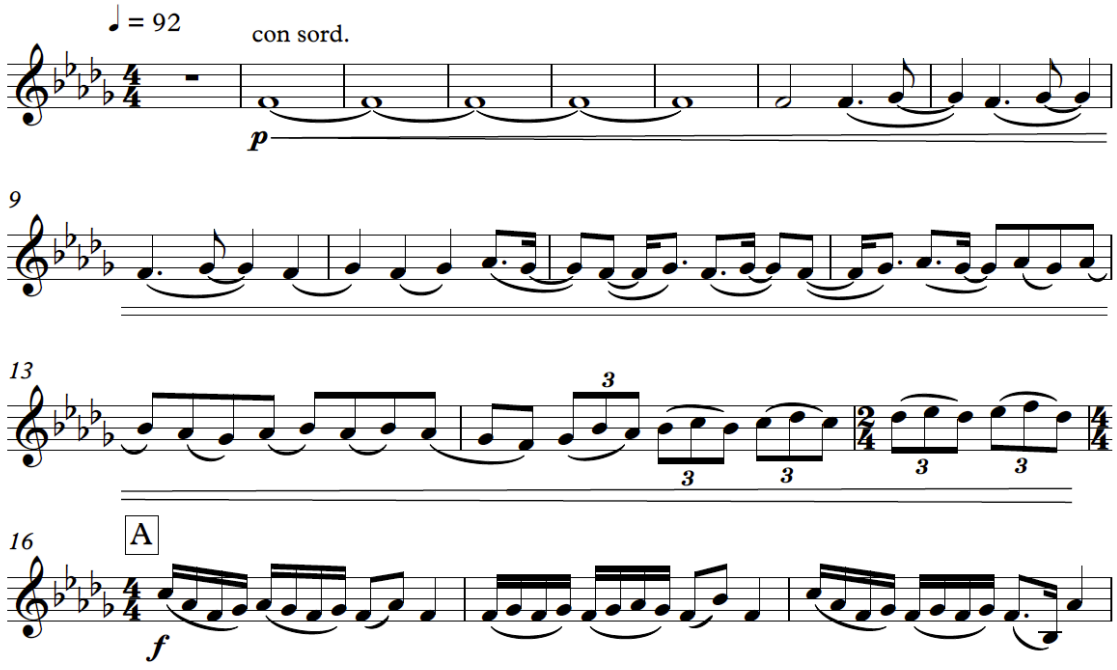


Figure 57: Violin ostinato diminishing in the opening until figure A in *Ten*

Rhythmic Unity and Contour Affect Theory

Section A aims to induce the first moment of catharsis in the work. The pulse of the material is 92 bpm – within the resting heartrate of an adult, but at the high end of the scale. The cello and the piano have pulsing accompaniment figures utilising every crotchet beat or minim beat, and the violin subdivides almost constantly into semiquavers. We have moments of syncopation (e.g., b. 17 piano, b. 18 violin), and together, this rhythmically driven material

(especially so since the lack of drive of the opening) encourages entrainment between the listener's heartrate and the music. The Rhythmic Unity paired with the major tonality expresses and aims to evoke positive excitement. The start of A is a climactic moment, and the descending contour of the main melodic line in the violin aims to release and deactivate emotion – the antithesis of the opening which utilised an ascending contour in the violin and aimed to build to the climactic, cathartic section A.

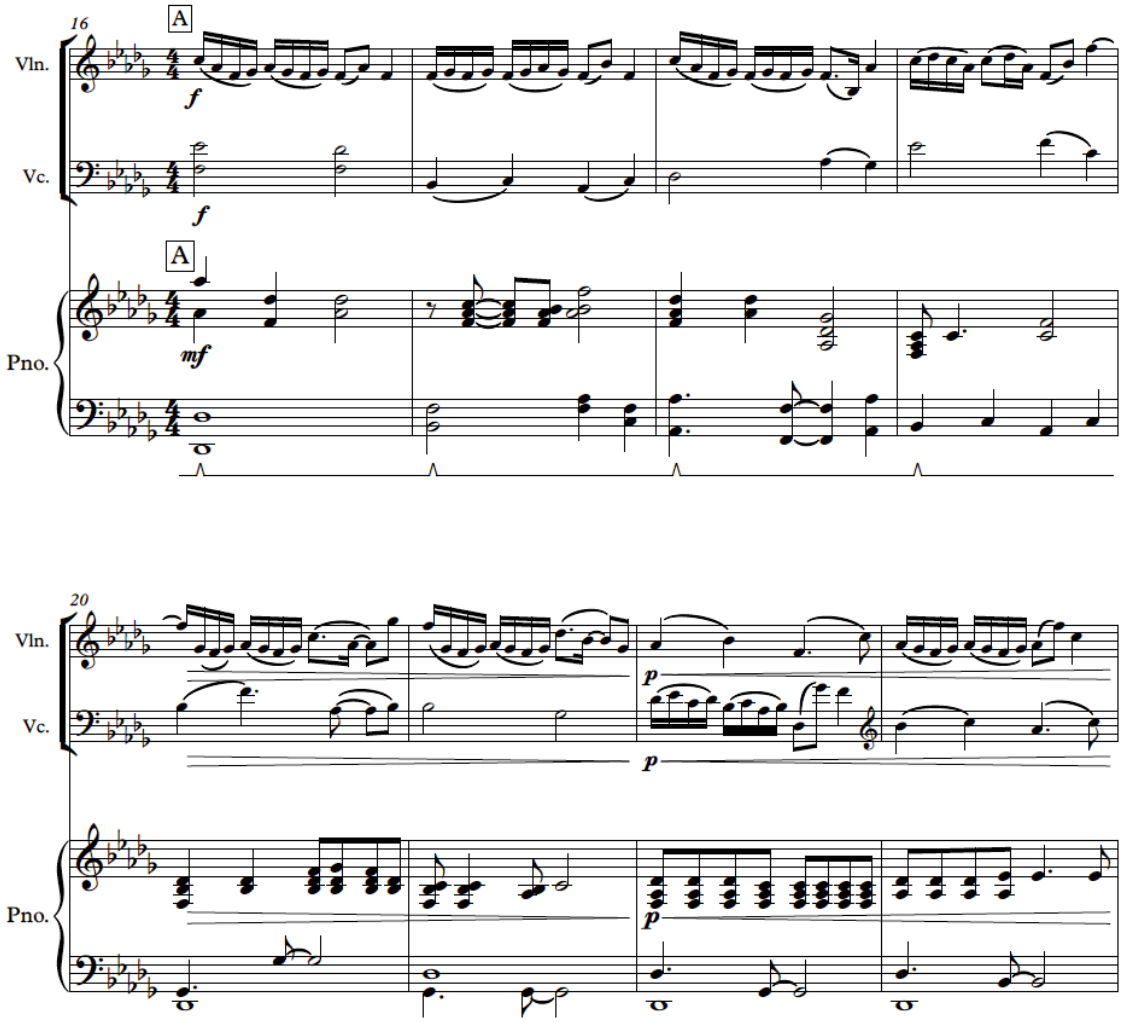


Figure 58: All instruments, bb. 16–19 rhythmic drive in *Ten*

Contour Affect Theory and Musical Expectancy

Approaching Letter B, the piece begins to move to the loudest point so far. The material is still connected to Letter A, and we remain in the first cathartic-inducing section, but to keep the listener engaged, the dynamics shift to piano in order to give way to a bold crescendo, and the

violin plays an ascending, soaring melodic line at B. It is expressive, auditorily improvisatory, and aims to evoke an uplifting of spirits, outward emotional expression, and activation.

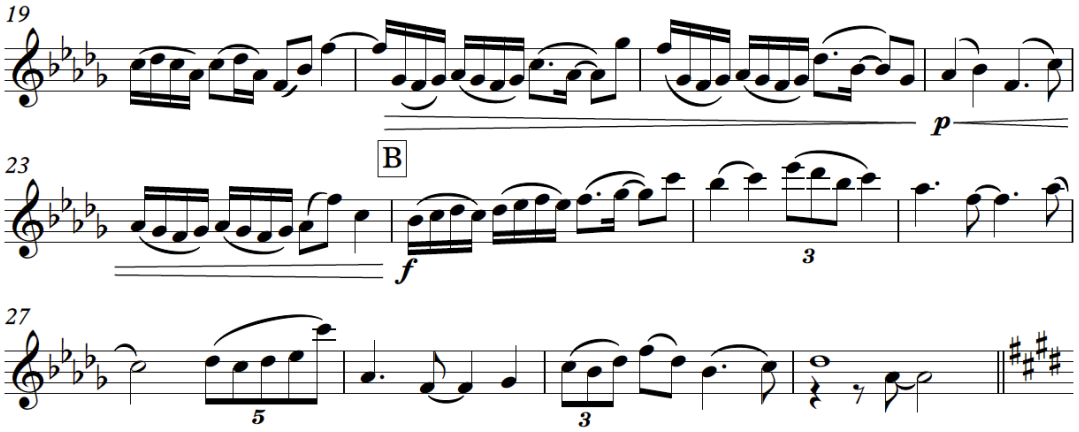


Figure 59: Violin ascending melodic contour approaching and into B in Ten

Musical Expectancy and Rhythmic Unity

Letter C aims to lower the listener's arousal levels in comparison to the previous section, and makes way for the boldness of the material that will eventually follow. A pulsing semiquaver ostinato and dissonant harmony ensures that this section is not comfortable enough to be perceived as calm, yet the dynamic and density shift clearly marcates it from the first ostensibly cathartic section.

Section three retains the left hand piano rhythmic pattern established in the first section (see b.20-23) but modulates to C# major. The harmony swiftly moves to the parallel minor key three bars later at b.35. This section utilises pulsing semiquavers rather than the quavers established earlier in the right-hand piano (not so dissimilar but not the same pattern either), and the strings' materials rhythmically augment gradually to taper out to silence. There is now a key variation, textural variation, and slight rhythmic variation, whilst only the accompaniment pattern of the left-hand piano is retained from earlier material.

The pulsing semiquavers syncopated with the left hand aim to continue to engage rhythmic unity with the listener, and now, the dynamic softness (the softest that has been heard in the

work so far), the modulations, and the solidarity of the piano alone in the texture attempt to renew listener attention and bring the work into a new, pensive and slightly darker space.

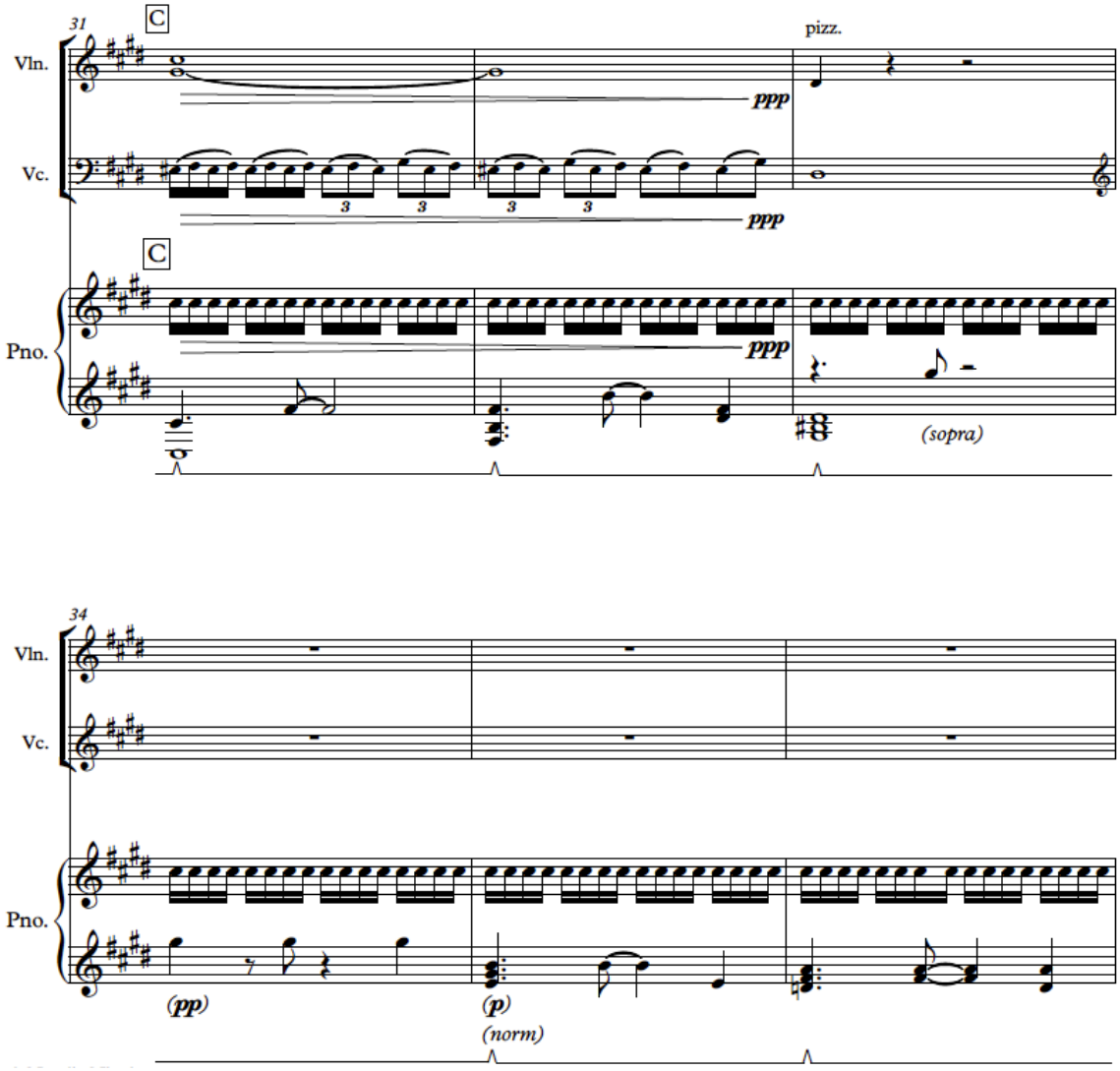


Figure 60: Rhythmic Unity and Musical Expectancy in section three of *Ten*

Intervallic and Contour Affect Theory

Letter D introduces a motif to the pulsing accompaniment material of C. Still in section three, D prepares for the final climax of the work. The harmonic progression shifts upwards by a tone every bar for three bars. Then by bar 50, the right-hand piano specifically uses octaves (intervals of power and stability) paired with a dramatic crescendo in an ascending line, to lead to the biggest, boldest part of the piece so far – the climax (Letter E). This upward movement

aims to prepare the listener for catharsis of the climax by lifting spirits and activating optimism.

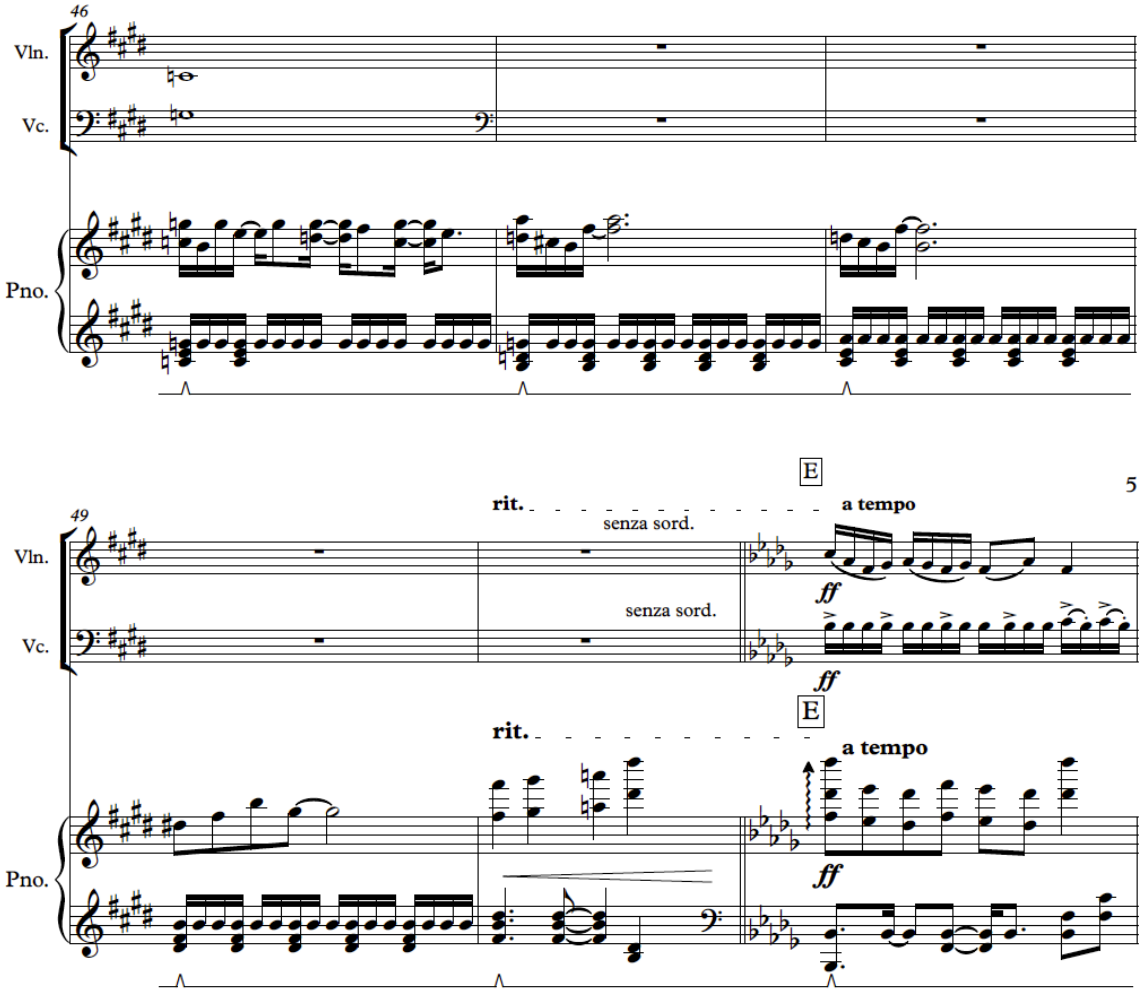


Figure 61: Ascending material to climax at E in *Ten*

Rhythmic Unity, Emotional Contagion, Intervallic and Contour Affect Theory

Letter E brings the listener the climax of the work. It is the loudest part of the work overall, the thickest in density, and the most dramatic, registrally and otherwise.

The left hand of the piano resumes a varied version of the syncopated ostinato pattern of 3 + 3 + 2 that it set up at the start of the work. It is rhythmically diminished to sound as 3 + 3 + 3 + 3 + 2 + 2, and paired with the moving semiquavers in the strings, suggests a faster, double-tempo speed, aiming to through Rhythmic Unity, promote a further raising of

heartrate. The syncopation further engages sensorimotor synchronisation and thus Rhythmic Unity.

Generally, the material here is the most complex for the players, especially the string players. The music was written this way in the hopes of triggering Emotional Contagion through the recording. The right hand of the piano utilises specifically placed octaves and plays quite high in its range – it is quite far from the left hand material and renders it difficult to perform accurately. The strings are both playing fast-moving lines, the cello with off-the-beat accenting at a fortissimo dynamic. The effort used to produce the music here in all parts is palpable in the recording through Emotional Contagion, representing force, effort and power – all climactically appropriate emotions.

Meanwhile, the piano's octaves represent intervals of power, the tonality of the work is major, and the registral use of the melody (held in the piano) is high – together through Intervallic Affect Theory, aiming to emanate positivity, assuredness, excitement, brightness, truth and transcendence.

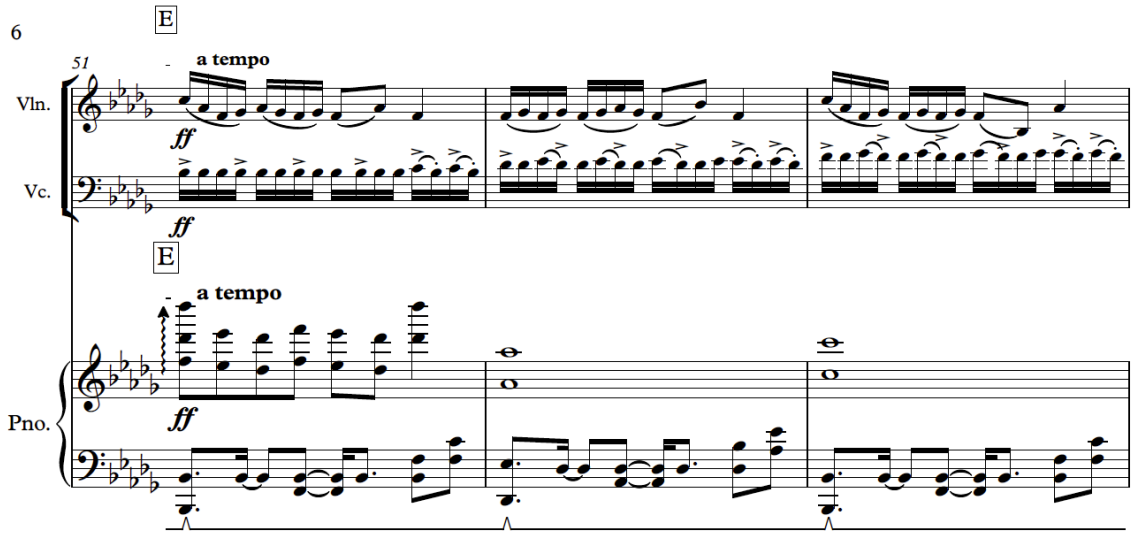


Figure 62: Climax of *Ten* at figure E

The end of E marks the end of the cathartic sections. The combined registers of the instruments move gradually closer together from bb. 56–58, and the registral content is levelled out to occupy a mid-register space with a thin texture and a lowered volume. This aims to effect a release of energy, the start of the deactivation of catharsis, and the arousal wind-down to the calm end of the work.

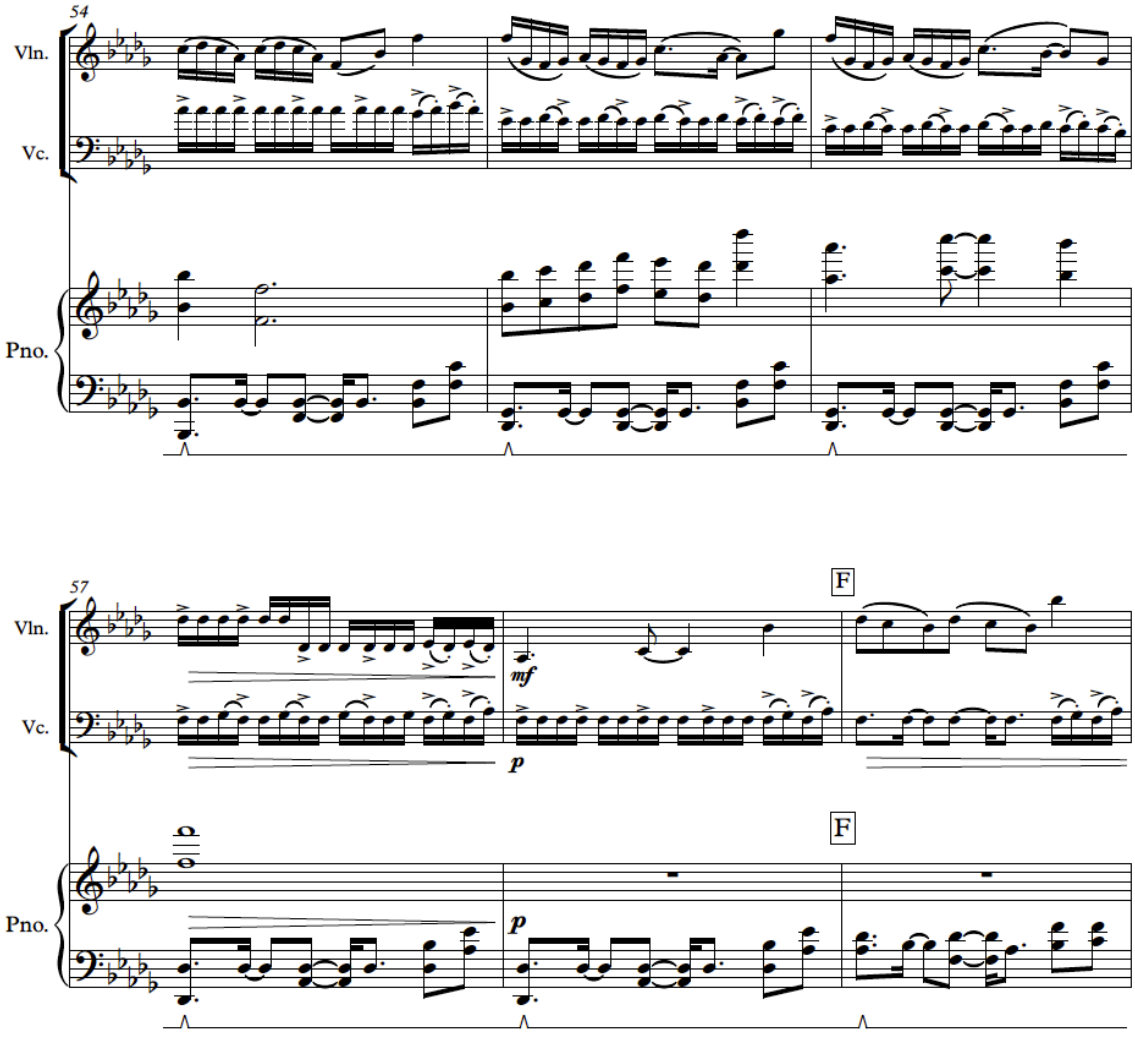


Figure 63: Release of energy for final section of *Ten*

The piano resumes the original ostinato with pulsing quavers in the right hand to accompany. This promotes a lowering of the heartrate to more closely match the original tempo and bring the listener down in energetic arousal. Meanwhile, the strings play an expressive melody that

retains an overall level contour over the course of the 7 bars (representing calmness and stasis through Contour Affect Theory), and the duality of the melody descending between two instruments here aims to be emotionally palpable, as nostalgic, and restful.

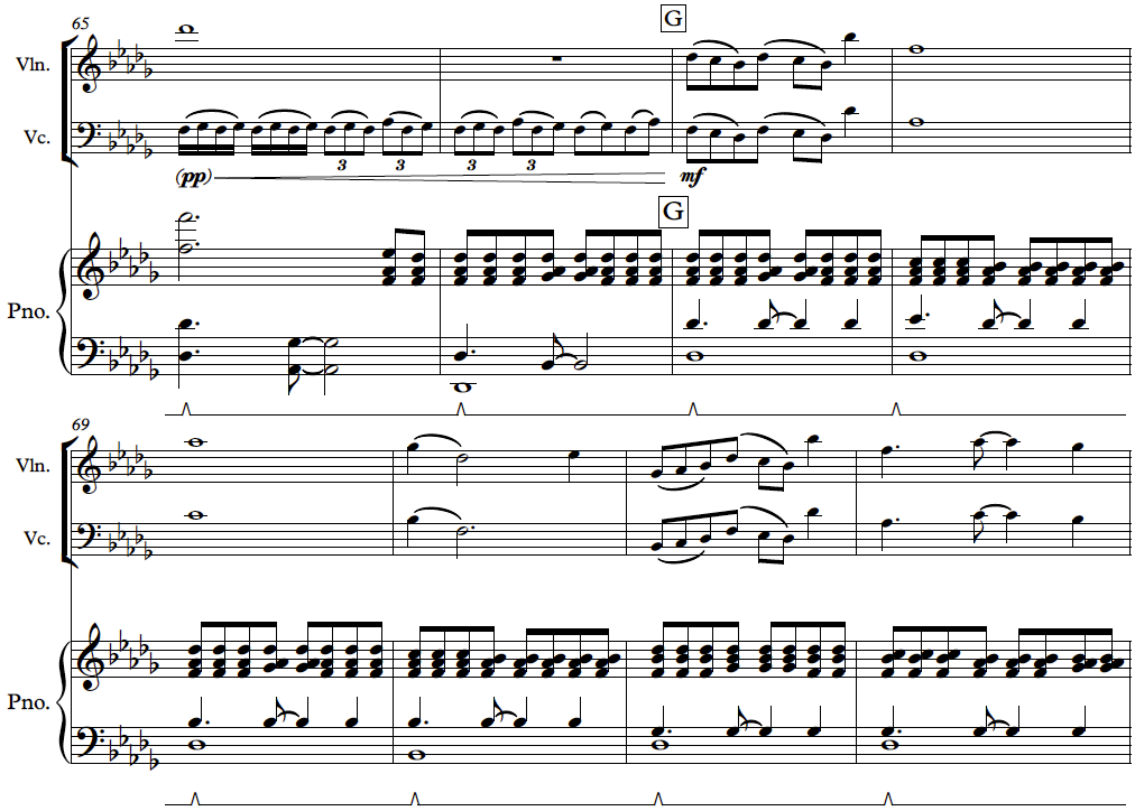


Figure 64: Arousal deactivation in final section of *Ten*

Rhythmic Unity

The conclusion of the work from Letter H to the end thins the instrumental texture and reduces the note content. The notes in the piano ostinato are progressively rhythmically augmented (see the semibreves in the left hand and the aberration to the usual syncopated rhythm), and the pizzicato rhythmic reinforcements by the strings are on whole beats of the bar. At the end of the work, the rhythmic drive is completely augmented and removed, aiming to enable a gradual slowing of the heartrate and a state of final calm in the listener.

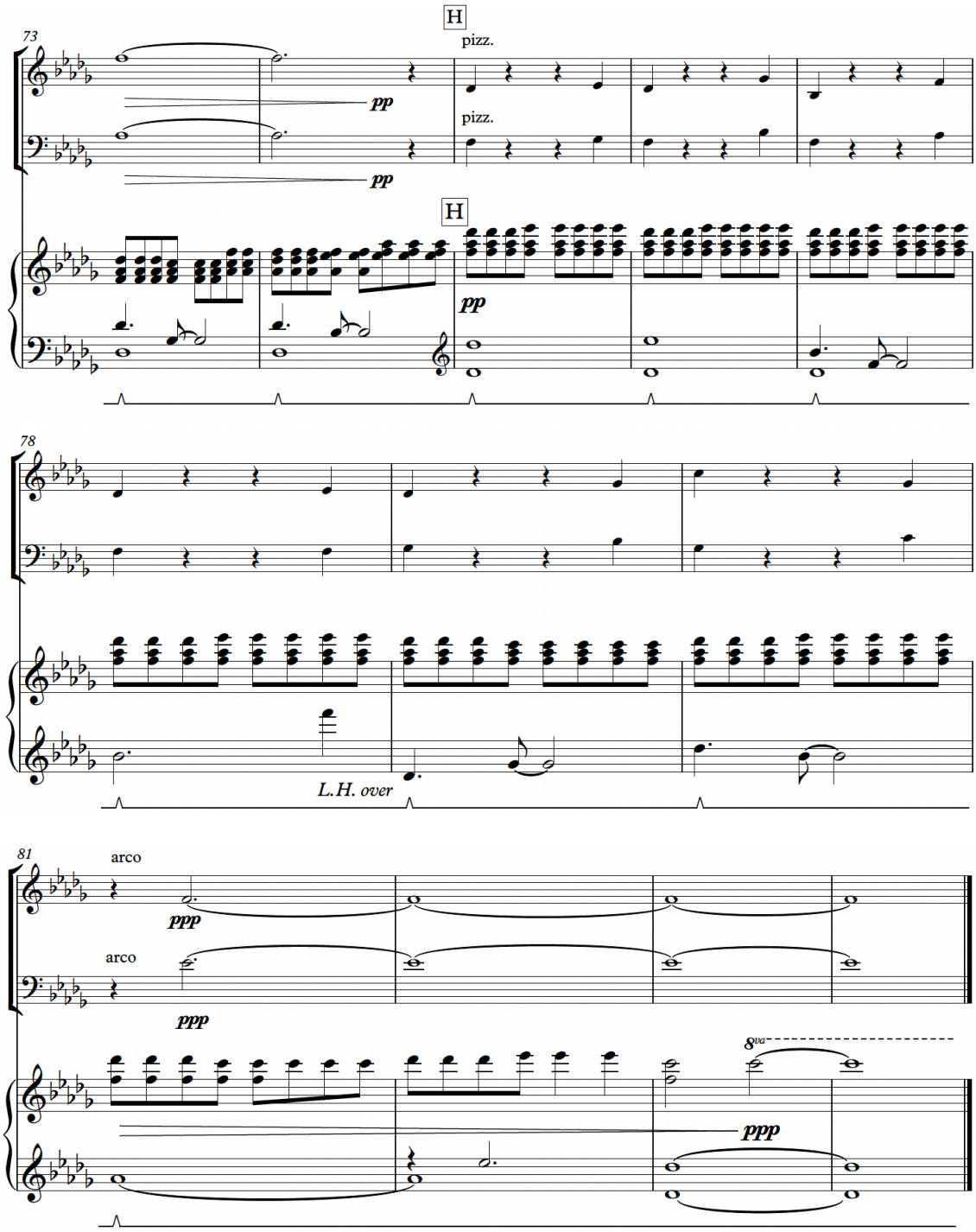


Figure 65: Calming ending of *Ten*

2.5.11 General Summation

Across all ten pieces, there were a number of commonalities in the use of the CTEE. Ostinato was the primary vehicle for Rhythmic Unity — it appeared in all pieces and was dominated by

syncopated rhythms. At the end of most works, the ostinato was broken down (fragmented, augmented) and paired with a tempo reduction to result in a final evocation of calm.

A certain amount of my compositional artistic identity predicated the decision to use ostinatos throughout the suite of works and further dictated the weight to which I assigned use of the various mechanisms in the CTEE. I utilised the following mechanisms in order of highest to lowest frequency: Rhythmic Unity, Musical Expectancy, Episodic Memory Recall, Intervallic and Contour Affect Theory, Emotional Contagion, Musical Expectancy, and Historical Association. The two mechanisms not utilised in the suite of works were Response to Stimuli and Visual Imagery. Visual Imagery relies on a second mechanism to induce emotional response. It is a vehicle for engagement with an image (conjured in the mind of the listener) and is volatile in that without a secondary stimulus or a pre-supplied program note, the listener has too much volition in what image is conjured and whether they cognitively engage with the image long enough for emotional response to ensue. For the sake of control in this study, it was not used. Response to Stimuli is another mechanism that for the sake of evoking calm and/or catharsis, seemed artistically counterintuitive. It relies on conditioning of the ear to urgencies of or prevalent sound that parallels a natural counterpart. It was not immediately obvious how this could be used in my work to evoke calm and catharsis.

Despite their similarities, each work aimed to be unique in character. The works were designed to be able to be seamlessly experienced in succession of each other, yet pointedly employed unique characteristics through various musical choices. This is particularly evident between pieces such as *Six* and *Eight*, where not only are their emotive narratives quite varied, but their characters are that of the quiet, pensive work, versus the playful, whimsical work.

I aimed to communicate the intended emotional narrative to the players through pointed expressive and articulative markings throughout each of the pieces. Gestural performance heavily influences timbre and perceivable affect (through mechanisms such as Emotional

Contagion), and this was a crucial component to linking my compositional intent to performance through the pages of the scores. Markings such as “Sweetly” at the start of *Two*, “With a little bit of magic” at the start of *Four,* “With curious energy” at the start of *Seven*, and “Playful, blooming” at the start of *Eight* are examples of this, as are notations such as “Ped. ad lib., use excessively” that also appears at the start of *Eight*.

2.6 Findings and Discussion

Statistical Analysis

The graph below shows the averages of the scores across each sample.

On the valence (pleasure) scale, all but pieces 4, 6 and 10 ranked an average response of 3 or higher (neutral, happy, very happy), and pieces 4 and 6 score below 3 (neutral, sad, very sad), with track 6 the saddest overall out of the 10 pieces. Interestingly, pieces 4, 6 and 10 rank between neutral and sad, with 4 and 10 closer to neutral, and 6 very close to sad.

On the arousal (excitement) scale, all pieces but 1, 8 and 10 rank below 3 on the arousal scale (neutral, calm, very calm), with track 6 the calmest overall (ranking somewhere between very calm and calm). Pieces 1, 8 and 10 rank on the low side between neutral and excited, and no track ranks excited or very excited overall.

Track 6 ranks the lowest scores on both scales, being the calmest and the saddest.

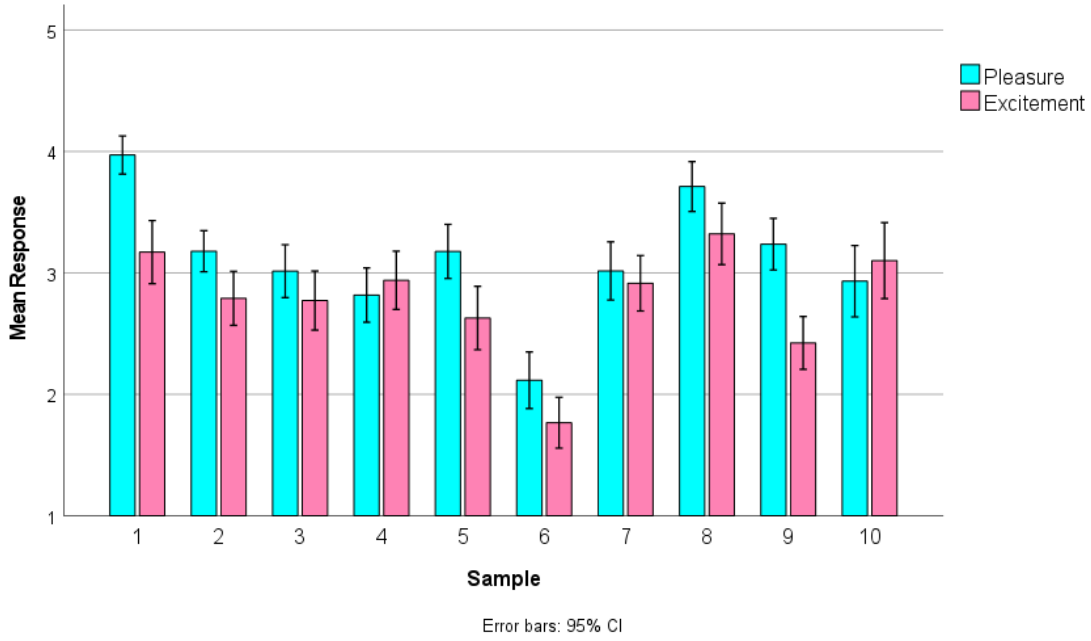


Figure 66: Mean response across 10 samples for Valence and Arousal

The below graph shows how often (frequency) valence (pleasure) were rated amongst the pieces. On the y axis, we have 1–5 (very sad to very happy) and on the x axis we have how many times it was recorded. Each panel represents a sample from 1 to 10.

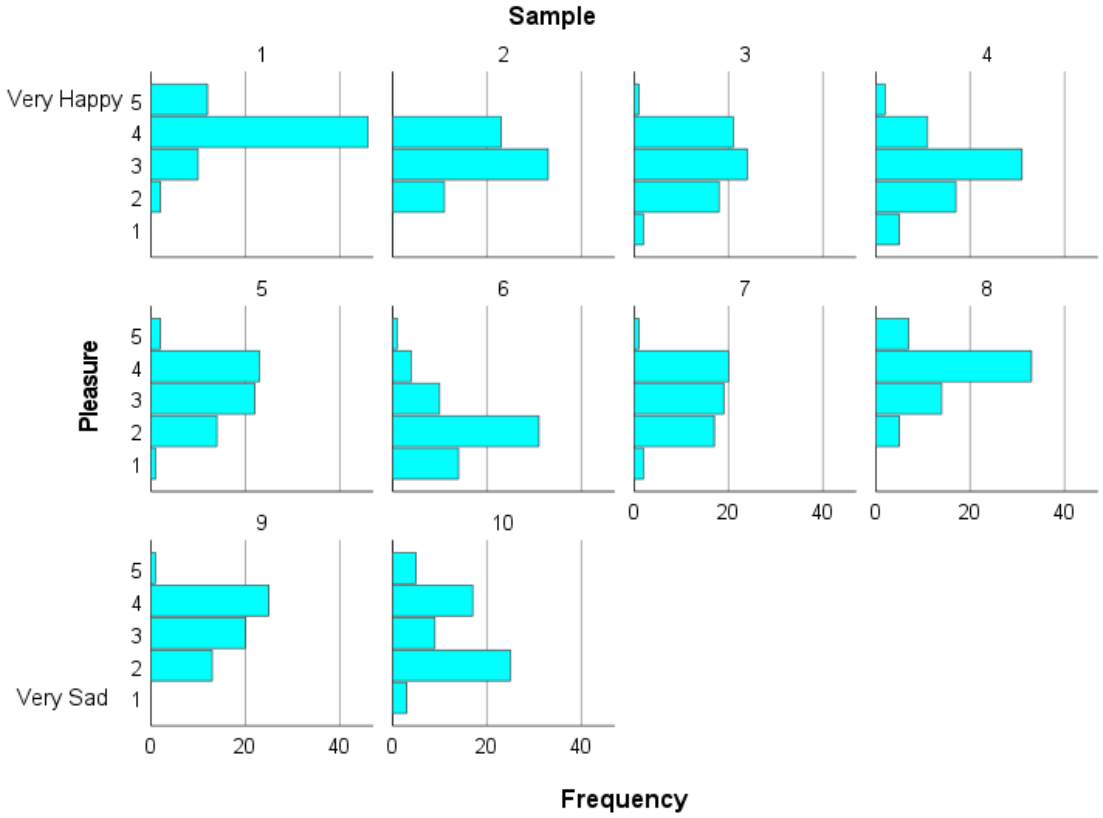


Figure 67: Pleasure score frequencies across all 10 samples

The below graph shows how often (frequency) excitement levels (arousal) were rated amongst the pieces. On the y axis, we have 1–5 (very sad to very happy) and on the x axis we have how many times it was recorded. Each smaller table represents a sample from 1 to 10.

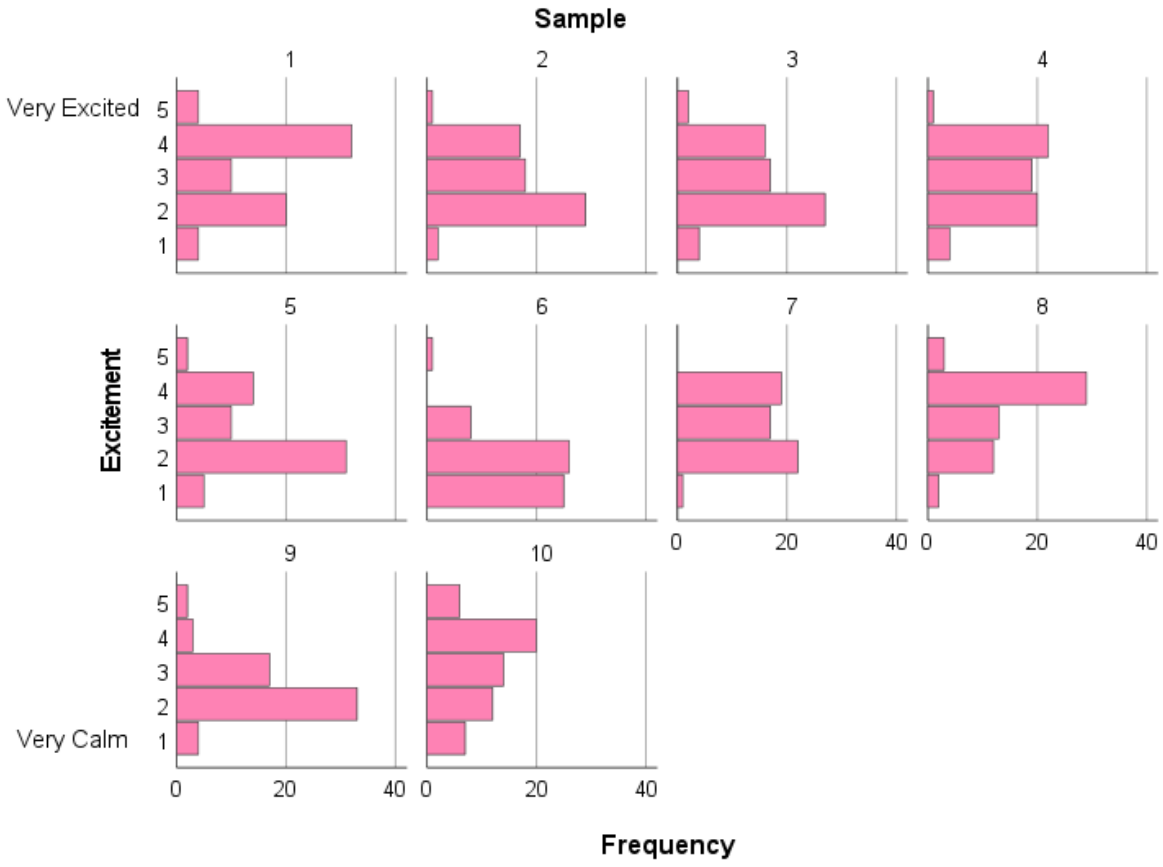
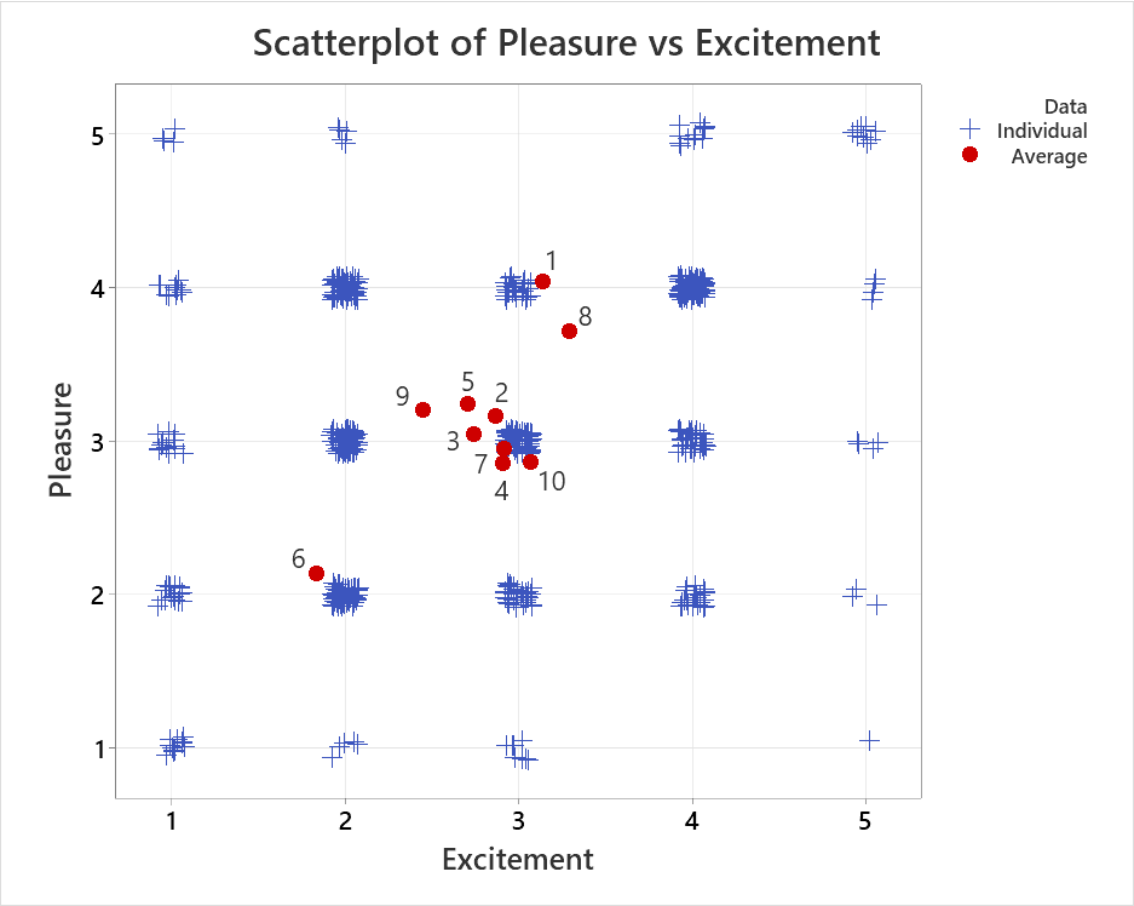


Figure 68: Arousal score frequencies across all 10 samples

Red dots on the next graph show the averages of arousal versus valence, of all pieces. Blue crosses show individual responses.

There is a small but significant positive correlation between values on the valence (pleasure) scale and values on the arousal (excitement) scale.

This graph also clearly visually depicts how different the lowest scoring sample on the valence (pleasure scale) is – track 6, compared to the highest scoring pieces – pieces 1 and 8.



Correlations

		Pleasure
Excitement	Pearson Correlation	.299**
	Sig. (2-tailed)	<.001
	N	627

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 69: Scatterplot of pleasure versus excitement

The following analysis investigates the scores for valence (pleasure). It is analysing the scores for pleasure to observe any differences that occur between people and between samples. Technically, a general linear model is fitted to the pleasure scores with Sample as a fixed effect and Subject as a random effect. The first table, 'tests of between-subjects effects', indicates

that Subjects are significantly different ($p<0.001$) and that Samples are significantly different ($p<0.001$). This shows that on the valence (pleasure) scale, the differing pieces had a statistically significant influence on the results. This means that the pieces were significantly different in terms of perceived emotional evocation.

Tests of Between-Subjects Effects

Dependent Variable: Pleasure

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	4162.692	1	4162.692	3681.180	<.001
	Error	116.259	102.811	1.131[a]		
Subj	Hypothesis	92.290	69	1.338	1.997	<.001
	Error	367.030	548	.670[b]		
Sample	Hypothesis	140.703	9	15.634	23.342	<.001
	Error	367.030	548	.670[b]		

a. .690 MS(Subj) + .310 MS(Error)

b. MS(Error)

Order of means (small to large):
(6) (4 10 7 3 5 2 9) (8 1)
(9 8)
means in the same bracket are *not* significantly different

Estimates

Dependent Variable: Pleasure

Sample	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	3.971	.098	3.779	4.164
2	3.165	.102	2.965	3.366
3	3.008	.103	2.805	3.211
4	2.811	.103	2.608	3.014
5	3.162	.107	2.952	3.373
6	2.100	.109	1.886	2.315
7	2.997	.110	2.781	3.213
8	3.692	.110	3.475	3.908
9	3.217	.110	3.001	3.433
10	2.912	.110	2.696	3.128

Figure 70: General Linear Model for Valence in terms of subject and sample

The table of estimates and the graph (Figure 72) show which pieces are similar and which are not (from their mean results) in relation to valence (pleasure). Sample 1 seems to be the highest, and sample 6 stands out as noticeably lower than the others. Pairwise post-hoc comparisons show that sample 6 is indeed significantly different from the other samples, and that sample 1 is significantly different from all others except sample 8. This is summarised in the 'order of means' (text at the top of page 124).

The following graph depicts the variance of results for valence (pleasure) perception across the pieces.

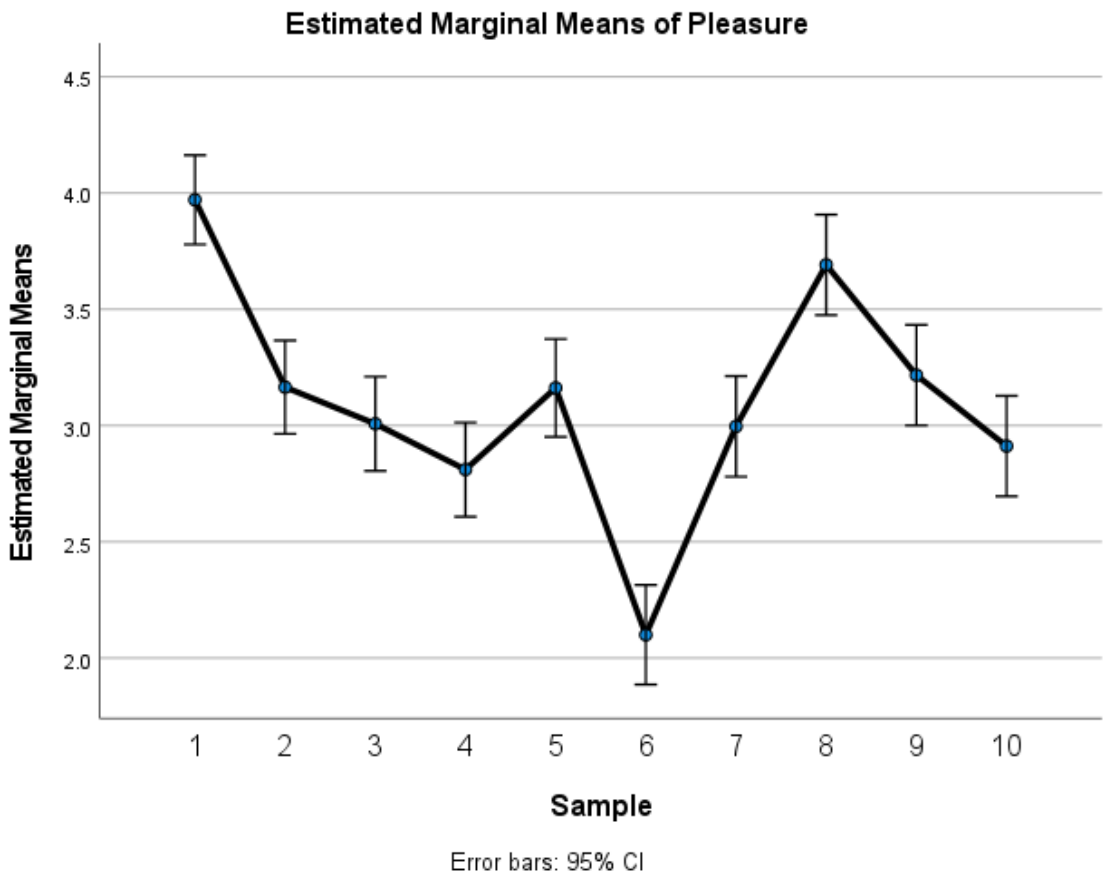


Figure 71: Estimated marginal means of valence

The below graphs depict the data analysis for arousal (excitement). Again, the statistical analysis here outlines various significances in the study – sample and subject. Where the significance is less than 0.001 (<0.001), we see that the parameter has significantly affected the results. 'Subject' and 'Sample' both show a significance of <0.001. 'Subject' is an expected influence, considering each participant is an individual person and therefore will have an individual response to the survey. However, the other parameter that scores <0.001 significance is "Sample". This shows that on the arousal (excitement) scale, the differing pieces had a statistically significant influence on the results. This means that the pieces were significantly different in terms of perceived excitement evocation.

Tests of Between-Subjects Effects

Dependent Variable: Excitement

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	3240.117	1	3240.117	2390.818	<.001
	Error	145.075	107.048	1.355[a]		
Subj	Hypothesis	108.312	69	1.570	1.790	<.001
	Error	480.509	548	.877[b]		
Sample	Hypothesis	111.241	9	12.360	14.096	<.001
	Error	480.509	548	.877[b]		

a. .690 MS(Subj) + .310 MS(Error)

b. MS(Error)

Order of means (small to large):
(6) (9 5 3 2 7 4) 10 1 8
(5 3 2 7 4 10)
(3 2 7 4 10 1 8)
means in the same bracket are *not* significantly different

Estimates

Dependent Variable: Excitement

Sample	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	3.171	.112	2.952	3.391
2	2.739	.117	2.509	2.968
3	2.735	.118	2.503	2.967
4	2.902	.118	2.670	3.134
5	2.568	.123	2.328	2.809
6	1.703	.125	1.458	1.948
7	2.865	.126	2.618	3.113
8	3.272	.126	3.025	3.520
9	2.374	.126	2.126	2.621
10	3.052	.126	2.804	3.299

Figure 72: General Linear Model for excitement (arousal) in terms of subject and sample

The order of means graph shows which pieces are similar and which are not (from their mean results) in relation to arousal (excitement). Pairwise post-hoc comparisons, summarised in the order of means text (graph/figure), indicate that again, track 6 is significantly different from all other pieces, and the pieces within each bracket are not significantly different from each other. Pieces 9, 1 and 8 are the most distinctive (equally so) after track 6.

The below graph depicts the variance of results for arousal (excitement) perception across the pieces.

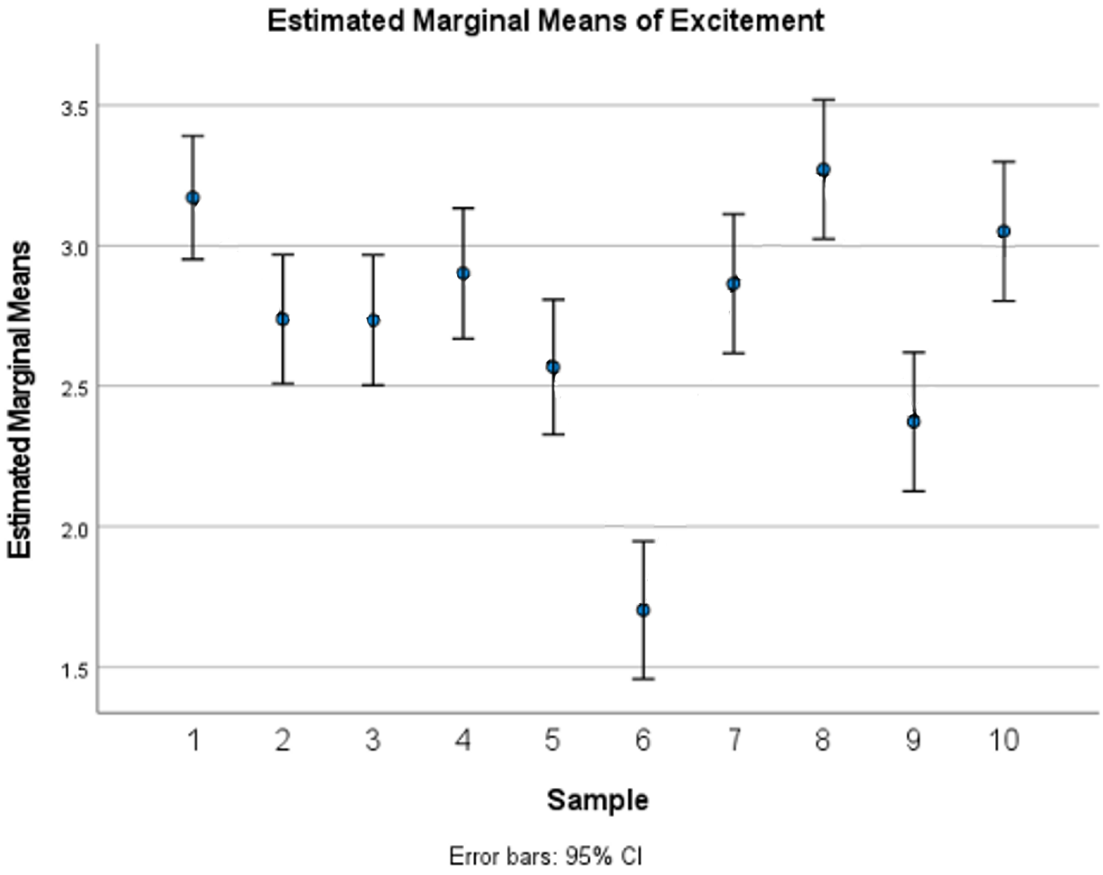


Figure 73: Estimated marginal means of Excitement

Visually, when comparing this graph and that for valence (pleasure), the contour is similar. This visually depicts the significant correlation between high value scores on the arousal (excitement) and valence (pleasure) graphs, and gives me an indication that participants associate higher levels of excitement with higher levels of valence (more excited, more happy).

The following graphs depict comparisons between the composed pieces/pieces (1–10) and the control pieces/pieces (11–14). The study results exhibited some interesting points for reflection here. Despite the inclusion of pieces not composed specifically using the CTEE, and the original aim of making comparison with other previously composed pieces, the decision was made not to proceed with that aspect of the analysis. By virtue of the control piece being composed by the same composer, using similar instruments, their results were not different enough (and could not be) to justify sound comparative results on the SAM scales. This is

discussed further in the coming chapter. In saying this, they still produced some interesting results. Overall, the controls ranked lower on average on the valence (pleasure) scale, than the composed pieces (p=0.08), and were significantly higher on average on the arousal (excitement) scale (p<0.001). This tells me that overall, the composed pieces using the CTEE were more pleasurable, and calmer, than the control pieces.

Group Statistics

	Comp	N	Mean	Std. Deviation	Std. Error Mean
Pleasure	1 Composition	627	3.13	.980	.039
	0 Control	232	2.98	1.105	.073
Excitement	1 Composition	627	2.79	1.055	.042
	0 Control	232	3.18	1.045	.069

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Pleasure	Equal variances assumed	5.012	.025	1.856	857	.032	.064	.145	.078	-.008	.298
	Equal variances not assumed			1.757	373.6	.040	.080	.145	.082	-.017	.307
Excitement	Equal variances assumed	.506	.477	-4.843	857	<.001	<.001	-.392	.081	-.550	-.233
	Equal variances not assumed			-4.863	416.0	<.001	<.001	-.392	.081	-.550	-.233

Figure 74: Comparison between Composed (1–10) and Control (11–14) results

The below graphs depict the frequency of responses to the pieces on the valence (pleasure) scale, and on the arousal (excitement) scale, compared to the composer's (my) own aims. Note: correlations with the composer's aim was not available as all responses = 4.

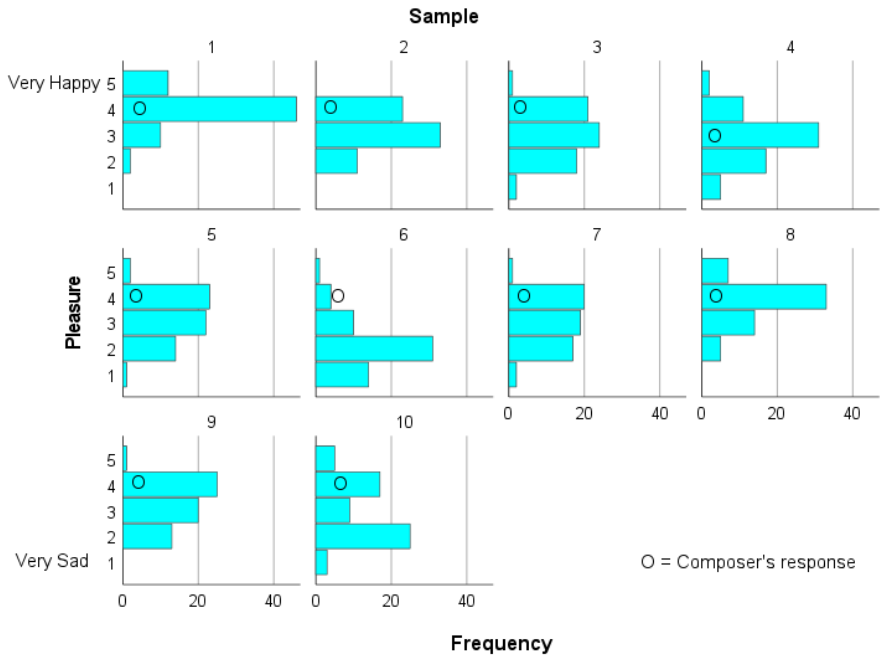


Figure 75: Valence Frequency compared to composer's aim (response)

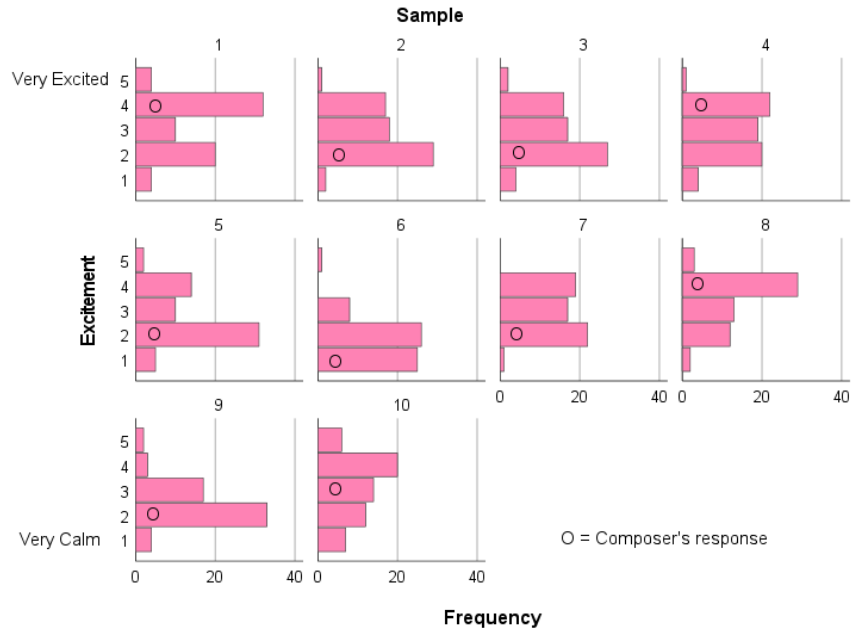


Figure 76: Excitement (arousal) Frequency compared to composer's aim (response)

Across both excitement (arousal) and valence (pleasure) scales, most of the pieces (more than half) have achieved their aim, relative to the most frequent response. If adjacent scores/categories are included, then there are only two (out of 20) cases where the composer's score was significantly divergent to the most frequent score (10%). On the excitement (arousal) scale, eight of ten pieces achieved their aim (80%).

There is a statistically significant correlation between the composer's aims and the most frequent scores on the excitement scale, and although correlation could not be statistically calculated for valence (due to the constant score), the indicative correlations are promising with five matches (50%) for the most frequent scores, and eight matches (80%) if the adjacent categories are included.

Overall findings

This study showed a statistically significant correlation between a high value on the valence (pleasure) scale and a high value on the arousal (excitement) scale, suggesting that participants associate higher levels of excitement with higher levels of pleasure (more excited, more happy).

Results also exhibited that the musical samples were all statistically significantly different in terms of perceived valence (pleasure), and were all statistically different in terms of perceived arousal (excitement). This tells researchers that each musical sample does indeed communicate a unique perceived emotional reaction, and that the samples participants listened to were effective emotionally communicative tools.

This study also showed that Track 6 was the saddest of all tracks on the valence (pleasure) scale, and the calmest on the arousal (excitement) scale overall, the latter which was congruent to my expectations.

In relation to the control pieces/samples used, the study showed that the composed pieces using the CTEE were generally more pleasurable and calmer overall than the control pieces.

Lastly, across both arousal (excitement) and valence (pleasure) scales, comparing the composer's (my) responses to the most frequent responses of participants, most of the musical samples achieved their aim. This is supportive evidence for the utilisation of the CTEE in studies to come.

2.7 Implications and Future Work

Drawbacks, changes/future concessions to be made

Some participants provided unsolicited feedback to the study. Some interesting points were that they felt 5 options were not enough to distinguish their emotions. Also, some participants noted that having a label of 'neutral' was counterintuitive, and that their inclination was to pick a side, rather than 'neutral'. An alternative might be to use a visual analogue scale (VAS) marked with very calm on one end and very excited on the other, on which respondents are able to move a cursor at will and mark a spot at any point in the scale to display their level of arousal or pleasure. The terms happy/sad instead of positive/negative (or pleasant/unpleasant) was an attempt at making the language more accessible to participants on the valence scale. Upon reflection, happy and sad are affects that fall on the Circumplex model, and sadness is understood by emotion theorists to be a lower arousal emotion than happiness. Therefore this might not be the best choice of analogous terminology in future studies.

The controls were 4 pieces with similar harmonic language, similar instrumentation and by the same composer. Because of COVID '19 limitations and study design, the 4 controls were not able to be written using the CTEE to effect specifically the opposite emotive reaction to those

of the 10. The emotive reaction was randomised. Also, the 10 pieces were not written to evoke the same excitement/valence (arousal/pleasure) levels. Because of this, there were limitations to the efficacy of the controls in the study design. Future surveys might use control pieces written using the CTEE trying to evoke excitement and anger (perhaps) as effective controls, against pieces using the CTEE that aim to effect identical scores to each other.

Potential research into music that is appropriate for teenagers versus music that is appropriate for adults might enhance the efficacy of future similar study. Although from an emotional awareness perspective, individuals aged 15 and up are presumed to have developed mental faculties and so the equal ability to self-assess, there is a potential that preference for music style and genre is being left out of the study design, and may impact the results in some capacity.

Participants may have identified the final valence and arousal level elicited from the music, or a prominent valence and arousal level they observed. Testing smaller fragments of the pieces (i.e., using the specific fragments listed for their correlative aimed affect at the start of each work's analysis) might produce more streamlined results. There is also potential that participants did not complete the listening of each piece, before responding, which would affect the results of the study. Further workarounds include programming a limit into the study platform that only allows participants to answer the study question once the sample is finished.

The measurement of perceived cathartic experience in this study has also in retrospect appeared challenging. If researchers deem catharsis as the process of excitement, then an arousal release to calm, catharsis is not measurable with only one arousal measurement at the end of the experience. I have assumed that the level of arousal would be higher at the end of the work than those of pieces that were deemed to be calm overall, however in future studies a more accurate measurement could be utilised – either as discussed above, using smaller

pieces of pieces and hence garnering multiple responses per work, or requesting responses at multiple points during the single experience.

The composer's (my) method to assigning an arousal score to each piece was created for the purpose of this study. I deemed sections of each work as either calm or cathartic, and then correlated the percentage of cathartic content to a number on the arousal scale. In future studies, a normalised or alternate approach might be beneficial. In proposed potential future testing of smaller fragments of pieces, however, the current segmentation of the works into calm or cathartic categories might be more suitable, or perhaps the segmentation should directly address the labels on the SAM scales.

In reference to the comparison of the composer's aimed results/own answers and the frequency scores (figures 76 and 77), further enquiry might investigate the cases that were particularly divergent. Samples 6 and 10 were aimed at being happy and were assessed as sad. Their arousal scales were similar to the most frequent scores (adjacent score), but the pleasure scale was quite divergent. An avenue for enquiry here might involve contacting participants who opted-in for contact regarding future studies, and interviewing them in a semi-structured manner to gauge nuance around their valence (pleasure) responses. It should be noted again, however, that my aim was to first affect arousal levels (excitement) in a specific way, and then observe valence levels (pleasure) to gauge initial data and any potential correlations between happiness and excitement. In this respect, the study achieved its aim.

2.8 Conclusion

The Wellness Project was a study that was successful in helping me gauge the effects of the CTEE on emotions. It provided insight into associations between excitement and pleasure and was a critical instrument for the progression of the use of the CTEE for music for emotional evocation.

The study showed that participants associate higher levels of excitement with higher levels of pleasure in these works (more excited, more happy). Results also exhibited that the musical pieces were all statistically significantly different in terms of perceived pleasure and excitement states. This tells me that each musical sample was an effective emotionally evocative tool, and that in comparison to the control pieces used, the study pieces were more pleasurable and calmer overall than the control pieces.

This study also showed me which of my musical pieces was the saddest and calmest overall (Track 6), and provided insight into how accurate the composer's (my) intended affect was compared to the participants' perceptions – that the majority of the musical pieces achieved their aim. There was also a statistically significant correlation between the composer's aims and the results on the excitement scale, and strong indicative correlation for the same on the valence scale — which is supportive evidence for the utilisation of the CTEE in studies to come.

Chapter 3:
Music and Video for Calming Children in Medical Circumstances – a Study

3.1 Introduction

Can the pairing of music and video affect calm and happiness in a child? Music and Video for Calming Children in Medical Circumstances was a pilot study aimed to ascertain through the testing of music examples created using the Compositional Toolbox for Emotional Evocation (CTEE), paired with video examples – the efficacy of their ability in inducing calm and happiness in children.

The project tested whether music written for brief and age-appropriate video game visuals could have an overall soothing effect. It also gauged preliminary feedback on children's opinions of the colours and climates depicted in the visuals. A video game was written and created by researcher Naseem Ahmadpour and scored by Natalie Nicolas (myself) with the aim of quickly placating a child under duress associated with general medical attention – aiding in combatting white-coat anxiety/hypertension. As previously explained in this dissertation, "white coat hypertension" refers to the prevalent occurrence of elevated blood pressure in children when they are at a hospital or doctor's office, primarily caused by the anxiety triggered by the clinical environment. Between 30 and 40% of children with general hypertension noted in clinics, can specifically attribute their high blood pressure to white coat anxiety (Jurko et al., 2016).

This pilot study aimed to validate the music written for said game, and the efficacy of its pairing to the visuals that would appear in the game, for potential use in a successive study

that gauges the efficacy of emotional communication by the musical and videographic samples when paired in their comprehensive game format in healthcare settings. Given the lack of existing literature and study on this topic to date, the study also aimed to fill a gap in the knowledge. Due to the COVID-19 pandemic and restrictions on study design, there were limits to the recruitment of participants, but the number of participants used in this study was sufficient for the pilot nature of the research (Hertzog, 2008).

3.1.1 Research Questions

The research questions that guided this study were: Can music written using a CTEE affect both arousal (excitement) and pleasure (valence) levels in a linear fashion (i.e., excited to calm, sad to happy)? Can colour and landscape-specifically engineered animations affect both arousal and pleasure levels in a child? Can the stimulus pairing of music and video specifically, have a more substantial arousal and pleasure affect on a child over an isolated musical experience? Is the music that was created for the study perceived to "match" the animations that were created from a pleasure and arousal perspective, and vice versa?

3.2 Background

For the purposes of this study, I define arousal and pleasure in the following ways: pleasure pertains to pleasure (valence), specifically on a scale from happy to sad, and arousal pertains to excitement, so variations of calm to excited.

There are various themes that shaped this study. I have acknowledged them and will discuss the existing literature to date, as shaped by said themes, below.

3.2.1 Music's Ability to Change General Emotional State

Large bodies of research exist attesting the ability of music to change both general and specific emotional state. Countless researchers since the 1960s have enquired and found evidence of music's ability to alter *general* mood (Götell et al., 2009; Kemper & Danhauer, 2005;

Konnikova, 2013; Salerian, 2015), and researchers such as McNair et al. (1981) have also proved the ability for music to alter *specific* mood.

3.2.2 Music and Game Production

Today, we are existing amongst the eighth generation of gamers. Generations Y/millennials, Z and Alpha are those who grew up with videogames – with the first video game emerging in 1961. By the time of Generation Y, video games were deeply embedded in the zeitgeist of their development (Persson & Medin, 2009).

The interpretation of mood, emotion and energy arousal (various affective phenomena) through these games has become an intuitive process. We now have a subliminal awareness of the foundational communication system/language that creators use to articulate and depict dramatic meaning (Thomas, 2017).

Chance Thomas in "Composing Music for Games" (2017) puts this eloquently:

> Individuals immersed in a given language naturally acquire a familiarity with that language over time. They develop expectations about its conveyance and assign meaning to certain modes of expression, patterns and dynamics. Children cultivate speaking patterns and acquire vocabulary in much the same way. In a media-saturated culture, familiarity with scoring language distils naturally from years of exposure to music scores across many formats.

My CTEE, paired with this intrinsic understanding having been developed over my lifetime as a member of Generation Y, meant the creation of music to match videos that were engineered in the design labs of the University of sSydney for this study was informed and calculated beyond even conscious thought.

3.2.3 Musical Features Associated with Emotions

Various technical musical facets are associated with emotional experience. Certain intervals can elicit specific feelings (Costa et al., 2000; Curtis & Bharucha, 2010; Gosselin et al., 2015), major and minor tonality are evocative of the respective notions of happiness and sadness in Western tonality (Gosselin et al., 2015), and pitch contours in melodic, countermelodic and accompaniment lines can elicit emotional reaction connected to the prosodic features of speech embedded in their cultural dialect (Frick, 1985). Musical features used deliberately in the samples created for this study, were utilised through the CTEE, which draws on data from said researchers and alike, to base its premises upon.

3.2.4 Videographic Features Associated with Emotions

Specific colours and visual patterns have been found to trigger emotional response through their association to real-life parallels due to 'Ecological Valence Theory' (Palmer and Schloss, 2010). See theories discussed in chapters 1.5, and 2.2.1 in this thesis for more information.

Visual storytelling is also an effective means of emotional alteration. Visuals depicting what would typically be considered a 'soothing' environment, can induce peace and catharsis for viewers (Ahmadpour et al., 2019). Furthermore, studies that paired music and visuals together have proved effective in altering psychological wellbeing for the better. Chemotherapy patients were exposed to visuals and music together in a study in 2010 that aimed to gauge whether the experiences would promote relaxation, reduce nausea and reduce emesis. The study aimed to alleviate common chemotherapeutic side effects, and results from the participants showed that the guided imagery with music was very effective in inducing relaxation for patients (Gimeno, 2010).

It is through these observations that Naseem Ahmadpour and her team endeavoured to create visuals in this study to pair with music, that depicted ostensibly pleasing exhibitions of fertile

nature and similar contexts when aiming to induce calm and happiness for children, and exhibitions of arid desert when aiming to 'match' possible existing feelings of anticipation.

3.2.5 Music and Meditation

A common association regarding calming music is meditation-specific music (music that individuals would expect to hear whilst meditating.) The further association then is that meditative music induces happiness (Dambrun et al., 2019). In the interview component of this study, participants regularly made connections with some music from the study and meditation music – specifically noting that the music makes them calm and happy and 'feels like' meditation music. It is surmised that this association is likely due to the participants' lack of extensive exposure to calming music outside of the meditation realm, and I purely note the participants' emotional reactions to the music as similar to that of meditative music, rather than the suggestion that the music in the samples in *feature*, akin to meditation music.

3.2.6 Filling A Gap in Studies of the Efficacy of Music and Visuals

Limited data exists that gauges the efficacy of music written specifically to induce certain emotions – particularly for children. Research to date has identified various technical facets of music that can induce certain emotions, investigated what psychologically occurs during musical and tandem emotional experience, and even verified that music can and does change specific emotional state. It has not however, pointedly examined the effect of music written to evoke specific emotions. The CTEE is an amalgamation of the aforementioned insights into the relationship between music and emotions from the perspective of music-making. This study tests the efficacy of said CTEE, and further, the efficacy of the visuals used in the production of the game.

3.3 Method

A video game was generated by a team of researchers/engineers in the design labs of the University of Sydney led by Dr Naseem Ahmadpour. The game was designed to have calming effects on children. The visuals in the video being used are a product of careful research and were designed specifically to appeal to children (using appropriate colours, animals and landscapes). The game shows four different landscapes (the first arid, the second less so, the third is a bridge crossing water and the fourth is a natural haven filled with butterflies, birds, etc.), and the participant 'walks' through each section, shooting pebbles at random items they can see in order to 'free the cats'. When an item is shot, a cat may appear, and it will join the participant at their feet in the game and walk through the remainder of the game with them. By the third/fourth stage, the participant has accumulated a hoard of cats, and by stage four, has led them to their haven.

Four different samples of music were created to match the four levels of the game by researcher and composer Natalie Nicolas (myself). The music was also created and designed to appeal specifically to children. It was created with the intention of matching the animations of the game. Child-appropriate instrumental choices and harmonies were utilised – the use of the marimba (similar to a xylophone – one of the most common instruments a child is first exposed to due to its bright colours and lack of dexterity complexity (Geringer, 1977; *Top 10 Instruments for Children to Learn to Play Music*, 2022)) and harmonies that are consonant and modally major, were deemed to be demographic-appropriate.

Both game visuals and matching audio were created for the purposes of calming children in heightened states. The aim of the samples were to match a participant's heightened state, and then over the course of the experience, calm them down.

For the purposes of this study, I was gauging data first around perceived emotional evocation of the audio only, and then matched with its video clip from the game. This was to help in

understanding the efficacy of the samples that were created for the game. The samples were tested on two scales: arousal (excitement) and pleasure (valence). The desired effect on the arousal (excitement) scale was a lower value (towards very calm), while the desired effect on the pleasure (valence) scale was a higher value (towards very happy).

Children/adolescents between the ages of 6 and 15, both male and female, engaged with audio and video excerpts, programmed by us. They engaged with eight examples in total – four pieces of music in isolation, and four pieces of music accompanied by video, through their personal devices and with headphones. After engaging with each example, they picked an arousal level from 1 to 5 (labelled 1 – very calm, 2 – calm, 3 – neutral, 4 – excited, 5 – very excited) and a pleasure level from 1 to 4 (1 – labelled 1 –very sad, 2 – sad, 3 – neutral, 4 – happy, 5 – very happy) from a provided list that best describes how each example made them feel based on a modified SAM scale, which is a Likert-type scale. The modified SAM scale was used with abbreviated images displayed in emoji form, which are widely recognisable by children (Swaney-Stueve et al., 2018). Children recognise/understand emotions from a facial perspective (Gross & Ballif, 1991) hence the addition of matching visual cues for the response options.

I collected the responses for each excerpt through the RedCap platform, and filed them with a unique participant code, indicating which excerpt the participant engaged with and what their specific responses were. The participants listened to the audio using headphones or speakers, and watched the video via laptops and other personal devices.

Twenty-six participants were tested. The excerpts were limited to four videos and four pieces of music so the sample size is large enough to test with this number of examples for a pilot study.

The selected age group was chosen as such, as I was aiming to inform the foundations of further study using the game in full, aimed at adolescents receiving needles and general procedures in practices and hospitals who suffer from “white coat anxiety”.

I also conducted interviews with selected volunteering participants. Participants in this study were able to opt-into future contact with researchers, and some chose to partake in our interview process. The interviews were semi-structured and aimed to help me gauge nuance and garner qualitative data surrounding the quantitative data collected from the SAM scales. Some of the questions asked in these interviews were: “What stood out more, the music, the video, or they were even?”, “Did this excerpt remind you of anything?”, and “Why did this excerpt make you feel [sad, happy, etc.]?” The interviews were then analysed using thematic analysis techniques to draw meaning out of the qualitative data gathered to better inform the results from the quantitative data.

I expected to see respondent’s answers change over the passage of time. Over the course of all four audio samples, and then over the course of all four videos, the samples tried to achieve the following:

- Arousal: moving from excited/very excited towards calm/very calm
- Pleasure: moving from sad/very sad towards happy/very happy

Music in the experience was created using the CTEE. A snapshot analysis of the presence of some of the mechanisms from the CTEE in the samples, is included in the Approach section of this chapter.

The study recruited 26 participants in total. The strategy for sampling participants was through word-of-mouth and social media recruitment. The only limitations placed on participants was an age range of 6–15 years, and there were 13 female and 13 male participants. The COVID-19

pandemic restricted participant numbers, but I was able to recruit enough participants for the scope of a pilot study.

The study utilised a mixed-method approach, combining both quantitative and qualitative research to provide a more comprehensive and holistic understanding of the research questions, whilst compensating for each approach's respective limitations. Also due to the small sample size, we believed the qualitative aspect would be crucial to garner meaning to the data. Dr. John W. Creswell is a prominent researcher who has extensively contributed to the field of mixed methods research. His work has highlighted several benefits of using mixed methods, as outlined below:

1. Comprehensive Understanding: Mixed methods research can provide a more complete and nuanced understanding of complex phenomena. Quantitative data can offer statistical insights and trends, while qualitative data can uncover the underlying meanings, motivations, and context behind those trends (Creswell et al., 2011; Creswell, 1999).

2. Triangulation: This refers to the process of comparing findings from different data sources or methods to enhance the validity and reliability of the study. By triangulating quantitative and qualitative data, researchers can confirm, cross-validate, or explain patterns observed in one type of data using the other type (Creswell et al., 2011; Creswell, 1999).

3. Enhanced Validity: Mixed methods research can enhance the validity of the study by addressing the limitations of each approach. Qualitative methods can provide insights into unexpected findings from quantitative data, and quantitative methods can provide empirical support for qualitative findings (Creswell et al., 2011; Creswell, 1999).

4. Personalisation of Data: Qualitative data allows researchers to capture individual experiences, perspectives, and context, which can be difficult to achieve through quantitative methods alone. Combining both types of data can lead to a more human-centered and contextually rich analysis (Creswell et al., 2011; Creswell, 1999).

5. Theory Development: Mixed methods research can facilitate the development of more comprehensive and well-grounded theories. Qualitative data can provide insights that generate hypotheses for further testing using quantitative methods (Creswell et al., 2011; Creswell, 1999).

The researchers involved in the study had backgrounds in design and in music composition, and experience in generating and analysing creative experiences for emotional evocation. It was our position as researchers that the visuals and paired music would be effective in inducing a range of pleasure and arousal levels depending on the intention for each sample.

All four samples of music used in this study were created using the CTEE. Below is a snapshot discussion outlining a single instance per piece of mechanism inclusion from the CTEE. It serves as an example of how the CTEE has been applied over the duration of each song.

3.3.1 "Stage One"

Rhythmic Unity

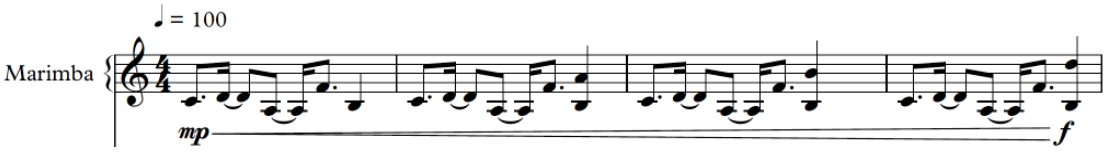


Figure 77: "Stage One" b. 1–4 marimba ostinato

"Stage One" aims to evoke the highest arousal level of all four samples. The excerpt above exhibits an ostinato established in the entry of "Stage One". The ostinato is syncopated, and at a tempo of 100bpm – within the range of the average resting heart rate of a child (Vega,

2017). Rhythmic Unity relies on a prominent rhythmic pattern to entrain with the listener's heart rate, and "Stage One" aims to achieve this from the onset of the work. Researchers aimed to match and entrain to a relatively high resting heart rate, anticipating children experiencing 'white coat anxiety' will have higher arousal (excitement) levels than normal. The ostinato is reinforced shortly after its introduction by other instruments (see below figure), and gradually the divisible beat is subdivided to allow for a feel of a faster tempo, and thus the possibility of entraining with a heartrate faster than 100bpm. The entrainment through Rhythmic Unity is crucial for "Stage One" so that researchers can use said mechanism in successive tracks to gradually slow the heartrate of the listener and evoke calm. Successive tracks also use ostinato to continue to entrain with and shift listener's heartrates in order to reflect the intended arousal narrative.

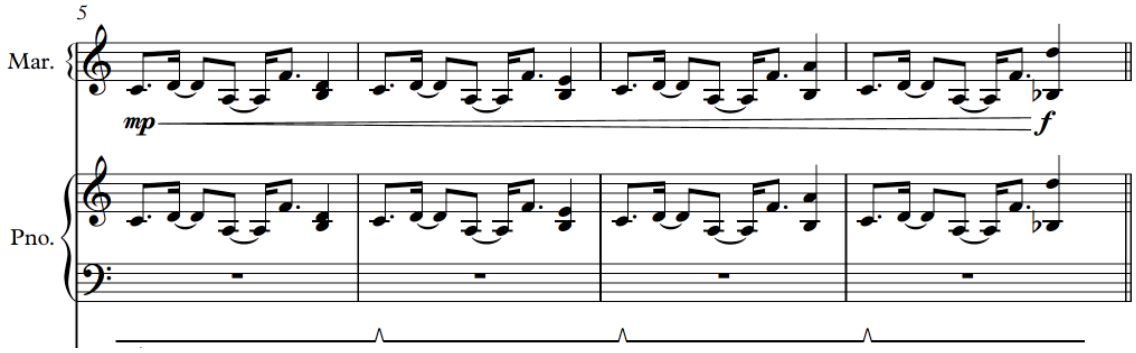


Figure 78: "Stage One" ostinato in marimba and piano, b. 9–10

3.3.2 "Stage Two"

Intervallic and Contour Affect Theory and Rhythmic Unity

The final section of this work utilises rising contour passages in the basslines (in cello, viola and left-hand piano), locking in with the ostinato set up earlier in the work that utilises syncopation in a 3 + 3 + 2 pattern. Through Intervallic and Contour Affect Theory, the ascending contour attempts to depict anticipation, a lifting of spirits, and positivity. Paired with the major tonality – which is associated with happiness (Parncutt) – the end of "Stage Two" attempts to begin to lift pleasure (valence) levels.

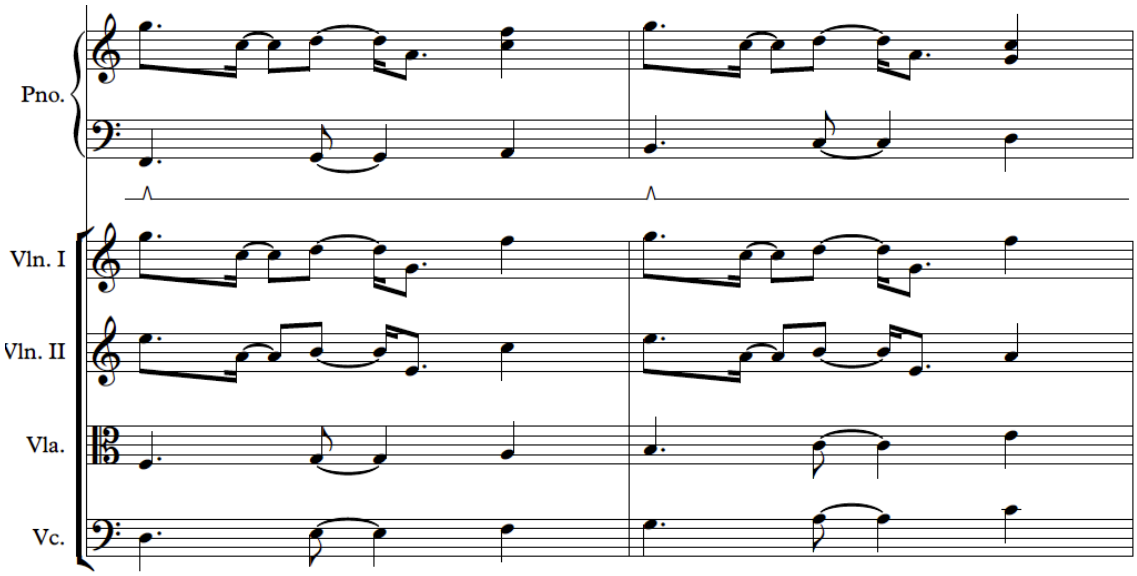


Figure 79: "Stage 2" rising contours in basslines of cello, viola and piano b. 21–22

3.3.3 "Stage Three"

Rhythmic Unity, and Intervallic and Contour Affect Theory

The below figure shows an ostinato set up in the work, to promote rhythmic entrainment with the listener's heartbeat. The tempo of the work is now 80bpm – a decrease since the first work. Despite utilising quavers in the ostinato, "Stage Three" is dominated by semibreves that counteract the quavers and aim to slow the perceptible pulse. This piece utilises Intervallic and Contour Affect Theory in the aim of depicting power, stability, and positivity. The aim of the work is to fully neutralise the high arousal of "Stage One" and moderate arousal of "Stage Two". Consider bar 5 of the excerpt below taken from the beginning of the work. From a vertical (harmonic) perspective, it collectively encompasses major 3rds, perfect 4ths, perfect 5ths, octaves; and from a horizontal (melodic) perspective, major 3rds, perfect 5ths and perfect 4ths. To support this intervallic valence, accompanying chords in the strings also use similar intervals. The harmony outlines an F major chord in first inversion, with intervals of a minor 3rd, minor 6th, and perfect octave from bottom to top of the range. Although the minor 3rd and 6th intervals might ordinarily evoke sadness or displeasure, paired with the major tonality of the chord and the surrounding intervals and their correlative affect, the aim of this

particular chordal affect (and this serves as an example of how the harmony is treated throughout the work) is to evoke emotion akin to pensiveness, nostalgia and/or neutrality. The chord proceeding this utilises again, major tonality, and intervals of a perfect 5th and major 3rd. Ideally, the balance of the positive valence intervals and tonality surrounding the minor intervals (that are a simple by-product of inverting the chord at hand – which would in root position ordinarily depict a perfect 5th, major 3rd and octave), aim to skew the affect away from sadness and towards positivity.

Figure 80: "Stage Three" bb. 4–6

3.3.4 "Stage Four"

Rhythmic Unity, and Intervallic and Contour Affect Theory

"Stage Four" aims to be the most positive and uplifting piece of the suite. It regards the final stage of the game, and the visual narrative depicts a character reaching a quasi-Utopia. The work significantly utilises Rhythmic Unity and Intervallic and Contour Affect Theory to shape this narrative. The below figure depicts the use of an ostinato in the work, surrounded by

repeating cells of rising contour material, and uses (in both a harmonic and melodic capacity) intervals of power, stability and positivity. The rising contour of the strings, piano and marimba aims to depict a picking up of spirits, optimism, and activation. The predominance of major 2nds, perfect 5ths, perfect 4ths in the intervallic content, aims to form an emotional foundation of positivity and power, and the overall major tonality of the piece supports this work with an overall positive valence. The tempo of the piece remains at 80bpm, however the excerpt below is a representation of the middle of the work, whilst the end of the work progressively augments its rhythms to encourage a feel of half (and even quarter) time, allowing the entrained heartbeat to slow to a state of calm.

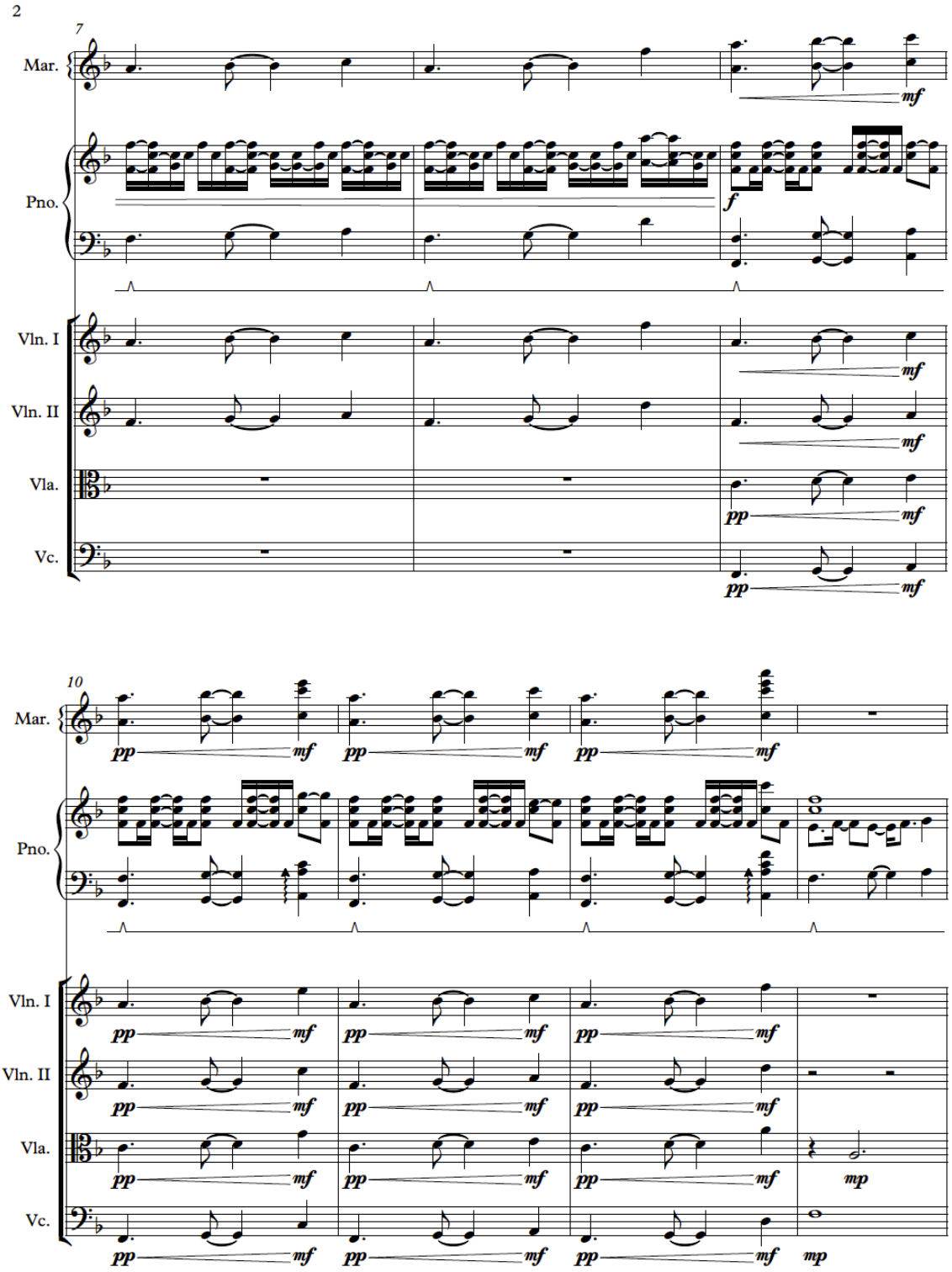


Figure 81: "Stage Four" intervals of power, stability and positivity, as well as rising contours, b. 7–14

3.4 Data Collection Method

I used mixed-method data collection in this study. The first was in the form of an online survey, and the second was in the form of a semi-structured interview. For the online survey, participants visited a website, and when the study began, listened to four excerpts of music in isolation, reporting how each made them feel in terms of arousal and pleasure. They then listened to and watched four excerpts of music and video paired together, reporting on each in the same way. Participants were informed that they were helping to inform researchers about music and video in order to help us create a game in the future. For the semi-structured interview, five participants (chosen at random) were asked a range of questions and responded in a conversational manner. The interview's scripts were generated, and thematically analysed for codes and themes to provide nuance to the quantitative data.

3.5 Data Analysis Method

Thematic analysis was used for the qualitative information collected, and the quantitative information was addressed using descriptive and graphical methods.

For the qualitative data, interviews were transcribed orthographically using the artificial intelligence system Otter. The transcriptions were then manually edited for accuracy, and all details were retained, e.g., false starts, laughter, hesitation, indirect acknowledgement such as "mm hm", etc. – I believe these details hold crucial nuance. An inductive approach was used for the thematic analysis, where the codes and themes were directly derivative of the data content (with inevitable relevance to the study being factored in). I carefully read through the transcriptions multiple times, and eventually highlighted passages I deemed important to the narrative of the study. From these passages, 39 codes were generated, and from the codes, five relevant overarching themes materialised.

More formally for the quantitative analysis, a general linear model was fitted to the questionnaire results, with sample (compositions 1–4), type (audio alone, audio plus video)

and their interaction as fixed factors, and participant as a random factor. The required assumptions were checked and found to be (at least approximately) satisfied.

The ages of the participants ranged from 5 to 15 years of age. The mean age of the various participants was 10.8077 and the standard deviation was 2.8003.

3.6 Findings and Discussion

We found that on the pleasure (valence) scale there were significant differences between some samples (and sample 3 (audio alone) was saddest). We also found that there were significant differences on the arousal (excitement) change between audio (alone) and (audio plus) video, with the latter being more exciting.

We also found that the audio samples depicted more significantly diverse change over the course of listening, than the video samples, on the pleasure (valence) scale. The happiest sample and the most excitable was 4A – track 4 (audio only).

On both the pleasure (valence) and arousal (excitement) scales, there was a general rise over time for the videos, and an increase in pleasure but a decrease in arousal for audio. Though not statistically significant, this was supportive indicative data for future studies.

3.6.1 Quantitative data

A reminder of the modified SAM scale is provided here for reference:

- AROUSAL (EXCITEMENT):
    - 1 (very calm) – 2 (calm) – 3 (neutral) – 4 (excited) – 5 (very excited)
- PLEASURE (VALENCE):
    - 1 (very sad) – 2 (sad) – 3 (neutral) – 4 (happy) – 5 (very happy)

The graph at Figure 82 shows how often (frequency) pleasure (valence) were rated amongst the samples. On the y axis, we have 1–5 (very sad to very happy) and on the x axis we have how many times it was recorded. Each smaller table represents the sample type (1–4 of audio, then 5–8 of video).

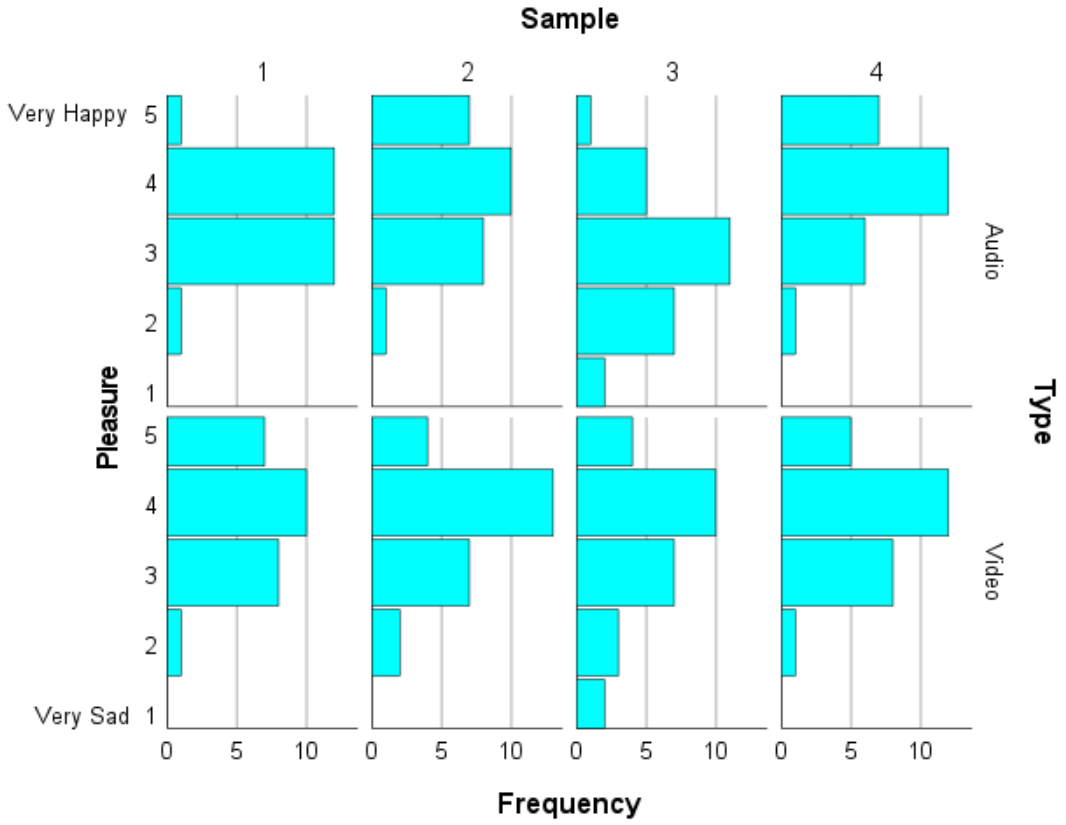


Figure 82: Frequency of pleasure (valence)

The graph at Figure 83 shows how often (frequency) arousal levels (excitement) were rated amongst the samples. Again, on the y axis, we have 1–5 (very calm to very excited) and on the x axis we have how many times it was recorded. Each smaller table represents which sample (1–4 of audio, and then 5–8 of video)

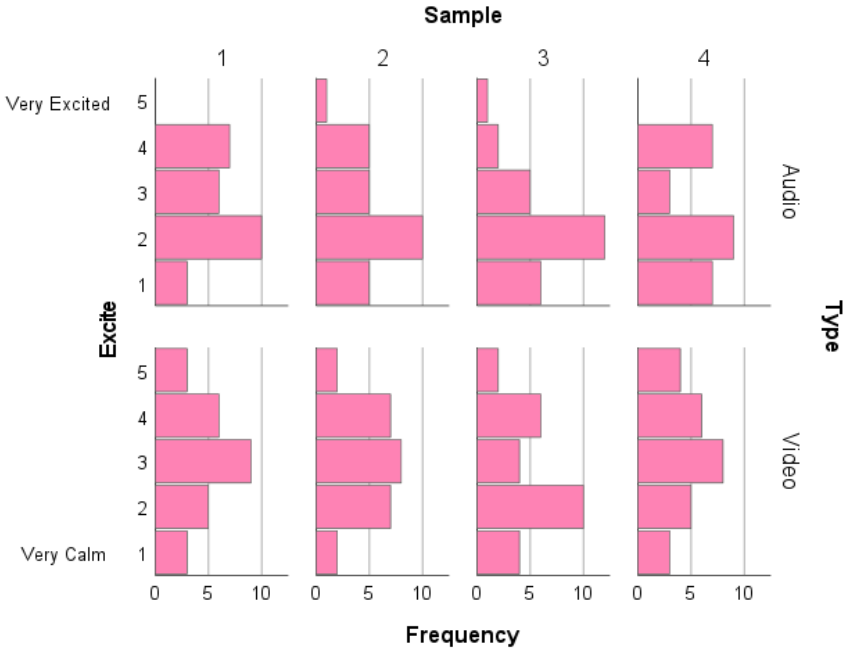


Figure 83: Frequency of excitement (arousal)

The graph at Figure 84 shows the averages of the scores across each sample (top row of samples are audio 1–4, and bottom row of samples are video 1–4). In respect to pleasure (valence), you can see that for audio – pleasure for samples 4, 2 and 1 (in that order) were neutral to happy, and 3 was sad to neutral, whereas pleasure for video sit between neutral and happy overall. Notably, sample 3 (audio) and sample 3 (video) is lowest on the pleasure (valence) scale for both. In respect to arousal (excite) overall, you can see that for the audio, the excitement responses are lower than those for the video, and vary more across all four audio responses than the four video responses. Similarly to the pleasure response, sample 3 (audio) and sample 3 (video) has the lowest arousal (excite) score of all four samples.

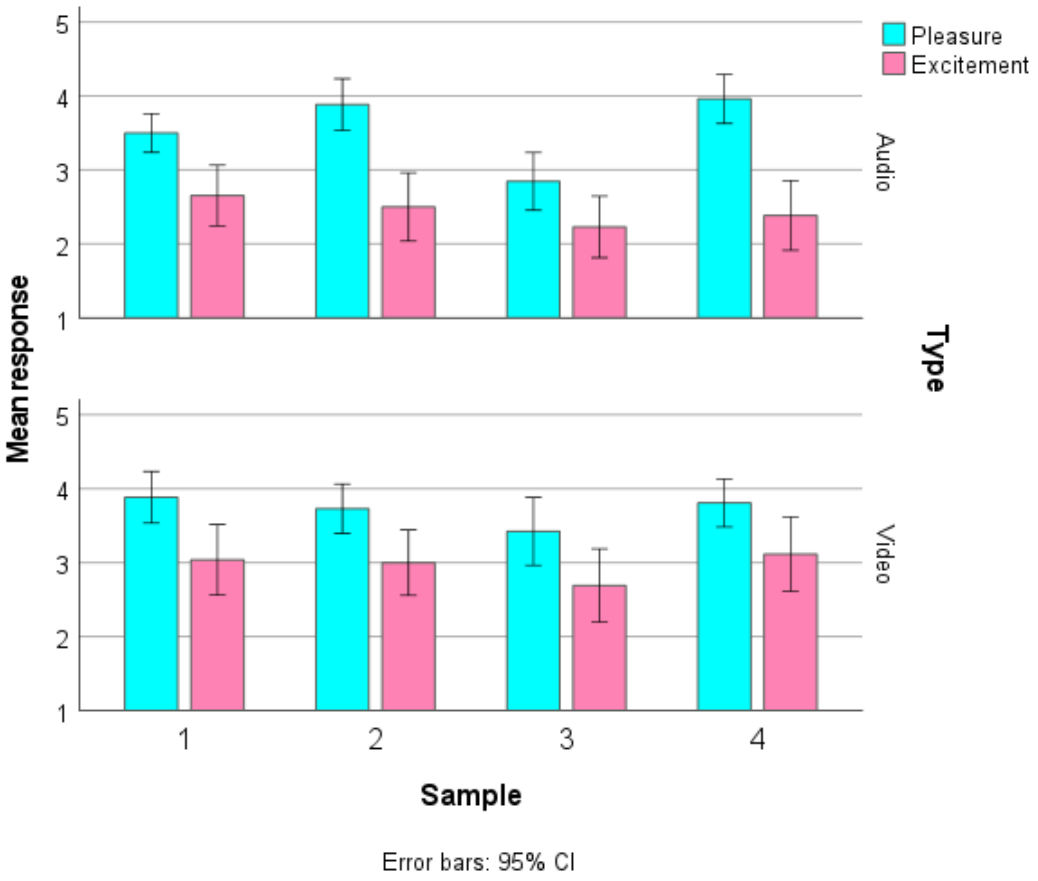


Figure 84: Mean responses in pleasure and excitement

The following graph is a depiction of the raw data results. The red dots show the averages of arousal versus pleasure (excitement versus valence), of all samples. Samples are labelled with a number and type, correlating “A” for audio or “V” for video, e.g., “1A” is audio sample 1. It is clear that it is the most pleasurable sample and the most excitable is 4A. However, this is closely followed by 2A, and so on. It is also clear that the saddest and least excitable sample is 3A. This is by far an outstanding result compared to the other samples, as is visually depicted in this graph.

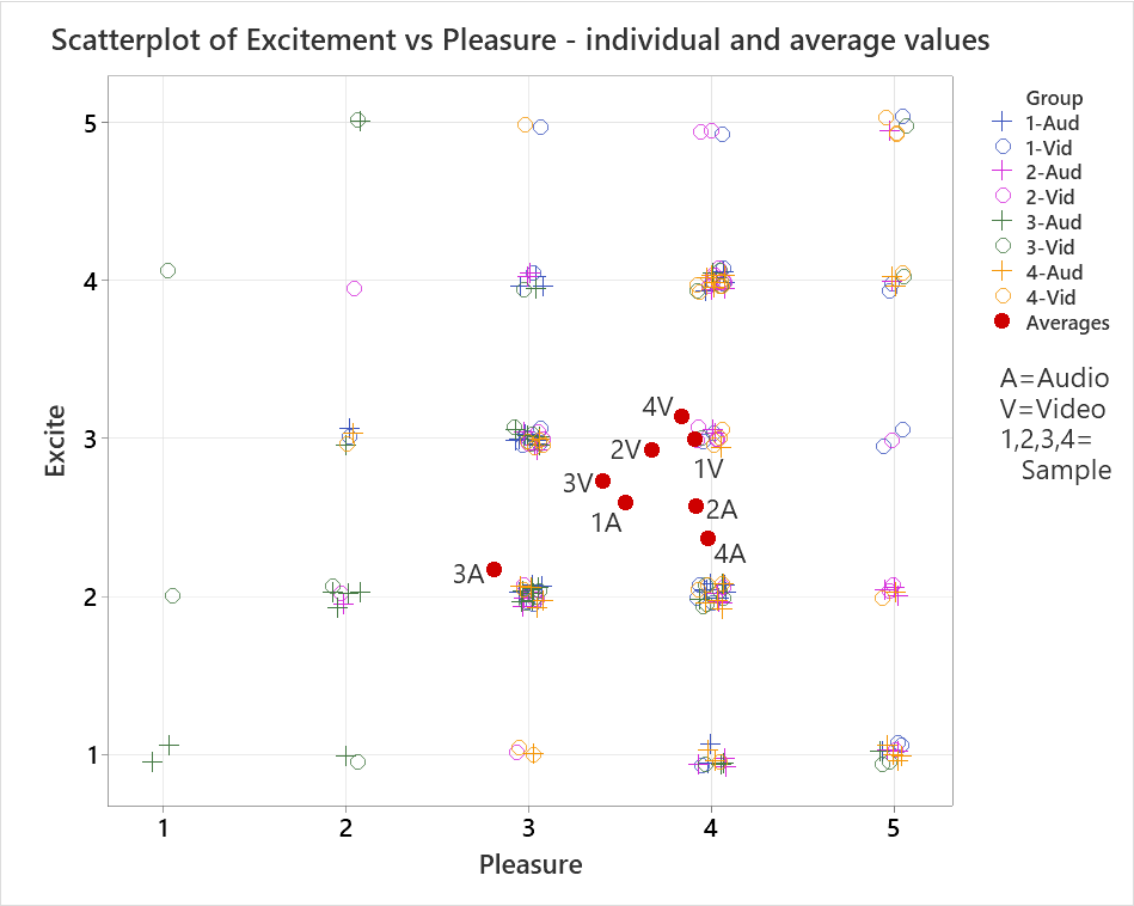


Figure 85: Scatterplot of Pleasure versus Excitement

The actual numerical report and its correlations depicted visually in the above scatterplot are shown in the following tables:

Report

Type	Sample	Pleasure Mean	Pleasure Stdev	Excitement Mean	Excitement Stdev
1 Audio	1	3.50	.65	2.65	1.02
	2	3.88	.86	2.50	1.14
	3	2.85	.97	2.23	1.03
	4	3.96	.82	2.38	1.17
	Total	3.55	.93	2.44	1.09
2 Video	1	3.88	.86	3.04	1.18
	2	3.73	.83	3.00	1.10
	3	3.42	1.14	2.69	1.23
	4	3.81	.80	3.12	1.24
	Total	3.71	.92	2.96	1.18
Total	1	3.69	.78	2.85	1.11
	2	3.81	.84	2.75	1.14
	3	3.13	1.09	2.46	1.15
	4	3.88	.81	2.75	1.25
	Total	3.63	.93	2.70	1.16

Correlations

		Pleasure	Excitement
Pleasure	Pearson Correlation	1	.041
	Sig. (2-tailed)		.561
	N	208	208
Excitement	Pearson Correlation	.041	1
	Sig. (2-tailed)	.561	
	N	208	208

Figure 86: Report on averages of Excitement and Pleasure, and correlations in statistical analysis

The statistical analysis in the following tables outline various significances in the study in regards to pleasure (valence). Sample (meaning sample number), type (meaning sample type – so audio or video), sample * type (the pairing of both), and subject (participant). Where the

significance is less than 0.001 (<0.001), we see that the parameter has significantly affected the results. The two instances relevant in this graph are Subject and Sample, which both show a significance of <0.001. Subject is an expected influence, considering each participant is an individual person and therefore will have an individual response to the survey. However the other parameter that scores <0.001 significance is Sample. This shows that on the pleasure (valence) scale, the differing samples had a statistically significant influence on the results. This means that there were significant differences somewhere in the samples. Post-hoc analysis via the pair-wise comparisons in figure 90 show that there are significant differences between 3 and the other samples, but that the other samples did not differ significantly from each other in terms of perceived emotional evocation. The low (r=0.041) and non-significant (p=0.56) correlation between scores on pleasure and excitement indicate that the two aspects are viewed independently by respondents, with no obvious relationship between their rating of pleasure and excitement.

Tests of Between-Subjects Effects

Dependent Variable: Pleasure

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	2740.505	1	2740.505	1686.664	<.001
	Error	40.620	25	1.625[a]		
Sample	Hypothesis	17.976	3	5.992	9.277	<.001
	Error	113.034	175	.646[b]		
Type	Hypothesis	1.389	1	1.389	2.151	.144
	Error	113.034	175	.646[b]		
Type * Sample	Hypothesis	5.476	3	1.825	2.826	.040
	Error	113.034	175	.646[b]		
Subject	Hypothesis	40.620	25	1.625	2.516	<.001
	Error	113.034	175	.646[b]		

a. MS(Subject)

b. MS(Error)

Figure 87: Tests of subjects-between effects

Estimates

Dependent Variable: Pleasure

Type	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1 Audio	3.548	.079	3.393	3.704
2 Video	3.712	.079	3.556	3.867

Estimates

Dependent Variable: Pleasure

Sample	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	3.692	.111	3.472	3.912
2	3.808	.111	3.588	4.028
3	3.135	.111	2.915	3.355
4	3.885	.111	3.665	4.105

Figure 88: Estimates of Pleasure per sample and type

Pairwise Comparisons

Dependent Variable: Pleasure

(I) Sample	(J) Sample	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-.115	.158	.465	-.426	.196
	3	.558*	.158	<.001	.247	.869
	4	-.192	.158	.224	-.503	.119
2	1	.115	.158	.465	-.196	.426
	3	.673*	.158	<.001	.362	.984
	4	-.077	.158	.626	-.388	.234
3	1	-.558*	.158	<.001	-.869	-.247
	2	-.673*	.158	<.001	-.984	-.362
	4	-.750*	.158	<.001	-1.061	-.439
4	1	.192	.158	.224	-.119	.503
	2	.077	.158	.626	-.234	.388
	3	.750*	.158	<.001	.439	1.061

Based on estimated marginal means

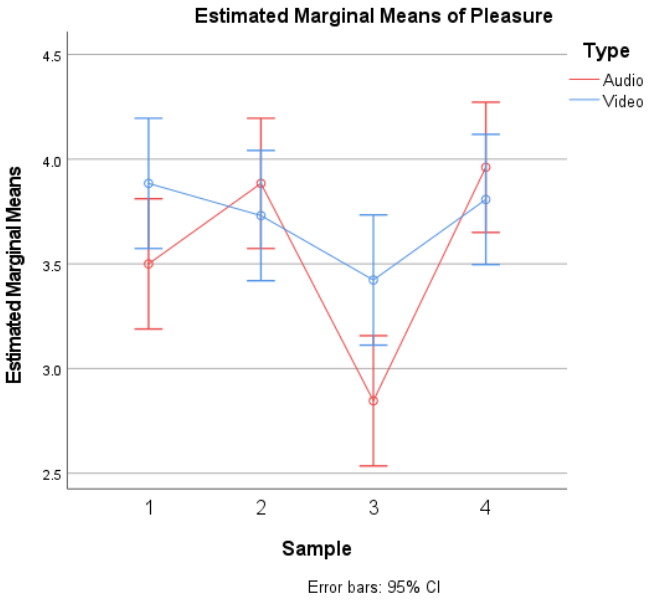
*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Figure 89: Pairwise comparisons for Pleasure

The following graph and table depict the variance of results for pleasure (valence) change across both the video and the audio samples. Overall, the audio samples depicted more diverse change than the video samples, on the pleasure scale. The marginally significant

Sample by Type interaction (p=0.04) indicates that the profiles of audio and video are somewhat different across the samples, which can be seen in the graph below.



3. Sample * Type

Dependent Variable: Pleasure

Sample	Type	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1 Audio	3.500	.158	3.189	3.811
	2 Video	3.885	.158	3.574	4.196
2	1 Audio	3.885	.158	3.574	4.196
	2 Video	3.731	.158	3.420	4.042
3	1 Audio	2.846	.158	2.535	3.157
	2 Video	3.423	.158	3.112	3.734
4	1 Audio	3.962	.158	3.650	4.273
	2 Video	3.808	.158	3.497	4.119

Figure 90: Estimated means of, and sample comparisons for Pleasure

The statistical tables below again outline various significances in the study, in this instance, in regard to arousal (excitement), Sample (meaning sample number), type (meaning sample type – so audio or video), sample * type (the pairing of both), and subject (participant). Where the significance is less than 0.001 (<0.001), we see that the parameter has significantly affected the results. The two relevant parameters here are “Type” and “Subject”. Subject is an

expected influence, considering each participant is an individual person and therefore will have an individual response to the survey. However, the other parameter that scores <0.001 significance is Type. This shows that the type of sample (whether audio or video), has statistically significantly affected t scale beyond reasonable doubt. Meaning that there is a significant difference in the data regarding arousal (excitement) levels between the audio samples, and the video samples. In other interesting observations, figure 94 shows no significant results in the pairwise comparisons.

Tests of Between-Subjects Effects

Dependent Variable: Excite

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	1518.481	1	1518.481	438.770	<.001
	Error	86.519	25	3.461[a]		
Sample	Hypothesis	4.327	3	1.442	1.452	.229
	Error	173.788	175	.993[b]		
Type	Hypothesis	14.019	1	14.019	14.117	<.001
	Error	173.788	175	.993[b]		
Sample * Type	Hypothesis	.865	3	.288	.290	.832
	Error	173.788	175	.993[b]		
Subject	Hypothesis	86.519	25	3.461	3.485	<.001
	Error	173.788	175	.993[b]		

a. MS(Subject)

b. MS(Error)

Figure 91: Tests of between-subjects effects for Excitement

Estimates

Dependent Variable: Excite

Sample	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	2.846	.138	2.573	3.119
2	2.750	.138	2.477	3.023
3	2.462	.138	2.189	2.734
4	2.750	.138	2.477	3.023

Estimates

Dependent Variable: Excite

Type	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1 Audio	2.442	.098	2.249	2.635
2 Video	2.962	.098	2.769	3.154

Figure 92: Estimates of Excitement per sample and type

Pairwise Comparisons

Dependent Variable: Excite

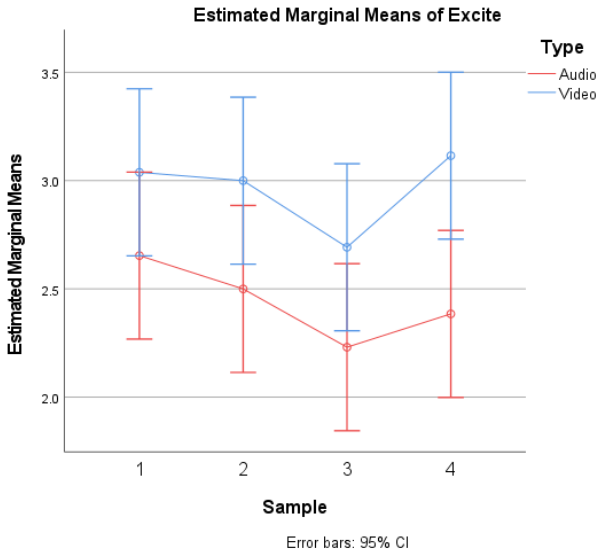
(I) Sample	(J) Sample	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	.096	.195	.623	-.290	.482
	3	.385	.195	.051	-.001	.770
	4	.096	.195	.623	-.290	.482
2	1	-.096	.195	.623	-.482	.290
	3	.288	.195	.142	-.097	.674
	4	.000	.195	1.000	-.386	.386
3	1	-.385	.195	.051	-.770	.001
	2	-.288	.195	.142	-.674	.097
	4	-.288	.195	.142	-.674	.097
4	1	-.096	.195	.623	-.482	.290
	2	.000	.195	1.000	-.386	.386
	3	.288	.195	.142	-.097	.674

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Figure 93: Pairwise comparisons for Excitement

The following graph and table depicts the variance of results for arousal (excitement) change across both the video and the audio samples. There is an average of a 0.5 point difference between the audio and the video on the arousal (excitement) scale, where the video is consistently 0.5 points more exciting than the audio alone. 0.5 points is an appreciable difference on a Likert scale. This shows that the video (paired with audio) was more exciting overall than the audio alone was.



3. Sample * Type

Dependent Variable: Excite

Sample	Type	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1	1 Audio	2.654	.195	2.268	3.040
	2 Video	3.038	.195	2.653	3.424
2	1 Audio	2.500	.195	2.114	2.886
	2 Video	3.000	.195	2.614	3.386
3	1 Audio	2.231	.195	1.845	2.616
	2 Video	2.692	.195	2.307	3.078
4	1 Audio	2.385	.195	1.999	2.770
	2 Video	3.115	.195	2.730	3.501

Figure 94: Estimated means of, and sample comparisons for Excitement

The below graphs and tables show the narrative of answers from participants over the course of the eight groups (combinations), for pleasure (valence) and arousal (excitement) (sample*type values). The red line is the average of all responses. It shows that there is not a statistically significant change over time across the four samples of audio, nor the four samples of video. However there is a general rise in both pleasure (valence) and arousal (excitement), which is supportive data for future studies.

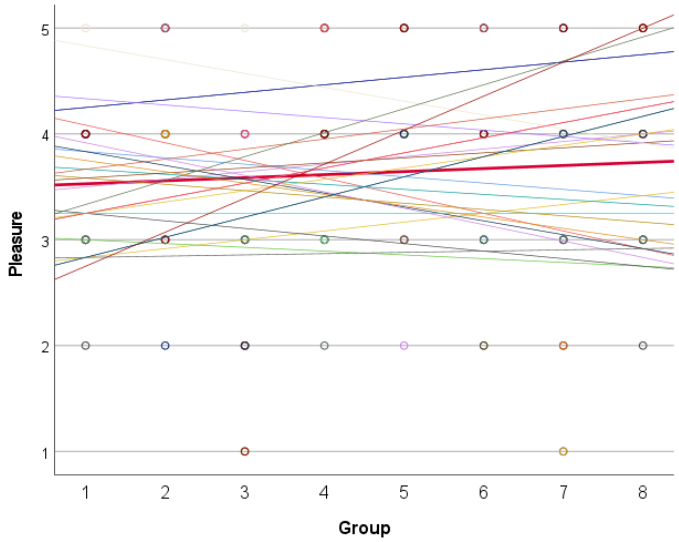


Figure 95: Analyses over time for Pleasure

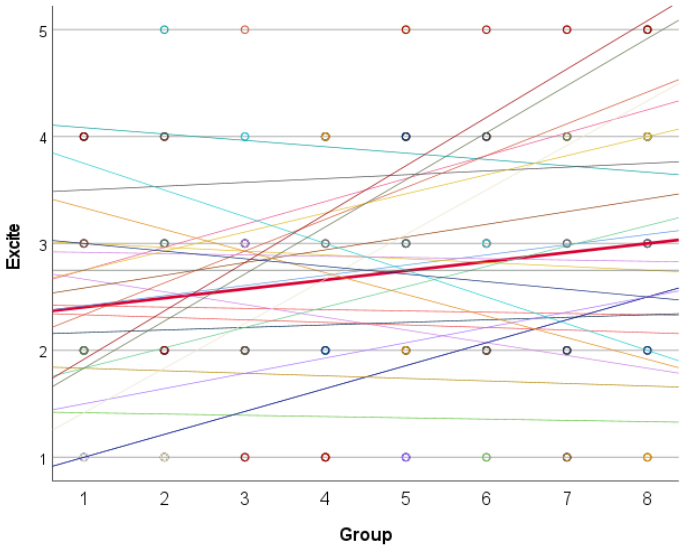


Figure 97: Analyses over time for excitement

The below graphs show the analysis of pleasure over time (Samples 1 to 4) by Type; lines fitted to individual subjects (figure 96) and then averages (figure 97); while some subjects show appreciable change over time (increase or decrease), the average effects are not statistically significant (p=0.67 Audio, p=0.45 Video).

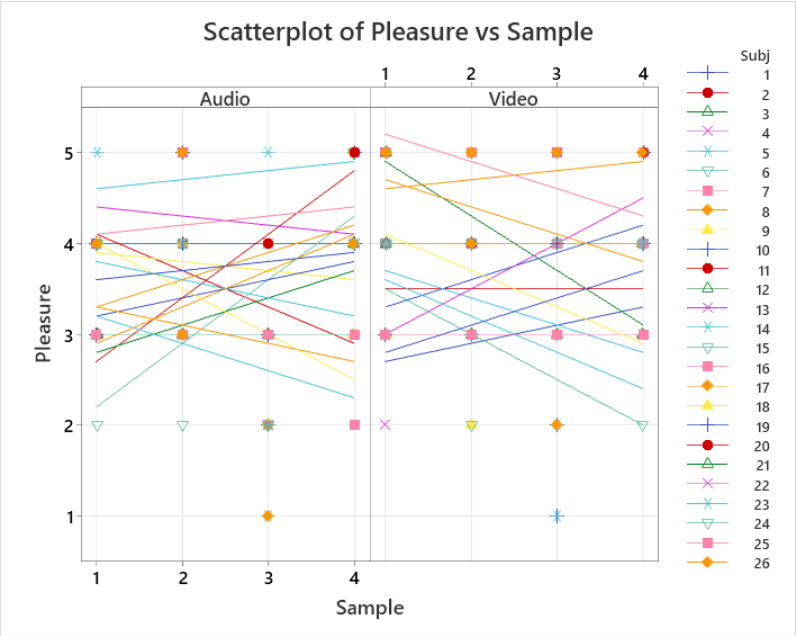


Figure 96: Scatterplot of Pleasure versus Sample

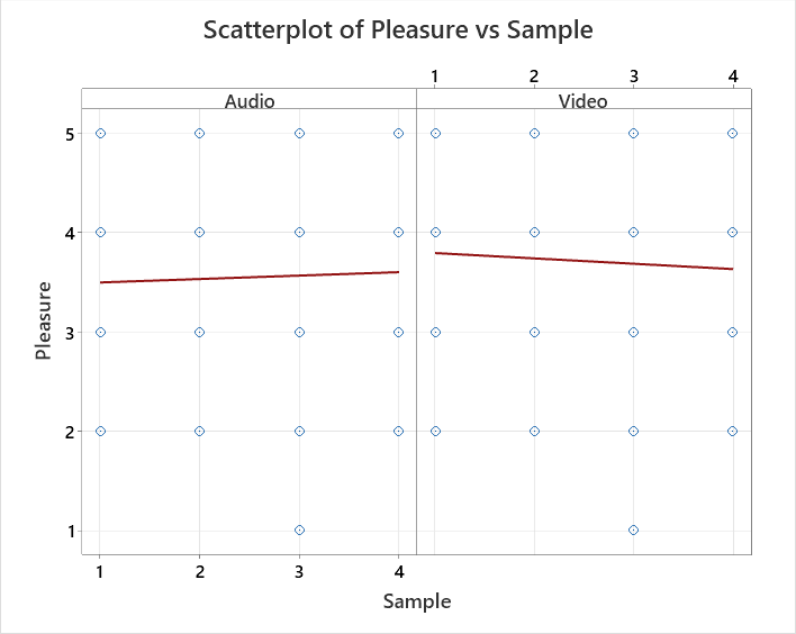


Figure 97: Scatterplot of Pleasure versus Sample 2

The below graphs show an analysis of excitement over time (Samples 1 to 4) by Type; lines fitted to individual subjects (figure 98) and then averages (figure 99); while some subjects show appreciable change over time (increase or decrease), the average effects are not statistically significant (p=0.22 Audio, p=0.92 Video)

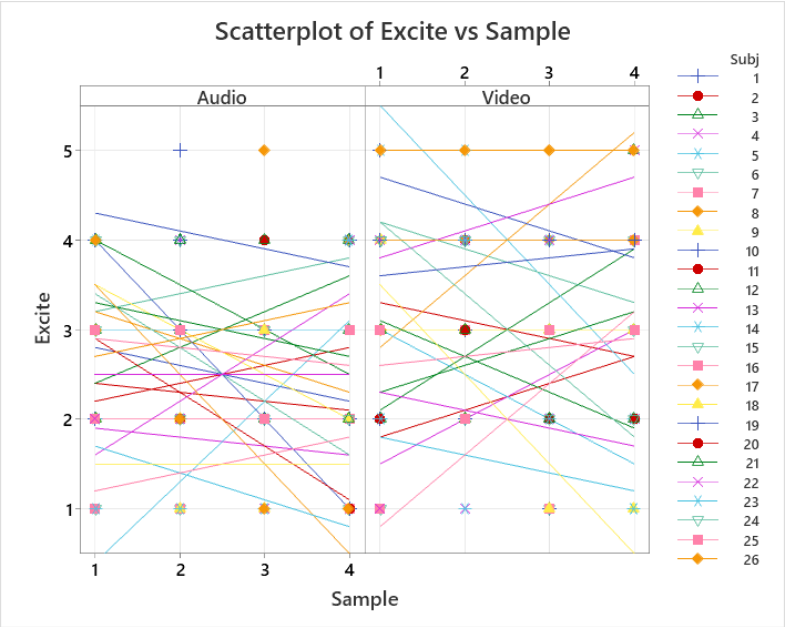


Figure 98: Scatterplot of Excitement versus sample

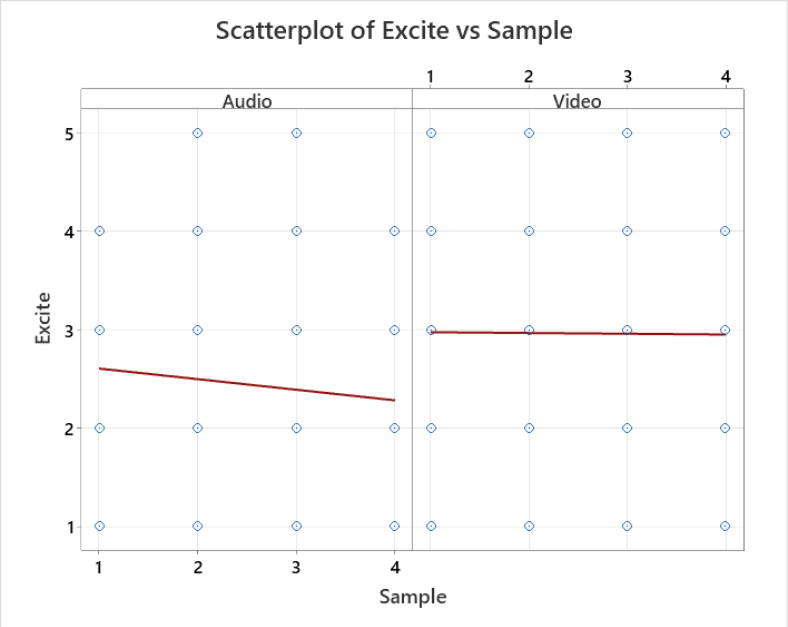


Figure 99: Scatterplot of Excitement versus sample

The groups (combinations) and samples alone aimed to begin in a higher arousal mode (to match and entrain with the ostensible existing arousal of the participants) and taper off to the lowest arousal mode by the end of the experience overall. The analysis over time does not

statistically significantly support this narrative, though there are some supportive tendencies reflected (i.e., “excite” for audio).

One factor may be due to the game being engineered for use in waiting rooms and in general medical contexts that trigger white-coat anxiety, whereas the participants in this study were not under the influence of this situation and rather were in the comfort of their homes. There may have been no high arousal to entrain with.

A question that asks how the participant is feeling before the study, would help provide nuance to this part of our results. Executing a replica of this study in the context for which it was intended might also help clarify these results.

3.6.2 Qualitative Data

Five participants (20% of the recruitment pool) were interviewed in a semi-structured manner, after they interacted with the samples. The qualitative thematic analysis conducted on the interviews provided substantial noteworthy information surrounding the quantitative data collected. The main themes that emerged from the interviews were concerning General Emotional Change, Music and Game Production Effectiveness, which Musical Features are Associated with Emotions (and that they were interpreted much in the way they were intended), which Videographic Features are Associated with Emotions (and that they were interpreted much in the way they were intended), and frequent connections between our samples to Meditation Music.

In the qualitative thematic analysis conducted on the interviews, themes were drawn from the data that were underpinned by a number of codes that emerged. Please refer to Appendix B for in-depth details of the themes, codes and quotes from participants. The themes that materialise from the thematic analysis were as follows:

- General Emotional Change
- Music & Game Production Effectiveness
- Musical Features associated with Emotions
- Barriers to Self Assessment
- Videographic Features Associated with Emotions
- Meditation and Music (and Associations with General Music for Calm)

It was anticipated that the lack in emotional maturity of a child (discussed in the background material of this chapter) might prevent their awareness of gradations of emotion beyond happy and sad. The interview data did support this hypothesis, showing that a child's ability to self-assess their emotional (or the perception of emotional) state seems to be prone to barriers. This was observed in a number of comments by participants in the interviews. For example, when asked "why do you think it made you feel happy?", responses like "It's because … it's not like those sad music that makes a tear go down your eye" were prevalent. In other instances, participants conflated other affective terminology, associating 'very calm' only with the act of sleeping, and paralleling 'neutral' to 'calm'.

There were a variety of responses to how participants felt when they reached the end of the game, and the interview data shed some crucial light on said variance. It was found that the very fact that participants had reached the end of a game (and were aware of this fact), influenced how they responded to the questions of the study for the final excerpts. Participant 26 said they felt 'very sad' for affect, for sample four (video and music). By this stage, researchers hoped to evoke 'happy'. Similar occurrences were noted in other participants – some of whom were happy to have reached the end of the game and led the cats to safety, and some who were sad that the experience was ending. It shows that for some, the sample

itself did not make them feel what they noted, but rather they felt sad due to an alternate factor. This illuminates some of the data we have around the final excerpt, and also exhibits a barrier to self-assessment that is a lack of ability to separate how an excerpt makes a child feel and how it feels to reach the end of a game.

When asked, most participants felt differently to each other before starting the game, and most participants felt similar to each other after finishing the game. This is helpful indicative data supporting the game's ability to alter the way a child is feeling.

Three instances of comments were made that the video stood out from the music in the experience (particularly associated with the presence of cats in the clips). Participant 21 commented that the music stood out from the video in three other cases. A 3:3 ratio being equitable tells researchers that they have achieved an ideal balance between the music and video when observing the interview responses. Participants also gratified the researchers' use of cats in the visuals in four different instances, an agreeable response for the game design.

> "Yeah, I think it just reminded me of any like experience of like, coming home after like a journey …" – Participant 4

This comment arose on seven occasions from four different participants. It shows the relatability and relevance of the visuals used for children interacting with games today. Participants thought that the music and video was well matched, and though one participant noted that the game wasn't familiar, said that they still enjoyed the experience overall. This tells us that though were was a common positive reaction to the familiarity of playing a videogame, that for those who didn't feel an alliance to it, it was still enjoyable. Overall, participants thought the game/study was fun, and this is a very positive response for researchers and notable for the design of follow-up studies.

The musical features written into the pieces were emotionally interpreted much in the way they were intended. It was noted that “catchy” music made participants excited, which alludes to researchers that music that rhythmically entrains a listener can affect perceived arousal levels, as was anticipated. It supports the Rhythmic Unity tool from the CTEE. Other musical features that were interpreted as anticipated, were as follows:

- Music that’s not catchy is neutral
- “Sad” is associated with soft and low pitches
- Slow tempo is calming
- Fast tempo = exciting and happy
- Higher pitches = exciting and happy
- “Neutral” for “arousal” scale when tempo is moderate
- “Happy” and “excited” for “pleasure” scale when speed is fast/upbeat
- Instruments associated with calm are stringed instruments, piano and marimba.
- Rhythmic drive = exciting
- Textural build = exciting
- Meditation/calm = happy
- Crescendo = exciting
- Repetition and lack of change in music = neutral
- Major = happy, minor = sad (harmony)

That children associated meditation/calm with happiness in this study was interesting, despite the two being extricable. Again, this could be because of a lack of emotional maturity in a child. Also, the associations to tonality (major = happy, minor = sad) supports theories of tonality and their correlative affect (as is depicted in the CTEE).

Videographic features associated with emotions were interpreted much in the way they were intended, with:

- Warm colours = positive
- Darker colours = sad
- Bright colours = exciting
- Emotions following the journey of the story – belonging/coming home

Participants frequently noted their reactions to the sets of the videos as convergent with the researchers' aims. For example, for the final scene (of sample four), in which the researchers aimed to depict a calming, happy set, P4 noted "it kind of reminded me of like, like a fairy … kind of like woods or something like that. Like fairy tale land or something. yeah, and it was …. it seemed like a really nice place." This was all positive indicative data for researchers to take into account for follow-up studies.

Lastly, in relation to meditation music, two participants frequently associated their responses of 'calm' from samples, to meditation. They both noted that Track 3 was meditative in nature. Track 3 was statistically significant in that it was the saddest and calmest sample of all 8 samples. Interestingly, the same participants had earlier associated calm with happiness, and yet the quantitative data suggests it scored the lowest on the pleasure scale. It would be interesting to observe how said participants self-assessed on the pleasure scale for Track 3 compared to how they described it in their interviews. Perhaps said participants coincidentally

were not those who ranked Track 3 as ‘sad’/‘very sad’, or perhaps this supports the notion that a child’s capacity for self-emotional assessment has limitations.

The themes and codes generated from the qualitative data support the research aims and questions in a way that the quantitative data so far does not in regard to two of the research questions. “Can colour and landscape-specifically engineered animations influence emotional state in a child?” and “Is the music that was created for the study, suitable for the animations that were created, and vice versa?” were exclusively answered by the interview data. The themes and codes have also provided crucial nuance to some of the results of the quantitative data.

Overall, the data from the thematic analysis suggests: potential limitations to a child’s capacity for self-emotional assessment; that there is a strong link between what participants understand to be happiness and calmness; that Rhythmic Unity successfully entrains and affects arousal (excitement levels); that some participants associate calming music (no matter its intention) to meditation; that some participants felt that the cats seemed ‘lost’ and this affected their perception of valence throughout the game; that cats are a comforting visual; that some children are unable to discern finer gradations of emotions such as “happy is any emotion that doesn’t make a tear go down your eye”, or that anything that isn’t exciting is inherently calm (rather than discerning an arousal level somewhere in between); and that participants reaching the end of the game were actually disappointed in some cases, and this affected valence (pleasure) responses and could have contributed to pleasure responses for sample 8 in the quantitative data.

Interestingly, the fact that Track 3 was interpreted as the “most sad” may have to do with the use of the aforementioned (in the snapshot analysis) CTEE tool Intervallic and Contour Affect Theory, where researchers aimed to use minor 3rds and 6ths surrounded by positive affect intervals to evoke neutrality (or a pensive emotion). Perhaps this was not effective.

3.6.3 Implications and Future Work

Regarding the research question: “Is the music that was created for the study perceived to ‘match’ the animations that were created from a pleasure and arousal perspective, and vice versa?”, the only data we have to explore this question is from the five interview participants (20% of the recruitment pool). It is therefore difficult to draw conclusive results from the quantitative data for this question. In hindsight, I may have collected more data on this question by utilising controls in the study. This could be accounted for in future studies.

In sample one, the passage of time has not been accounted for. In analysing the data, researchers found that an initial question “What are you feeling before you engage with this study?” would have allowed for an accurate assessment of the effectiveness of “Stage One” in changing pleasure (valence)/arousal (excitement). The interview participants were asked this retrospectively, but these answers weren’t enough to substantiate the claims of sample one’s ability to *change* pleasure (valence)/arousal. The successive samples however, had the data from the previous samples to substantiate the change over the passage of time.

The qualitative data exhibits potential barriers in a child’s self-assessment of their emotional state. Other means of emotional assessment means could be explored for more effective future studies with children. For P26 and P15, I discovered suggestions such as “happy is any emotion that doesn’t make you cry”, and that their emotional reactions to the end of the samples were to do with completing the study, rather than the effect of the stimulus themselves. An initial workaround going forward might be to ask the participants how they think the sample would make someone feel, rather than how they feel themselves.

The sample size of 26 participants meant researchers could not expect statistically significant data from the results. This was a result of the COVID-19 pandemic and consequent study design restrictions. Although 26 participants proved sufficient for a pilot study, with effective

indicative and significant data as a result, larger sample sizes should be employed in future studies to produce a larger volume of statistically significant results over indicative results.

3.7 Conclusion

Music can and does change the way a child is feeling. The use of music created using the CTEE paired with video, was a more effective means of valence (pleasure) and excitement evocation than audio alone (also created with said CTEE). The technical facets of music creation outlined in the CTEE that were used to create the music in this study were interpreted as I expected, and the sample size used had enough power to find that some samples were significantly different (for pleasure) and that types (audio/video) were significantly different (for excitement). To gauge more statistically significant data regarding the change of affect (arousal and pleasure), a larger sample size could be used going forward. Regardless, this study did provide crucial insights into the testing and use of the CTEE for music creation, the pairing of music and video as a means of multi-sensory control for emotional evocation, the ability for music and video to change pleasure (valence) and arousal (excitement) levels in a child, and the efficacy of colour and image – theorems for creating virtual worlds that appeal to children.

In regard to the communication of calm and the process of catharsis, this study confirmed the efficacy of inducing pleasurable valence over the course of the samples (the intended valence match for ‘calm’), and indicatively (though not statistically significantly) confirmed that the audio lowered arousal levels towards calm.

Chapter 4:
Further Compositions for Calm and/or Catharsis

> That listeners tend to agree about the emotional expression in music is one thing, but to what extent can music composers and performers actually communicate specific emotions to listeners? (Miell et al., 2005)

As well as the works created for the two studies discussed previously, I created a vast portfolio of works that utilised the CTEE that acted as my own practising the application of the toolkit, and also creating a suite of works that could be used for future potential studies.

Composers' ability to communicate emotions to listeners has received little attention over the years. However in a 1992 study by Thompson and Robitaille, listeners reported their ability to gauge the specific emotions that the study's composers intended to evoke. The emotions were communicated through scoring (rather than performative expression or other means), and MIDI-type audio was played to the participants. The participants recognised the same emotions as were intended by the composers (anger, joy, and others). Although the study recruited only 14 participants, it was an important enquiry into the power of a composer to communicate emotions specifically.

My work as a composer is concerned specifically with facilitating emotional experiences for my listeners, and this dissertation has been a platform to extend upon my skills in this field. This chapter will discuss some of my experiences writing music for said aim and will introduce a large suite of pieces I have written with the aim of evoking calm and/or catharsis using my CTEE during the course of this PhD. My personal style as a composer lends itself to the utilisation of Rhythmic Unity as a means of emotional evocation, and this will be evident in the following brief analysis. The works written during this PhD (including those used in the two studies here) are included in score and recorded format as part of the submission of this dissertation. The scores can be found in Volume Two of this dissertation. Five works will be

briefly discussed in this chapter as a snapshot or proof-of-concept, to demonstrate instances of the use of the CTEE in some of the aforementioned works. However, *all* the pieces written over this doctoral period have used the CTEE in a similar way.

The Hush Foundation is an organisation that facilitates the connection of composers and performers to patients in need. I worked with the Hush Foundation in 2017 and wrote a commissioned piece for the Australian Chamber Orchestra. The work's ethos was to aid in the mental strain on children living in care at the Westmead Hospital. The project was a timely opportunity that further fuelled my interest in the field of music and emotions for wellness, and exercised my skills built initially (and around the same time) through my Master's research. My Master's dissertation (in which the CTEE was initially conceived) armed me with the tools to evoke catharsis and happiness for the patients at the hospital, and the piece *We Won't Let You Down* became a part of the amassed portfolio I now have of pieces with a similar aim. Between the two degrees, I have written over 200 minutes of music, practising my skills through the CTEE in emotionally invigorating my listeners.

Across the suite of works written during my Master's and for this dissertation, I utilised the tools from the CTEE to emotionally charge my music in a pointed manner. During my experimentation with the Toolbox, I ascertained what mechanisms were most effective depending on various musical facets — instrument and ensemble choice, thematic utilisation, articulative choices, etc. For example, music that utilises the voice lends itself particularly well to Emotional Contagion, or the use of an ostinato is an effective vehicle for Rhythmic Unity. I accounted for these observations in the use of the CTEE in my writing with the aim of rendering the mechanisms as powerful as practicable.

The following analyses represent a brief snapshot of the use of the CTEE during my PhD, and the recordings have been made by some of Australia and the world's leading performers. These are works that weren't included in the two studies of this dissertation, but which might

be used in instances of emotional evocation for calm and/or catharsis in listeners. Only a snapshot has been provided due to word-limit restrictions, and no particular framework has been applied to make the selection other than that they represent a variety of works created in totality. A brief description of the purpose and context of each commissioned work is also included, primarily to exhibit the relevance of each piece that I've created during my doctoral research.

4.1 Full List of Pieces Written for this PhD

A full list of the works included in the submission of this dissertation is as follows:

The Shift 9:45 min

suite of three pieces for guitarist Matt Withers, commissioned by ABC Classic and recorded for release as an album, *The Shift*, on the ABC Classic label

The Rain Will Go Away	3:13 min
Sunbeam	4:21 min
Beyond the Mist	2:11 min

Something from Nothing 8:00 min

for string orchestra, composed for performance at opening of the Music and Health Node at the Charles Perkins Centre by Ensemble Apex

Union 7:00 min

for the Melbourne Symphony Orchestra, premiered at Hamer Hall, Melbourne

The Business of Recovery 5:00 min

for the Geist String Quartet and violinist Ilya Isakovich (ACO), premiered at the Sydney Jewish Museum

Bloom 7:00 min

for piano duo ZOFO, premiered at Connecticut Summerfest

The End 8:00 min

for the Flinders Quartet, premiered at Library at the Dock, Melbourne

Ground Level of my Mind's Eye 7:00 min

for violin, viola and cello, commissioned by The Australian Ballet as part of their

Bodytorque series. Digital choreographic development program and recorded by the Orchestra Victoria string trio

Secrets 7:30 min

for the Southern Cross Soloists and guitarist Slava Grigoryan, chamber ensemble, premiered at QPAC Brisbane

Music for Calm and Catharsis 24:59 min

suite of ten short pieces for violin, cello and piano, recorded by the Muses Trio as an album for digital release

One	2:10 min
Two	2:05 min
Three	2:25 min
Four	2:11 min
Five	2:30 min
Six	2:50 min
Seven	2:30 min
Eight	2:12 min
Nine	2:21 min
Ten	3:50 min

Music and Video for Calm for Children 8:00 min

for marimba, piano and strings, composed for the study Music and Video for Calm for Children, produced in a DAW

Stage One	2:00 min
Stage Two	2:00 min
Stage Three	2:00 min
Stage Four	2:00 min

4.2 The Rain Will Go Away – for solo guitar

The album *The Shift* was commissioned by ABC Classic in 2021 and written as a means of evoking calm during a pandemic. It is an album of three short works for solo guitar, representing musings on the psychological struggles of a loved one observed during the COVID-19 pandemic. It was subsequently performed and recorded by award-winning

Australian guitarist Matt Withers in the Eugene Goossens Hall at the ABC (Australian Broadcasting Corporation) Ultimo Centre in Sydney, and receives extensive airtime on national radio station ABC Classic. My aim with this album was to reflect deeply and draw on personal experience in order to understand what a lay listener might want to hear to help alleviate the anxiety of living in the time of the pandemic. All three works utilised similar tools from the CTEE, predominantly being Rhythmic Unity (through the vehicle of ostinato), Musical Expectancy (specifically through MAV), and Emotional Contagion. *The Rain Will Go Away* aimed to evoke overall calm, with moments of nostalgia, and a tone of happiness. It will now be discussed in further detail.

Rhythmic Unity

An ostinato is established after a brief exhibition of the main motif in prime form at the onset of the piece. The ostinato is an interpolated form of the main motif, and the pulse is set to 60bpm. The ostinato is maintained for the duration of the work, and the rhythmic prominence encourages pulse entrainment with the music. Despite the interpolated notes being semiquaver divisions, they are not emphasised, and although there are tenuto markings on the melodic notes, the strongest natural accents still fall on each dotted crotchet beat of the bar. This is particularly evident in the recording of the work. These accents establish a pulse of 60bpm – a low average resting heartrate (Vega, 2017), which aims to encourage calm.

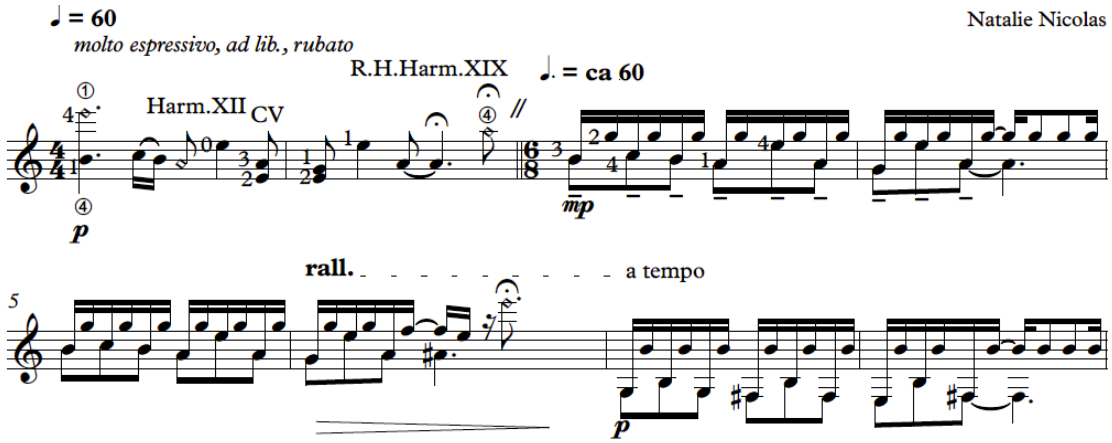


Figure 100: Excerpt from *The Rain Will Go Away*

Emotional Contagion

The work is marked “molto espressivo, ad lib., rubato” (see above figure). The marking itself and Matt Wither’s resulting interpretation is exceedingly expressive. Notes such as the volatile-sounding harmonics at bb. 1–2, 6, 26, 50, 62, 66 and 74 (the final note of the piece) are embedded in the rapid semiquaver movement and call for utmost care in approach, for them to feasibly sound. This aims to audibly portray vulnerability and softness – Matt slows his pace at these passages and the listener is invited to hear and feel the tenderness.

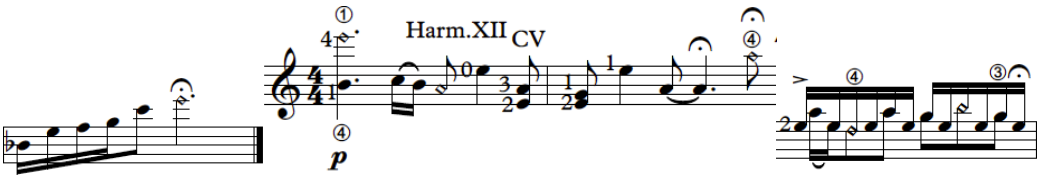


Figure 101: Various bars featuring harmonics in *The Rain Will Go Away*

Musical Expectancy

Although the work utilises the same ostinato theme, at key points, modulations are utilised that aim to contradict listener expectation, and renew conscious engagement with the music. Although the use of Musical Expectancy through MAV in particular might not in itself promote a specific emotive evocation (possibly frustration?), the destination keys are all (but one), major or major modal, which promotes an emotional landscape of positivity (Bowling et al., 2010; Parncutt, 2014). The modulations are as follows:

- bb. 1–10, G major
- bb. 11–14, E mixolydian
    - VI of G, or rather tertiary dominant – chord V of A major – chord V of D major – chord V of G major (original key). See A major key signature at b. 11 in below figure.

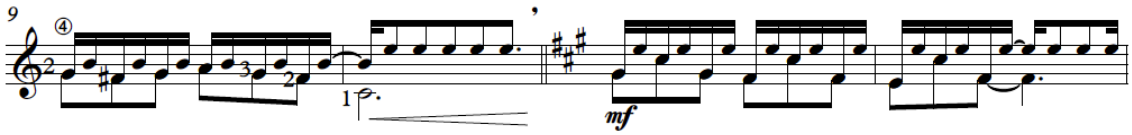


Figure 102: G major to E mixolydian modulation in *The Rain Will Go Away*

- bb. 15–19, A major
    - Use of chord IV through here and the repeated 7 to 8 melodic notes leads to anticipation of chord I of A in a typical plagal fashion. Instead, we get;
- bb. 19–22, E mixolydian
    - Repetition of the tertiary dominant
- bb. 22–50, A major
    - bb. 22–27 repeats harmony of 15–17, but finally at b. 27 we receive chord I and a resolution – a sense of release ensues. We have 28 bars of I–IV movement that aims to comfort listeners through this typical Western harmonic progression.

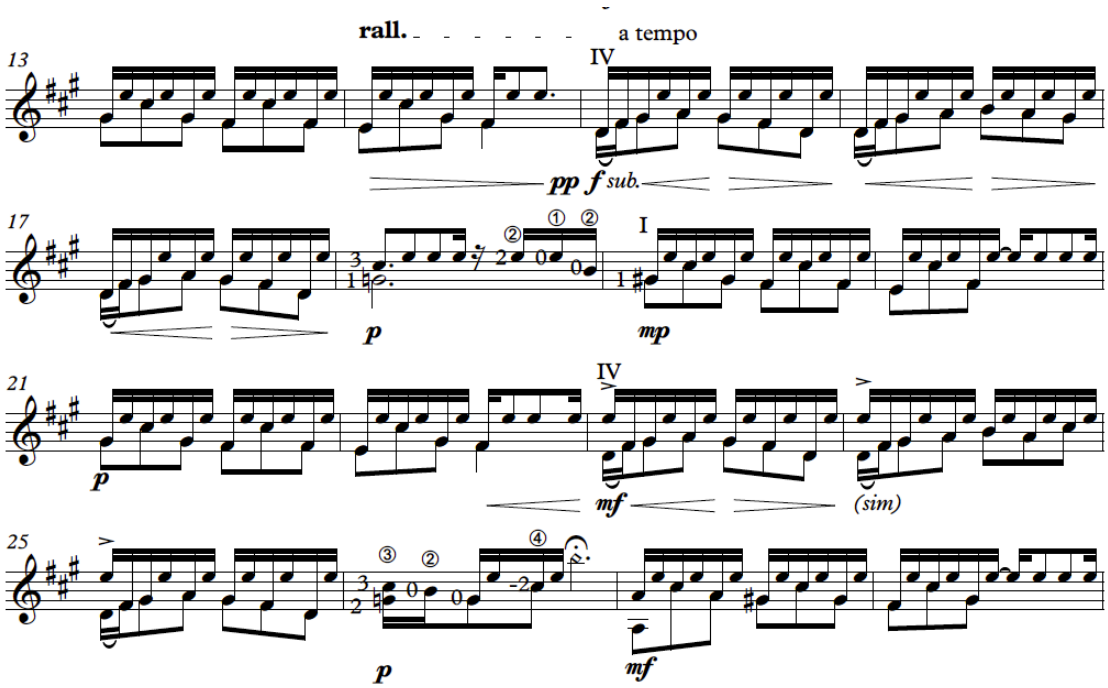


Figure 103: Modulations through A major, E mixolydian, A major in *The Rain Will Go Away*

- bb. 52–54, A aeolian
    - The parallel minor of A major is used briefly for interest retention, and utilises the major VI chord F to pivot into the next key via a plagal cadence.
- bb. 55–end, C major
    - The relative major is utilised to end the piece. Ending in a modulation to a closely related key aims to fully restores the comfort of familiar harmonic landscape and progression, and ends the work with low harmonic tension.

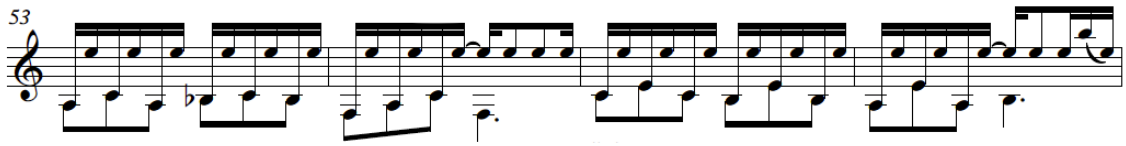


Figure 104: Modulation between A aeolian and C major in 'The Rain Will Go Away'

The unorthodox modulations aim to sustain listener interest through the deprivation of confirming the harmonic expectations of the typical ABC Classic listener, a layperson attuned to Western harmony.

4.3 Something From Nothing – for string orchestra

Something from Nothing was commissioned by the Charles Perkins Centre for its 10th birthday. The Charles Perkins Centre is a nation-leading interdisciplinary research hub, committed to health. It is a University of Sydney institution and focuses on facilitating unique projects that might otherwise not exist between researchers of all disciplines.

When I was first introduced to the Charles Perkins Centre (CPC), it was in relation to this very PhD candidature. Soon after, Stephen Simpson AC FRS FAA (director of the CPC) was looking for interesting and appropriate ways to pay homage to the hub of groundbreaking knowledge, and came to me for assistance. I created a new research node, Health and Creativity, based on the work of this PhD, and became co-leader with researcher and producer Martin Brown.

Something from Nothing was the inaugural project of the new node – born of an idea to effectively "flash-mob" an audience of cocktail partygoers at the CPC's 10th birthday soiree. At the CPC, ideas come out of the woodwork, flourish, and the researchers then return to their spaces. I wanted to capture this musically, by having performers literally come out of the woodwork of the building, to gather in the centre hub of the space, and then return.

Something from Nothing saw a string orchestra – the vivacious and innovative Ensemble Apex – emerge from the various balconies and staircases of the award-winning CPC building, playing cells of music that built a wave of sound, before eventually coming together (literally and musically) to form a cohesive, approachable and fully structured piece. I co-directed the performance with Martin Brown (director and producer of *Strictly Ballroom* and *Moulin Rouge*) and the audio-visual was produced by James Atkins.

The piece was written to slowly and organically engage the audience, rhythmically entrain them, and raise their heartrates to excitement, encouraging catharsis with a drop back to calm at the end of the work. The tonality remains major and major modal throughout the work, in order to promote a baseline emotion of positivity (Bowling et al., 2010; Stephenson et al., 2013).

Rhythmic Unity

This piece gradually and organically entrains the listener by very gently introducing a rhythmic prominence with a slow pulse, and increasing it progressively until the end of the work.

The piece begins with aleatoric cells played by balcony players – cells that have no sense of pulse, and which aim to engage audience attention and covertly introduce the main motifs of the work.

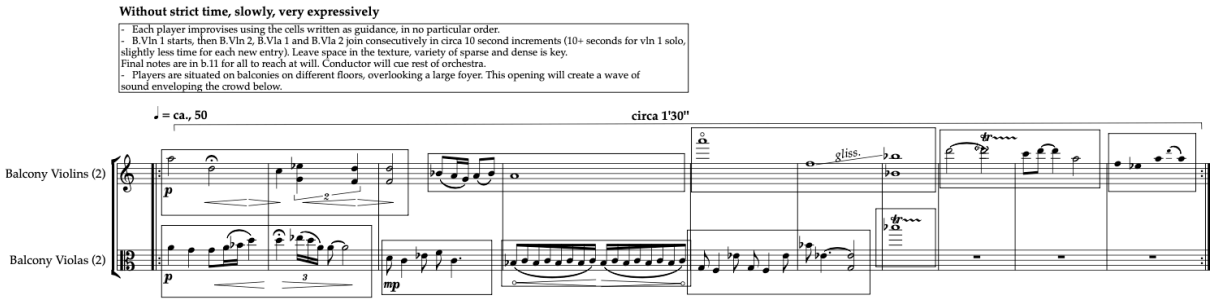


Figure 105: Opening of *Something from Nothing* with no pulse

Soon after, the piece transitions from aleatory into a still slow and stretched-out section, with a pulse of 50bpm (lower than the average resting heartrate (Vega, 2009)), however with little emphasis of the pulse written into the score. There is almost no entrainment as of yet.

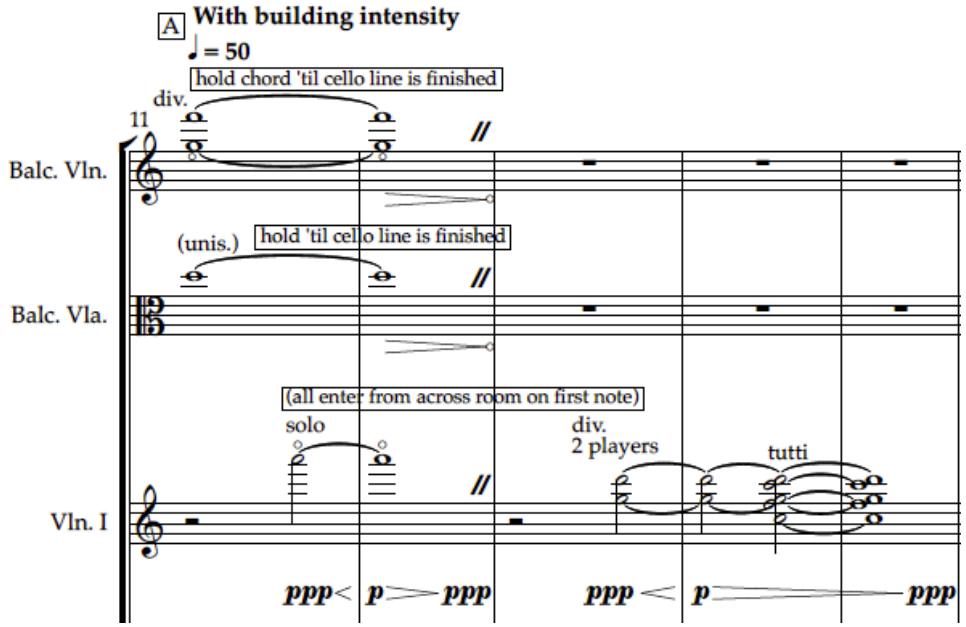


Figure 106: Long, held notes with no pulse in *Something from Nothing*

After the aleatoric and expressive introduction, an ostinato is suggested, then established. It transitions from the expressive timeless material by gradually subdividing (diminishing) the pulsing notes, to smoothly lead into the semiquavers of the ostinato. The ostinato, being rhythmically prominent and repetitive, is the vehicle for Rhythmic Unity and entraining the listener.

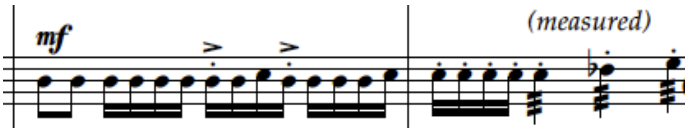


Figure 107: Gradual subdivision (diminution) of the pulsing notes to lead to the ostinato in *Something from Nothing*

The tempo of the work is set at 75bpm, but the ostinato subdivides this into semiquavers, and the melody into quavers. This is supported by semibreves initially – these long notes buffer the subdivisions and balance out the velocity, in order to progressively move the listener's heartrate from the initial lack of pulse, then 50bpm, then 75bpm, etc. Eventually, the ostinato is left exposed, and the effect is a pulse of 150bpm – well above the average resting heartrate range of an adult (Vega, 2009), promoting excitement. This pattern of gradual subdivision is extended as the piece progresses, eventually subdividing the ostinato into demisemiquavers, effecting an extremely fast tempo. This also exhibits physical virtuosity of players, the effort of which can be perceived through emotional contagion, also.

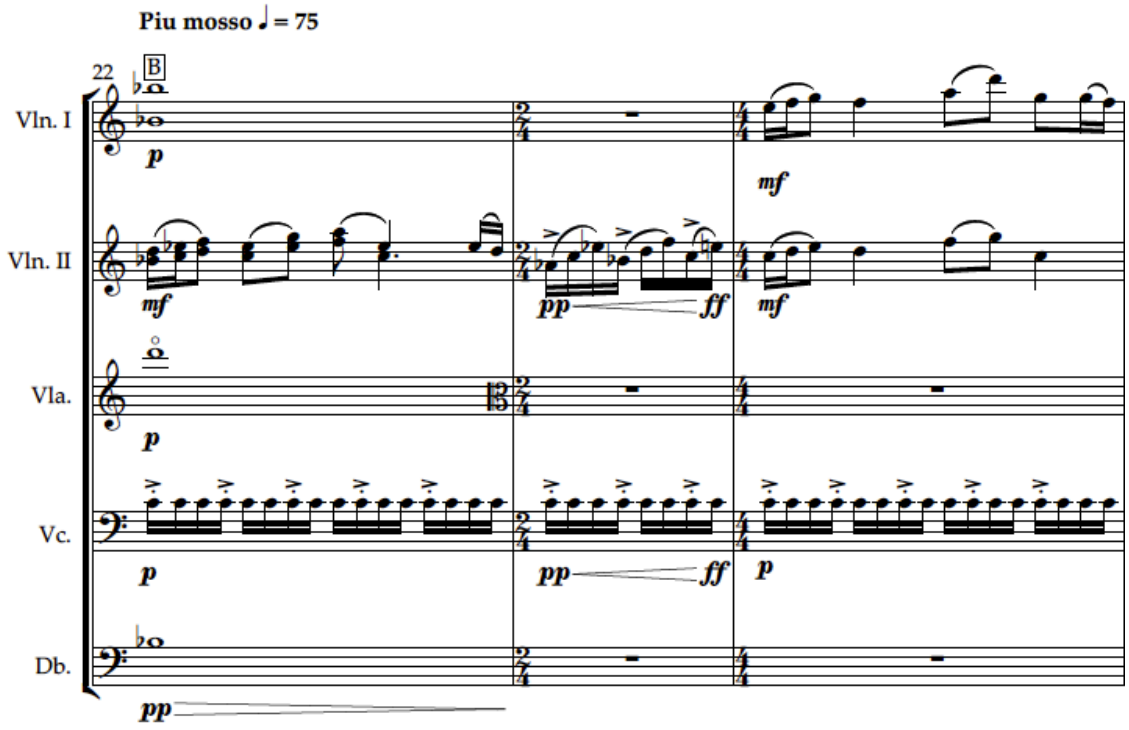


Figure 108: Ostinato in *Something from Nothing* in cello, supported by semibreves in other voices, and then exposed, at the beginning of the piece

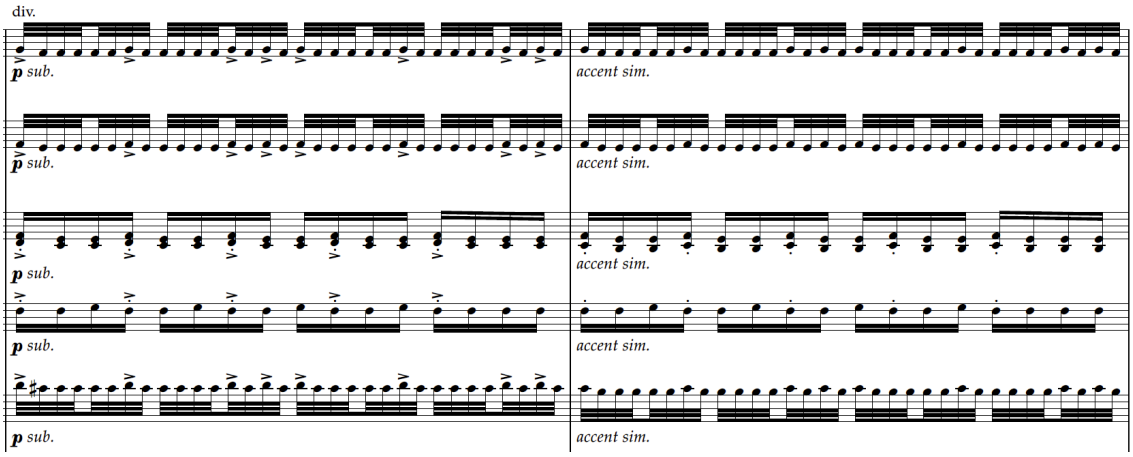


Figure 109: Ostinato continues and is emphasised by further diminution into semiquavers and demisemiquavers, later in the piece (b.49 onwards)

Contour Affect Theory and Conditioned Response

Throughout the eight or so minutes of the piece, I aimed to manipulate arousal (excitement) levels in continuous smaller ebbs and flows, with an overarching goal of general raised excitement by the three-quarter mark of the piece. At points, I utilised Contour Affect Theory to achieve these ebbs and flows, and further supported the rises in contour (aimed at evoking activation, picking up spirits, etc.) with dynamic increases, and the contour descents (aimed at evoking a release of energy, deactivation, etc.) with dynamic decreases. Dynamic increases create a sense of increasing urgency and decreases release urgency, due to evolutionary associations (Bryant, 2013; Filippi & Gingras, 2018).

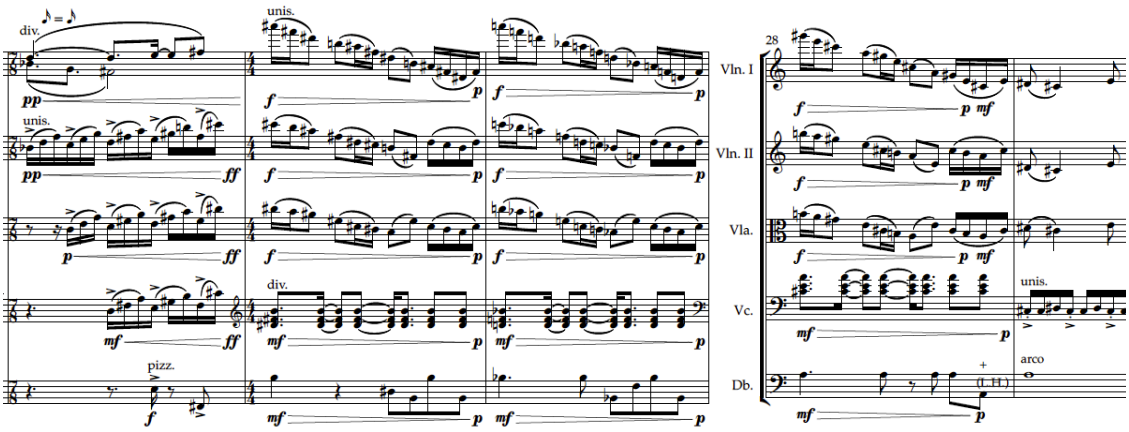


Figure 110: Rising and falling contours matched with rising and falling dynamics in *Something from Nothing*

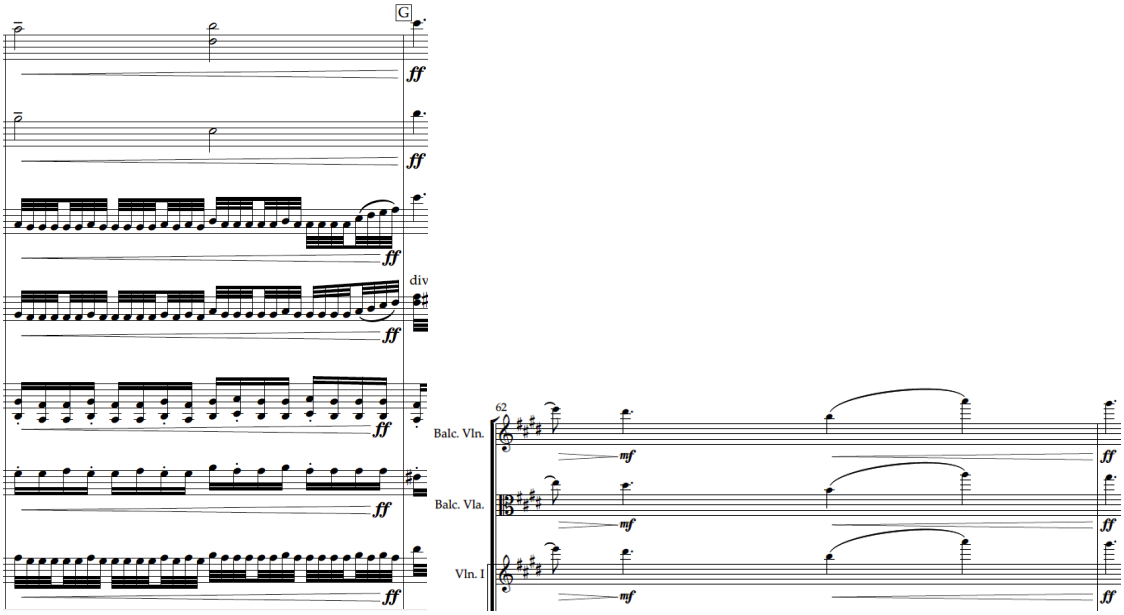


Figure 111: Further examples of rising and falling contours matched with rising and falling dynamics in *Something from Nothing*

Musical Expectancy

Something from Nothing uses modulations to unexpected keys, similarly to *The Rain Will Go Away*. *Something from Nothing* is based on only two themes: a motif and an ostinato. The piece uses these themes repetitively throughout the eight or so minutes of the work, and therefore calls for supportive technical application to maintain listener interest. This is achieved throughout the work through modulations to unexpected keys.

In the example figure below, we begin in E flat major. At b. 25, we modulate four times using the whole tone scale to guide the successive keys – every three semiquavers (which is an extremely rapid harmonic rhythm for Western Art Music), to B flat major, C major, D major, E major, F sharp major, and arrive at B major in b. 26. This resulting key stabilises the ear, making use of the F sharp major chord at the end of b. 25 as a pivot chord – chord V of B major, and effecting a V–I perfect full close cadential harmony. We remain in B major for only one bar however, and begin to cycle through further unexpected modulations. Bar 26 through the vehicle of a sequence, moves to B flat major (descending in a chromatic scale now), b. 28 continues the sequence and chromatic descension to A major, bb. 29–30 subvert the sequence, moving to E major – chord V of A (so more anticipated than other modulations), but through chord V of E in b. 30 (B major), we chromatically modulate up to C major for the first half of b. 31, shift to a whole tone ascending scale modulation to D major for the second half of b. 31, and land firmly now in our destination key of E major at b. 32. Happily for the lay listener's ears, the piece remains in E major with occasional use of the mixolydian parallel, for about 30 bars.

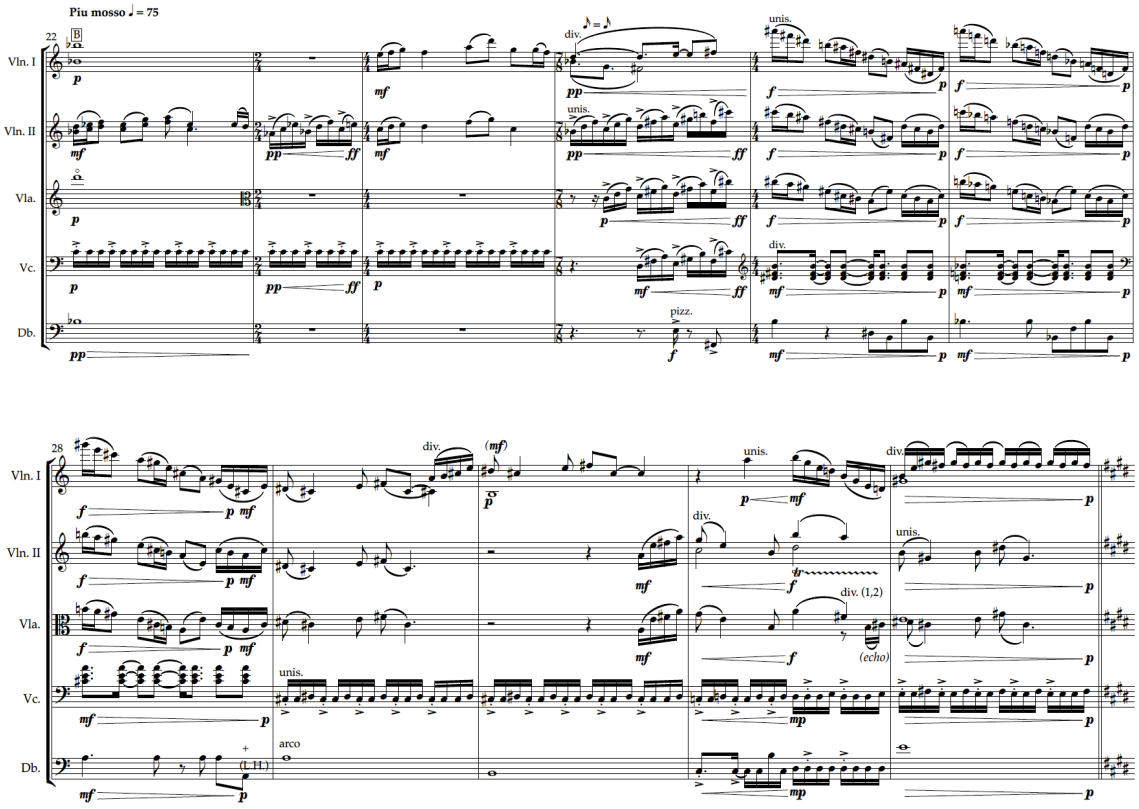


Figure 112: Modulations from b. 22–32 in *Something from Nothing*

The use of MAV in this case maintains and enhances tension and supports feelings of raised excitement. The subversion or contradiction of listener expectation functions to arouse feelings, and the pairing of the major modality keys help to retain a valence of positivity along the excitement (Parncutt, 2014).

4.4 Union – for orchestra

Rhythmic Unity, Intervallic Affect Theory, Conditioned Response and Response to Stimuli

Union was commissioned by and written for the Melbourne Symphony Orchestra's Cybec Association. It was premiered at Hamer Hall in Melbourne in January 2022 by the MSO and is a work that draws on my experiences during the turbulence that ensued during two years of the COVID-19 pandemic. *Union* pays homage to the united cohort of support that many of us are lucky to be able to turn to in times of need, and to the emotional release and overall calm that ensues from engaging with such a support system.

Opening Section

The opening of *Union* aims to paint a landscape of prevailing calmness, predominantly through the encouragement of a slow heartrate via Rhythmic Unity. The opening attempts to convey a gentle wake from sleep. The tempo of the piece is set at 48bpm – about 10 points lower than the average resting heartrate (60–100bpm (Vega, 2009)). The texture of the opening is sparse and sustained, with exposed, long droning notes beginning in the brass section and eventually joined by the strings. The opening bars see the trombone and horn in a harmonic drone, at the interval of a perfect 5th. This interval represents stability and power, particularly so when the scalic notes used are the tonic and dominant (as is done so here). The use of the trombone and the horn aim to evoke emotions of assurance, clarity and general emotive release (catharsis) through the Conditioned Response of brass with early fanfares, military, and in particular, the *Last Post* (Smyth, 2018; Turner, 2014). The first two notes of the *Last Post* are the tonic and dominant, and this particular passage of *Union* aims to draw out the emotion associated with the brass timbre from its earliest military applications.

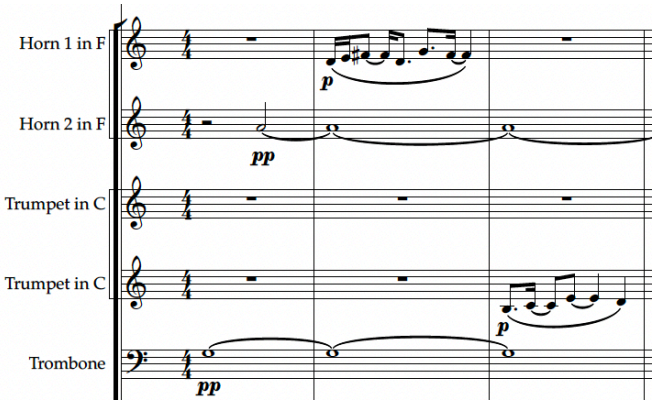


Figure 113: Perfect 5th exposed brass drone in opening of *Union*

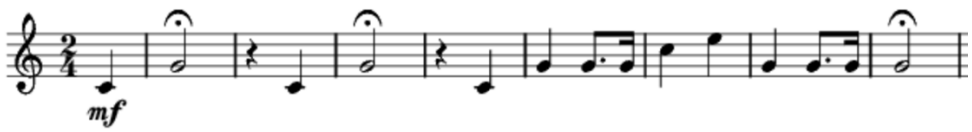


Figure 114: Opening bars of *Last Post*

While the drone is sustained, the orchestra passes around subtle iterations of every crotchet beat (the main countable beat of the pulse), using rhythmic articulations such as a pizzicato pluck of the stringed section, mallet marimba notes, and wood block hits, in order to musically emulate a literal pulse of the song and encourage entrainment with the listener's pulse through the prevalence of this pattern.

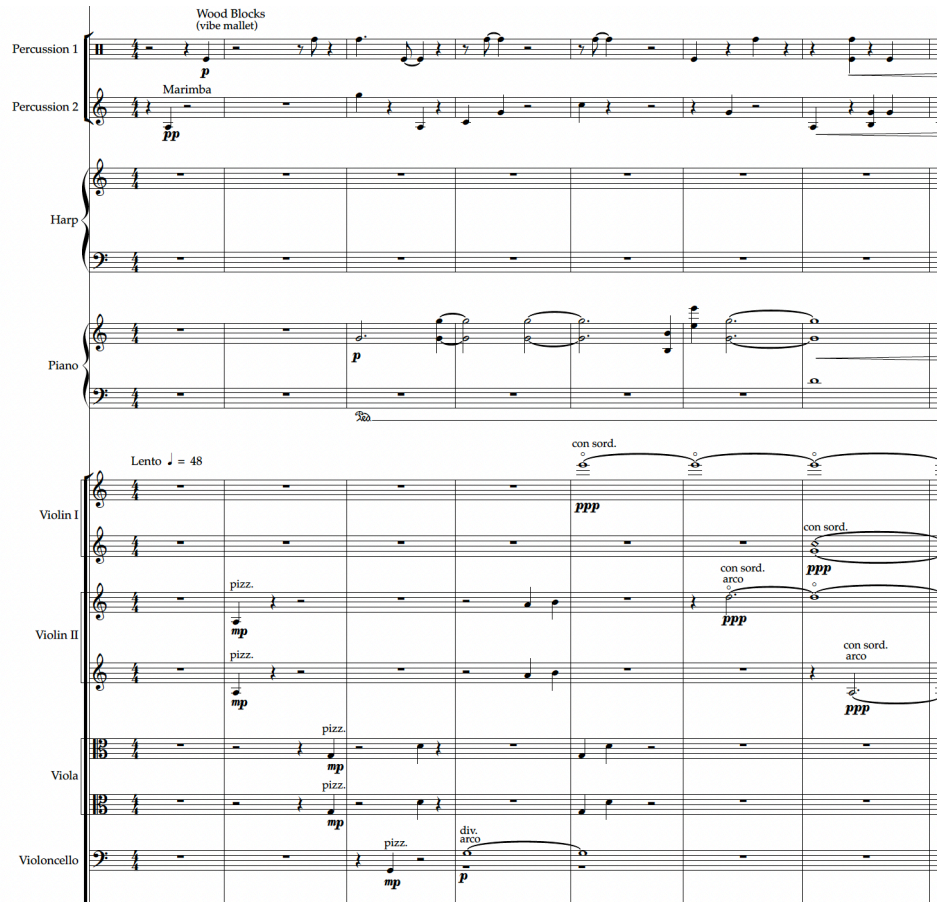


Figure 115: Pulse articulations by various instruments in the opening of *Union*

The notes move mostly in a pitched pattern of up-then-down, in a similar fashion to the pitch contour of a heartbeat (Parncutt, 1987). Although it is not an ostinato (as is most commonly used in my music as a vehicle for Rhythmic Unity), the repetition of the articulations of the main countable beats is exposed enough in the sparse texture, and, by virtue of the fact that it is a repeating rhythmic idea and is so similar to that of the heartbeat, it interacts with the brain and encourages pulse entrainment. The brain releases dopamine when it recognises patterns,

especially those with clear beginnings and endings – this is called a pattern recognition reward (Brown, 2017). Not only does a rhythmically prominent pattern encourage heartbeat entrainment, but the use of a recognisable pattern has the ability to release dopamine in the brain, which is associated with positive emotions (Navratilova et al., 2016).

The final CTEE technique used in the opening of *Union* is Response to Stimuli, through the appropriation of Australian native birdcalls in repeated cells throughout this section of the work. Birdcalls are associated, from millennia of evolution, with mornings, awakening, emotional energisation and the bringing of a new day (Ten Cate, 2004). Evolutionarily, morning bird calls were a function of each bird alerting their acquaintances of their survival through the night from predators, dangerous weather events, etc., and other species (including humans) evolved to hear this sound and associate it with the same functions (Ten Cate, 2004). In the opening of this work, I appropriated the birdsong of the Oriental Dollarbird, the Masked Lapwing (also known as the Plover), the Red Wattle Bird and the Eastern Yellow Robin. The songs of these birds are similar in contour and articulation, and are what I have heard frequently, residing and spending time in East coast of NSW, Australia. The use of the birdcall in the opening functions to enhance the painting of a morning landscape, where the music emotionally wakes the listener gently. The birdcall appears briefly at first and then more frequently throughout the opening of the work, much as it does in nature. It is an almost covert musical cell, and by the end of the opening, is spoken, responded to and supported throughout the entire orchestra.

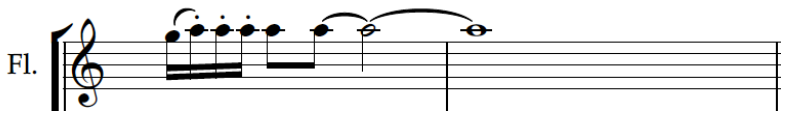


Figure 116: Australian native birdsong cell in opening of *Union*

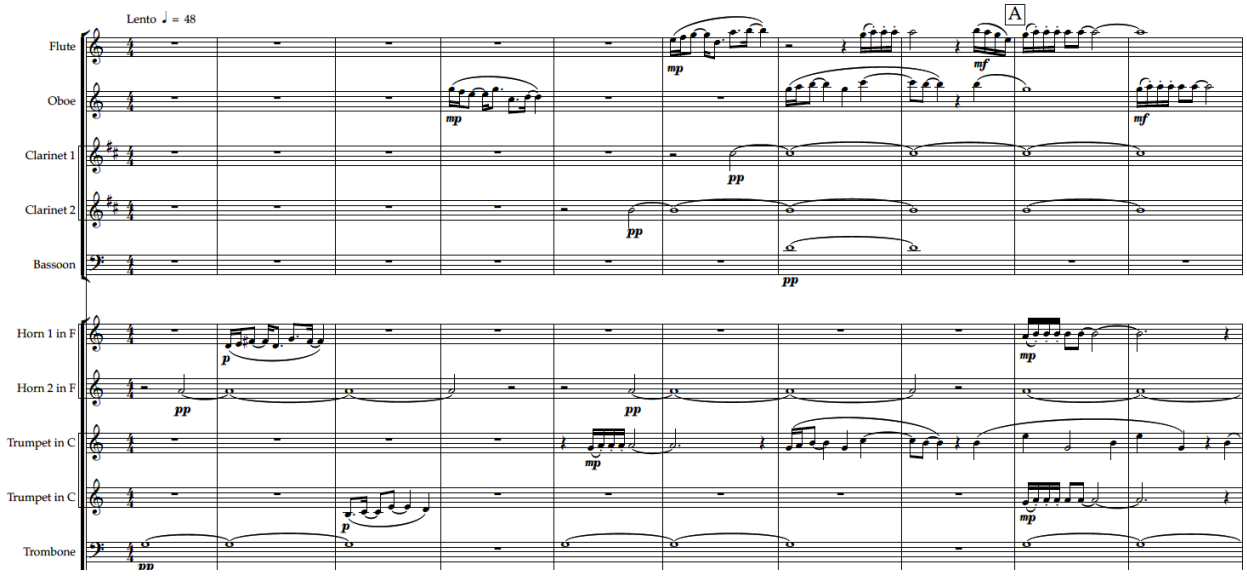


Figure 117: Use of Australian native birdsong calls in opening bars of *Union*

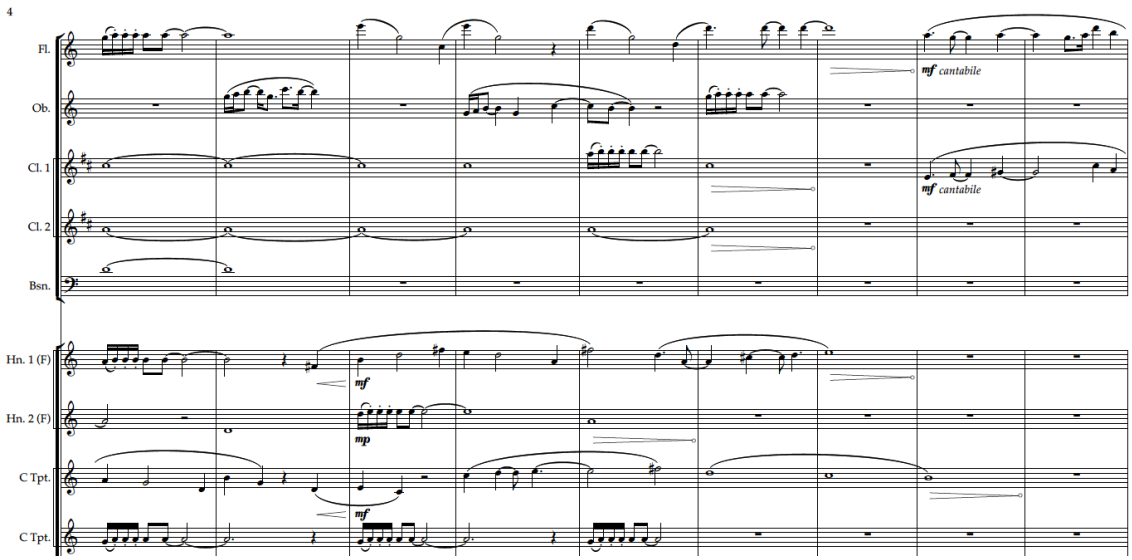


Figure 118: Frequent use of Australian native birdsong in later stages of the opening of *Union*

The combination of the use of Rhythmic Unity to entrain the listener at a calm heartrate, the use of Conditioned Response with brass timbres to allude to emotions of assurance, catharsis and clarity, Intervallic Affect Theory depicting power and stability through the open 5ths, and the Response to Stimuli of the bird-call cells are a four-fold attempt at my aim for pointed emotional evocation in the opening section of this work.

Overall Pulse Journey in *Union*: Rhythmic Unity and Contour Affect Theory

Union aims to initiate a process of catharsis in its listeners. This entails evoking calm, rising energy and evoking progressive excitement, and then evoking calm again to end. The predominant methods used from the CTEE for this were Rhythmic Unity paired with a progressive increase of tempo and successive reduction of tempo, and Contour Affect Theory, specifically with the use of ascending melodic phrases in iconic or outstanding moments of the piece.

The increases of tempo happen both actually and perceptively in the work. Within the first 30 bars, the tempo moves gradually from 48 to 63, with the assistance of carefully placed rhythmic subdivisions and diminutions to create a quickening of tempo between actual tempo increases.

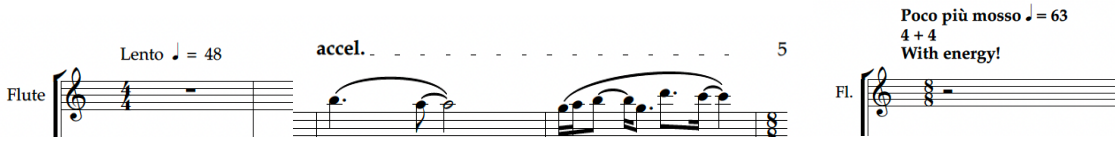


Figure 119: Tempo changes in the first 30 bars of *Union*

Beyond the first 30 bars, the absolute tempo of the piece does not change, but it utilises shorter and shorter note durations when aiming to increase excitement/arousal, and longer durations to reduce excitement/arousal.

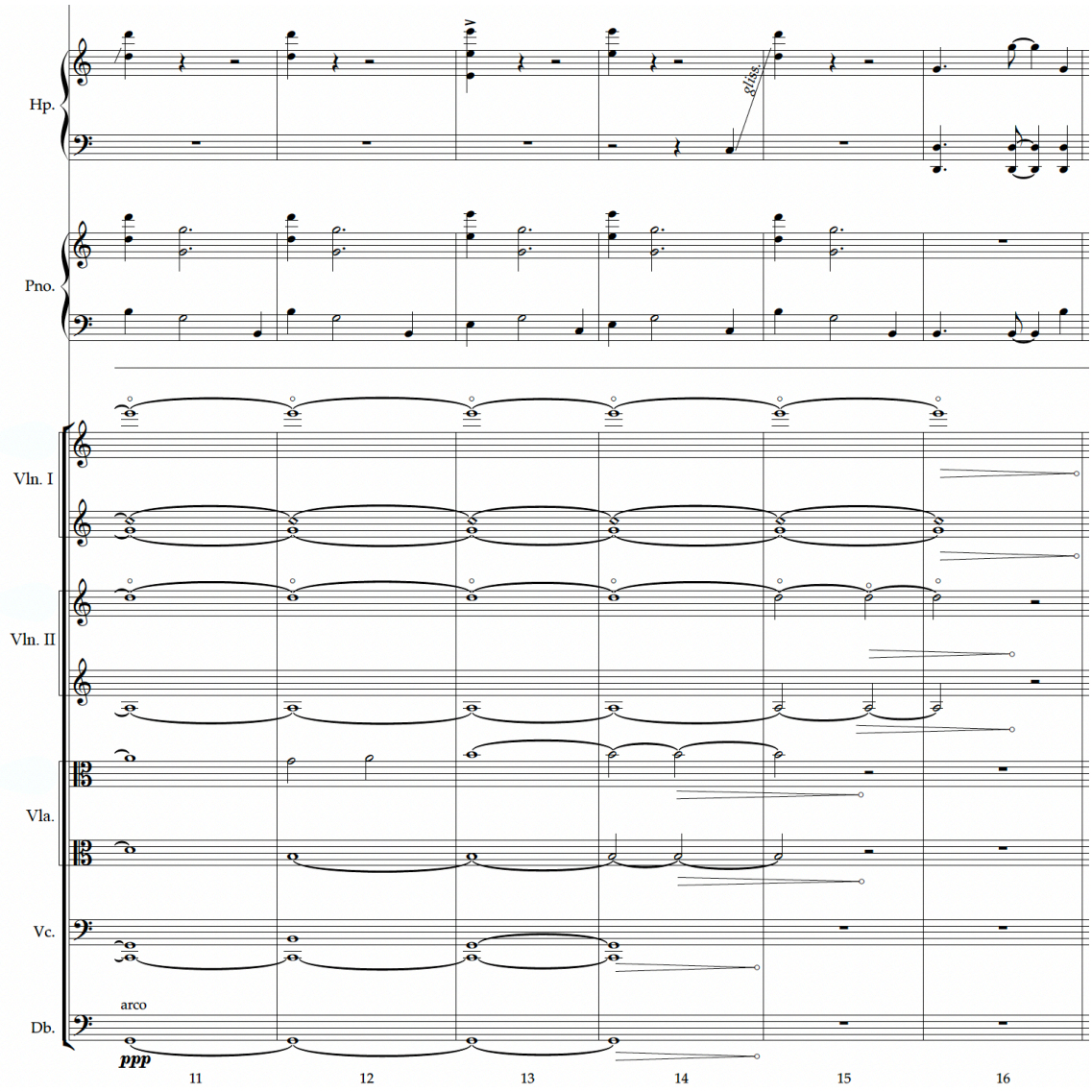


Figure 120: Long notes in the opening of *Union* (b. 11–16)

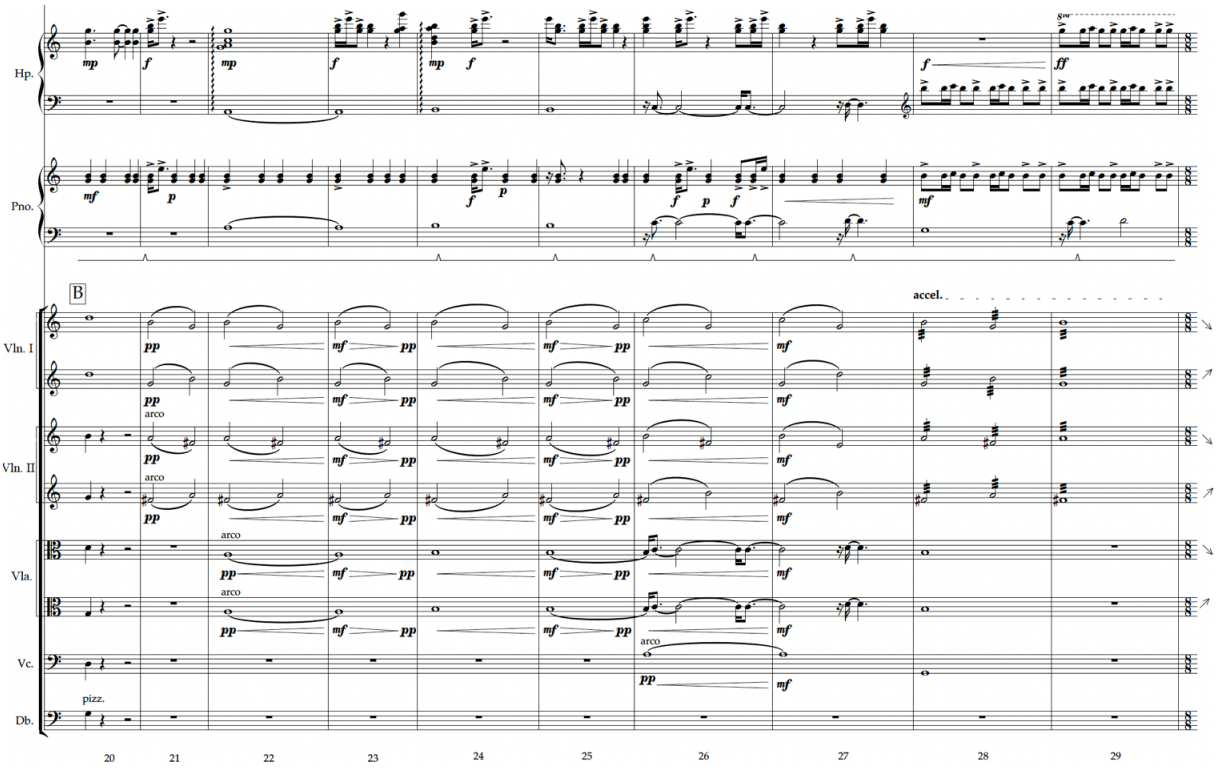


Figure 121: Shorter, diminishing rhythms in opening of *Union* (b. 20–29)

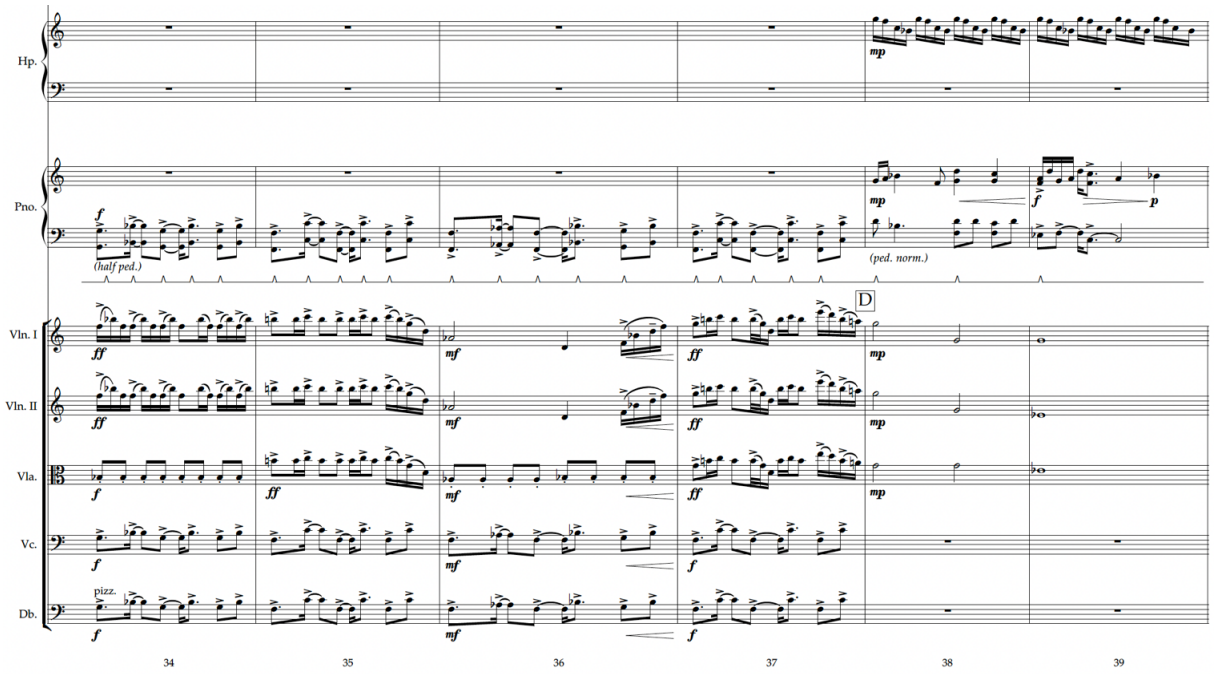


Figure 122: Further shortening and diminution of rhythms in opening of *Union* (b.34–39)

4.5 The Business of Recovery – for string quartet

The Business of Recovery was a piece commissioned by the Sydney Jewish Museum for the Geist Quartet featuring guest first violinist Ilya Isakovich (Australian Chamber Orchestra). The piece was a part of the Jukebox Jewkbox exhibition at the museum, and was premiered on 24 October 2019 at the concert New Spin on Old Vinyl.

The brief for this work was to pay homage to the Jewish contribution to music through history. As a commissioned artist, I was invited to tour the museum (which I had incidentally done so before), and experience again the poignance and depth of grief and atrocity that the museum represents. I found it very difficult to isolate the ethos of my work to paying homage to the Jewish contribution to music, and decided it was crucial not to ignore the pain that the museum signifies.

The Business of Recovery was inspired initially by Irving Berlin's song "There's No Business Like Show Business" – a world-famous work by an iconic Jewish composer written initially in 1946 for the musical *Annie Get Your Gun*, and borrowed again for the 1954 movie-musical *There's No Business Like Show Business*. The Jukebox Jewkbox exhibition at the museum featured a room with hundreds of vinyl records lining the walls, and vintage record players in the centre. Visitors were able to select a vinyl from the wall and play it on an available record player at their leisure. I was attracted to the familiar song "There's No Business Like Show Business" and latched on to the main musical cell of the motif:

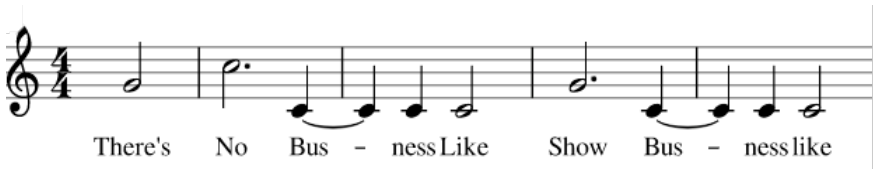


Figure 123: Main motif from "There's No Business Like Show Business"

I took this cell, halved the durations, applied the rhythms and intervallic content to a new mode, fragmented it, and threaded it throughout my work.

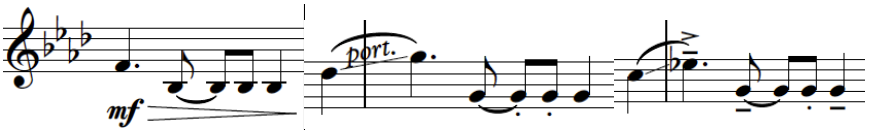


Figure 124: Fragments of appropriated cells from "There's No Business Like Show Business" in *The Business of Recovery*

I paid homage to this appropriation in the first half of the title of my work *The Business of Recovery*, and in the second half of the title, decided to reflect my choice to depict catharsis in my music as a means of purging of the pain and liberation from the memories of Auschwitz. Hence, the work became about recovery and catharsis from pain. I chose to evoke a cathartic process foremost through an emotional arousal contour of calm (to match listeners), building to excitement, climactic excitement, building away from excitement, back to calm. The primary tool I utilised from my CTEE was, expectedly, Rhythmic Unity. However, I will first note a key moment of manipulation of intervals through Intervallic Affect Theory in supporting the climax of the work.

Intervallic Affect Theory

Throughout this work, I have used intervals in a way to support the emotional trajectory of the piece. I will briefly touch on a particular use of intervals of power and stability in the final section of the work, that is supported by fortissimo dynamics (the loudest dynamic in the piece overall). From bar 98, we have a final climax of the work, and this is punctuated by double-stopped octaves in the violin, and perfect 4ths and 5ths in the cello. This moment aims to be the final push in excitement and arousal evocation, accompanied by feelings of certainty and power (from the intervals used), and an undertone of positivity articulated by the major tonality (Parncutt, 2014) before the release of tension and the ostensibly calm ending arrives

in totality.

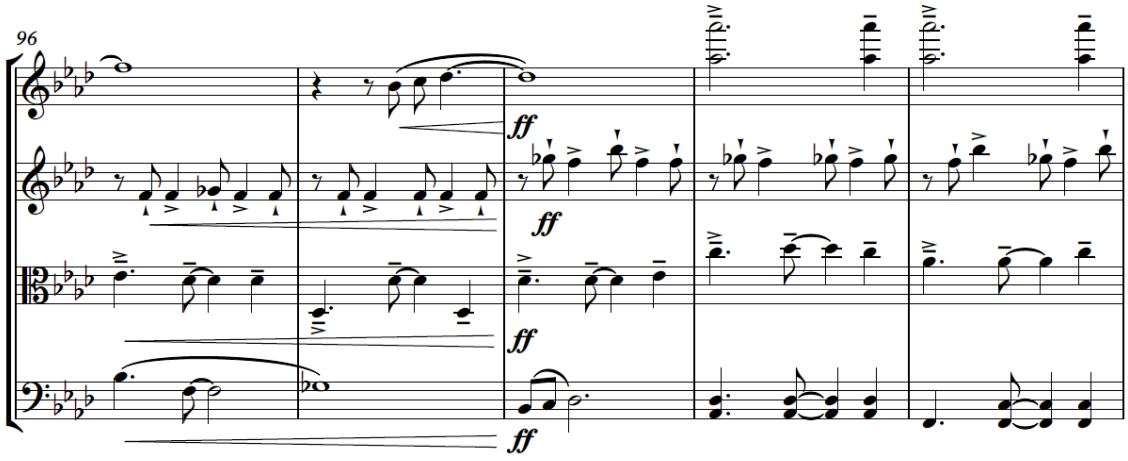


Figure 125: Intervals of power in the violin 1 and cello in *The Business of Recovery*

Rhythmic Unity

The opening of *The Business of Recovery* has a tempo marking of "ca. 76 (at your resting heartrate)". This unusual indication meant that, before commencing the work, the four players would hold their hands to their chests and gauge an average heartrate to use as the main countable pulse beat.

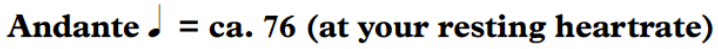


Figure 126: Tempo marking in *The Business of Recovery*

An ostinato is established from the onset of the work as a vehicle for entrainment with the listener's heartbeat in the same way I use ostinatos in other works. Because *The Business of Recovery* was to be performed live and the audience would be encouraged to walk through the museum before the concert began, I anticipated that the collective pulses of the crowd would likely sit within resting heartrate range. I also anticipated that – factors like nerves, health, and age aside – the closest I would come to finding a collective pulse average from the crowd would be from the players themselves. From here, I aimed to entrain the pulse of the audience

and utilise Rhythmic Unity to evoke progressing excitement/arousal in the audience, followed by final moments of calm.

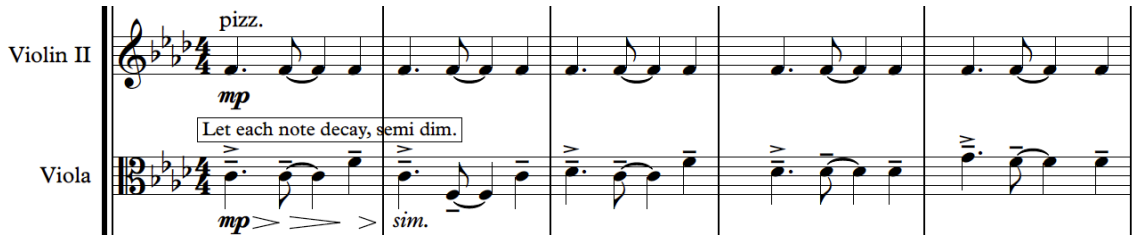


Figure 127: Main ostinato in *The Business of Recovery* as exhibited in the opening bars, by violin and viola

The work speeds up periodically throughout the piece, and by two bars after Letter B, we have reached 100bpm (about 20 points faster than the start), where the ostinato remains to encourage heartbeat entrainment.

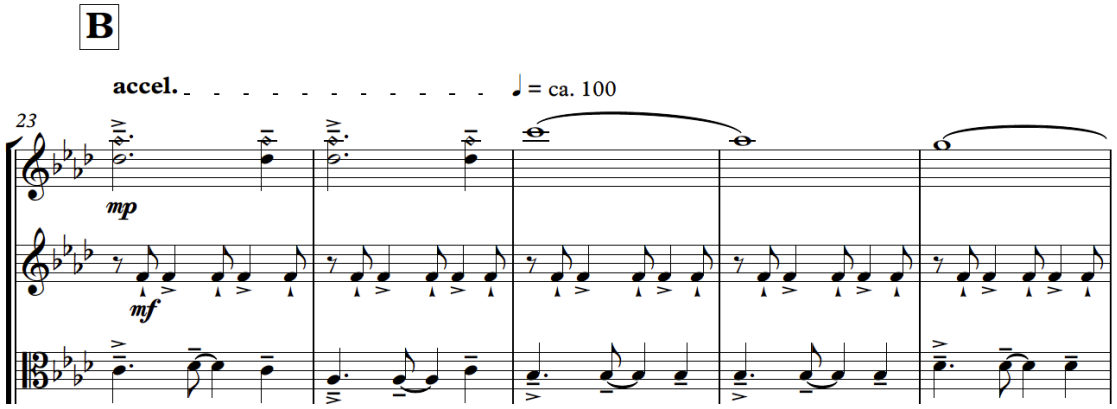


Figure 128: Tempo increases in *The Business of Recovery*

To further emulate tempo increases, the ostinato is gradually rhythmically diminished into quavers, then semiquavers. This happens in a single voice at first, and eventually in all four voices of the quartet. By bar 77, all lines are playing semiquavers, and effecting a tempo of about 200bpm.

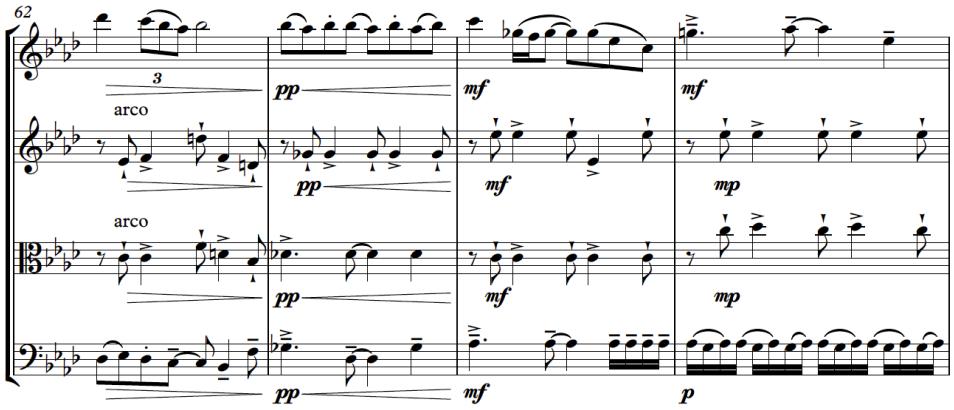


Figure 129: Ostinato diminution to quavers in b. 62 cello, b. 63 violin 1, semiquavers in bb. 64–65 cello, in *The Business of Recovery*

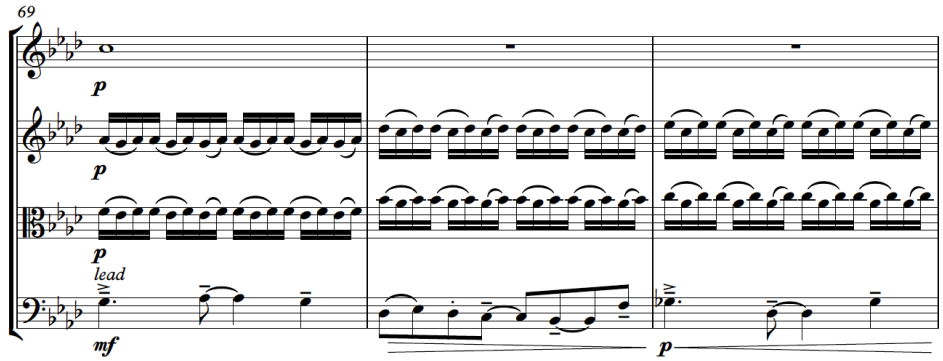


Figure 130: Ostinato diminution to semiquavers in two voices from b. 69 in *The Business of Recovery*

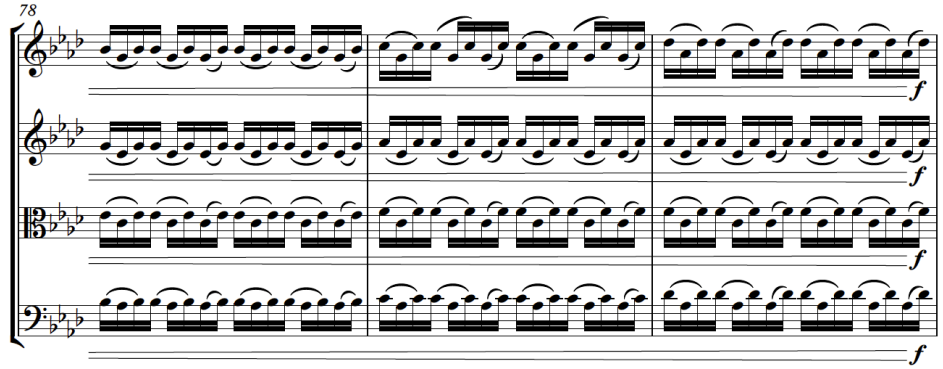


Figure 131: Ostinato diminution to semiquavers in all voices from b. 78 in 'The Business of Recovery'

The ostinato subdivisions gradually fall away much in the way they came about – rhythmically augmenting voice per voice, until the ostinato returns to prime form. This aims to leave space for arousal decrease and eventual encouragement of calm.

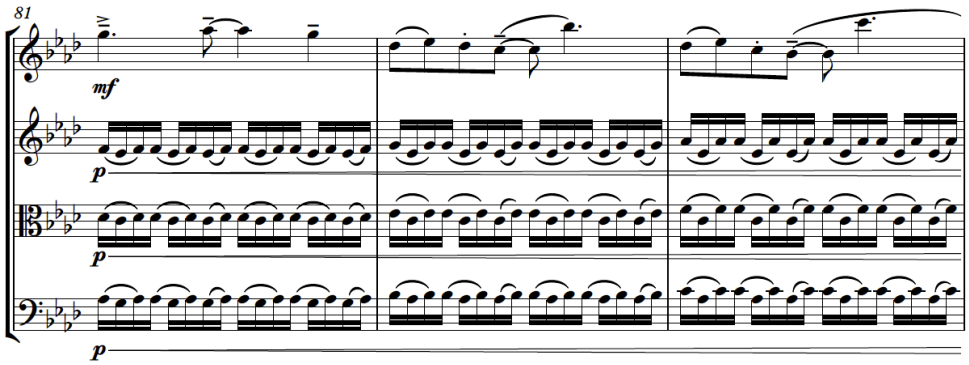


Figure 132: Ostinato augmentation from b. 81 in *The Business of Recovery* in violin

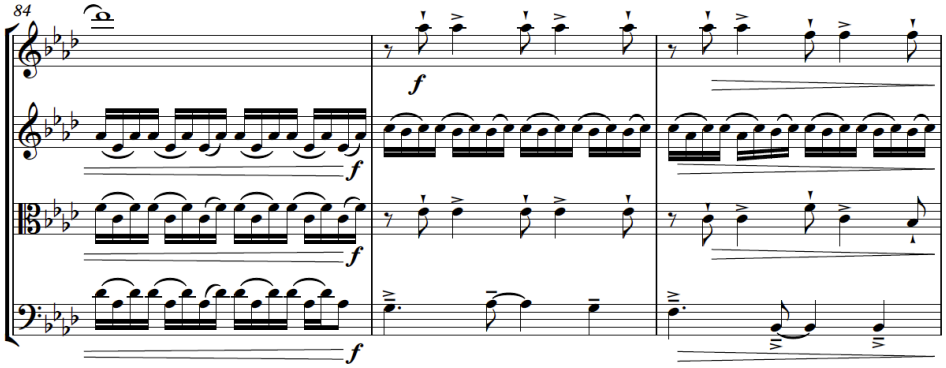


Figure 133: Ostinato augmentation continues, with diminution left only in violin 2 in b. 85

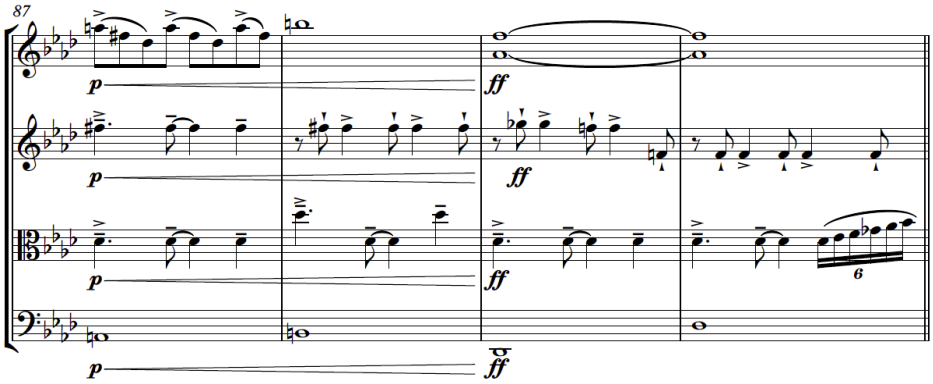


Figure 134: Ostinato augmentation continues, ostinato returns to prime rhythmic form in all voices from b. 88 in *The Business of Recovery*

The work finishes with the ostinato retained, and a gradual slowing of tempo through a rallentando marking, ending at around 60bpm – in the low range of the average resting heartrate of an adult. This aims to encourage a lasting feeling of calm, and consequently from the arousal trajectory of the work so far, an overall experience of catharsis.

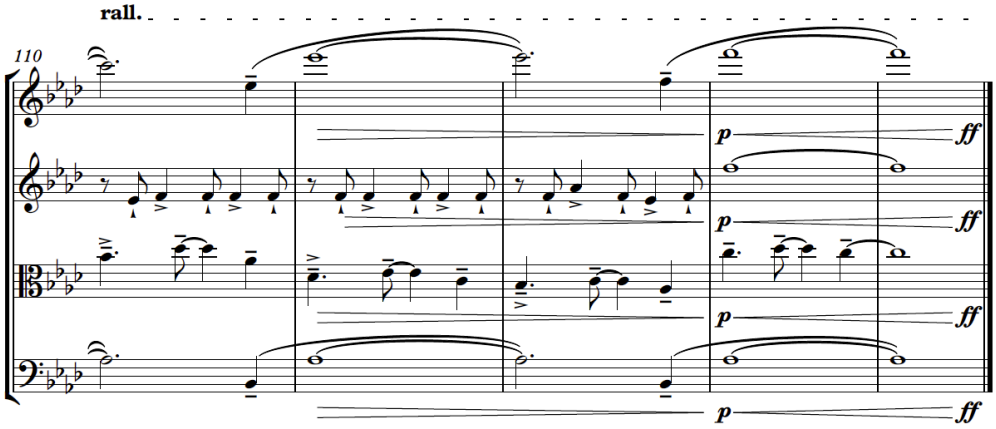


Figure 135: Ending of *The Business of Recovery* slowing in tempo to encourage calm

4.6 Bloom – for piano four hands

The final work of this analysis is one that was commissioned by Connecticut Summerfest in 2021. The instrumentation was for four-hands piano, specifically for the Grammy-nominated, internationally acclaimed ZOFO – a virtuoso piano duo based in San Francisco.

Commissioned shortly after a life-altering personal experience of mine during which I felt the intense need for purgation and expression of deep grief, sorrow and nostalgia, *Bloom* quickly became a work about self-rediscovery. I used my CTEE to write a piece that would help me feel as though I were letting go of, immortalising, and surrendering the emotional story I was enduring. As a composer, I believe vulnerability is crucial in connecting with an audience. *Bloom* took possibly the most vulnerability I have personally drawn upon to create a work. *Bloom* henceforth became a work that speaks of love, loss, intense grief, bargaining, trauma, and healing. From an emotionally evocative capacity, *Bloom* aims to paint and evoke the following journey: calm and numbed, timeless sadness, an energetically building and arousing

sense of grief, another short moment of timeless sadness, energetically arousing grief, happy nostalgia, powerful and fully arousing grief (building towards the climax of the work), excitement and nostalgia (marked by the duality of happiness and sadness accompanied by arousal), quiet and calm sadness, and, finally, calm happiness.

Musical Expectancy

Bloom aims to be a harmonically and stylistically accessible work for a broad audience. Its duration of seven minutes, however, is longer than that of a standard contemporary popular piece of music. In order to maintain listener attention, I utilised Musical Expectancy (specifically through MAV) as a foundational approach.

Due to the nature of the work's diverse emotional landscape, *Bloom* utilises multiple musical ideas in the forms of ostinatos and melodies (arguably motivic melodies). Unlike most of my other works of this length, which may use up to two or three themes, *Bloom* uses nine. The unifying feature of the work is the key, and a limited chord selection that each theme utilises in some order for the duration of the piece. The key of the piece is A natural minor (aeolian), and the chord selection i, VII, V and VI. The piece deviates from these chords only when using material that has been well established and developed previously. In this way, the work maintains unity through its key and chord progression/chordal choices, but balances this with a multitude of new musical ideas to maintain the listener's attention. When the key and/or chord progression changes, however, we hear familiar musical ideas.

The fine balance achieved between familiar material and new material or ideas, is a means of keeping a listener engrossed in the work. The manipulation of tonality, Rhythmic Unity, Intervallic Affect Theory and Emotional Contagion then portrays the actual emotions I am aiming to evoke in the listener. With the help of Musical Expectancy, the listener remains focused on the work for the duration, aiming to maximise the chances of emotional evocation efficacy.

The only exception to this rule over the course of the whole work, is for the material spanning ideas 4 – 5. Idea 5 is the first of two portions of the piece that modulates, and it moves to the relative major (C – a closely related key). Idea 4 utilises the ♭ II (Neapolitan 2nd) chord resolving to the tonic. The Neapolitan 2nd is a pre-dominant chord that ordinarily resolves to a dominant function chord (I6/4 or V), but in this case resolves to the tonic chord in root position. Nonetheless, the ♭ II is a chord from the parallel Phrygian mode of A, and this addition of a new chord foreshadows harmonic change to come – namely, said modulation to C major. The function of this somewhat out-of-place modulation is to introduce by way of fragmentation, the modulation of the end of the piece to the same key. The end of the work aims to paint and evoke emotions of calm happiness, and the latter is most associated with major keys (Parncutt, 2014). When the second and final modulation does appear in the work at the end of the piece, the material is certainly made up of an amalgamation of repeated ideas from the nine previously established, and hence adheres to the rule of balance discussed.

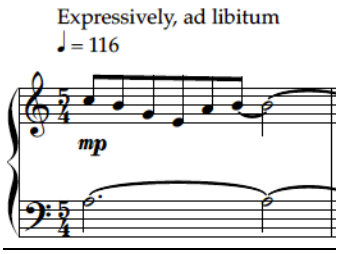


Figure 136: Idea 1, *Bloom*

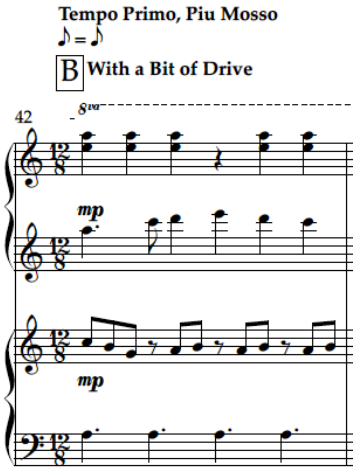


Figure 137: Idea 2 in top staves, idea 1 in bottom staves, *Bloom*

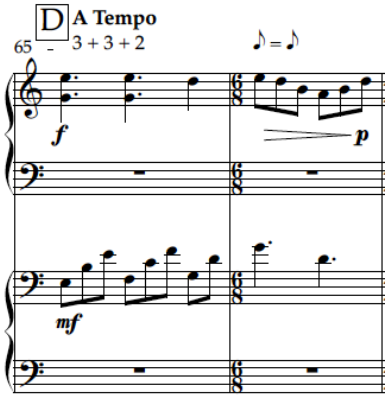


Figure 138: Idea 3, *Bloom*

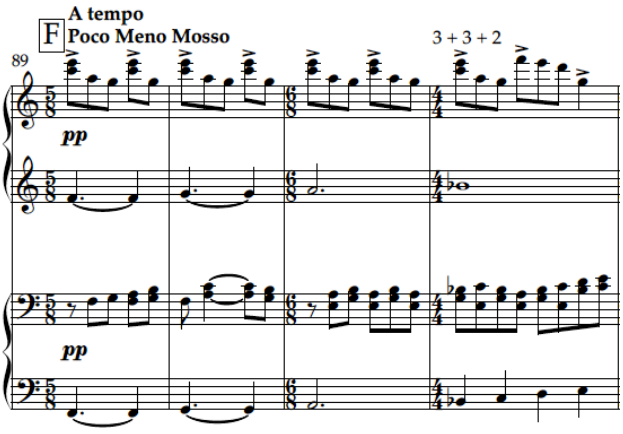


Figure 139: Idea 4, *Bloom* – melody in bottom staves accompanied by ostinato in top staves

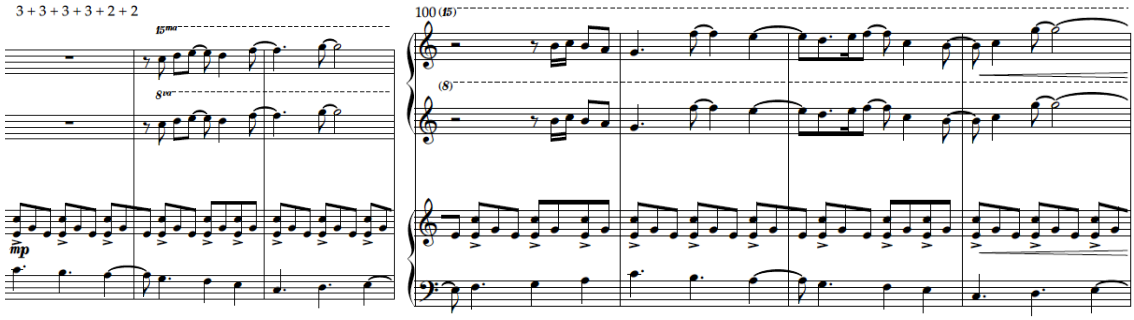


Figure 140: Idea 5 – motif and ostinato paired in *Bloom*

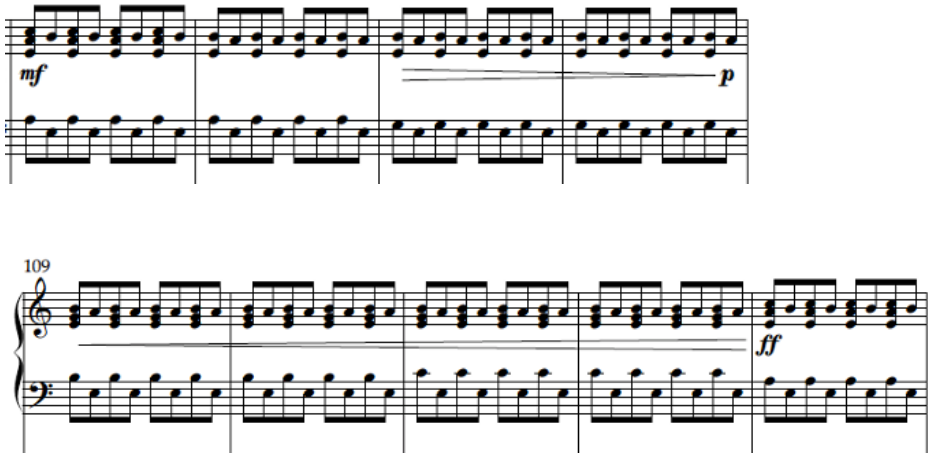


Figure 141: Theme 6, ostinato in *Bloom*

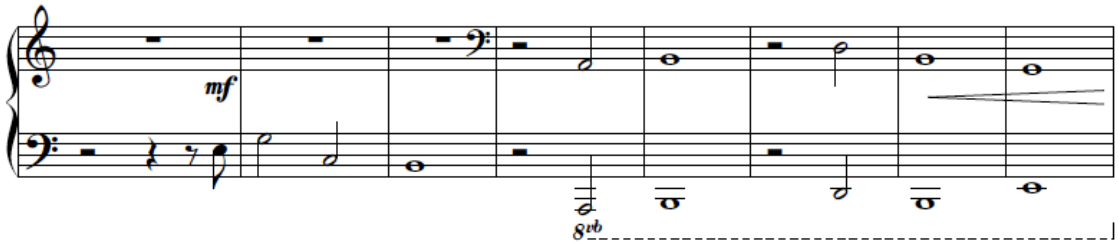


Figure 142: Theme 7, melody in *Bloom*

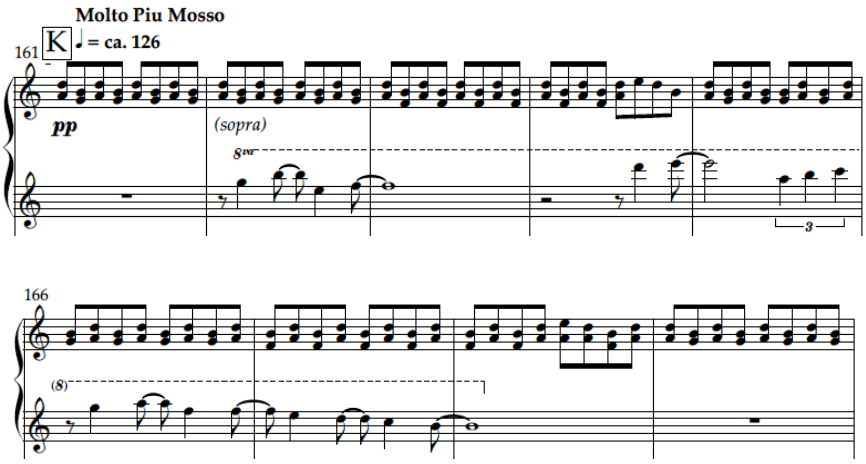


Figure 143: Themes 8 and 9 – ostinato top stave, melody bottom stave, in *Bloom*

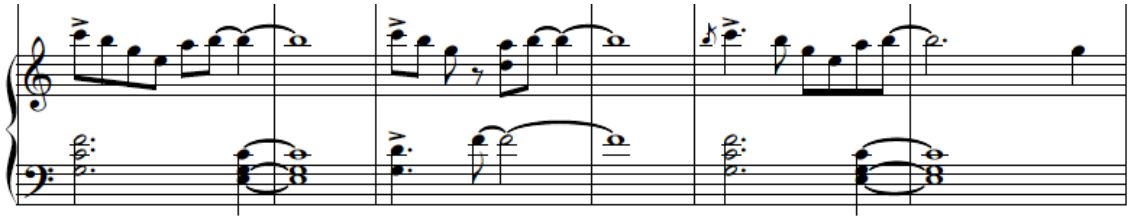


Figure 144: Final bars of *Bloom*, in C major, utilising idea 1 in the top stave

Chapter 5:
Conclusion

This dissertation describes a framework of compositional approaches that composers can use to create music for emotional evocation. Composers have succeeded in creating emotionally effective music for hundreds of years by drawing on anecdotal, feedback-driven, and intuitive decisions. Indeed, because of this, much research has been devoted to understanding what it is exactly, that makes emotional music so powerful. Therefore, the creation of a framework for emotionally evocative composing does not arise, not because of a lack of existing emotionally evocative music, but rather because of the ubiquity of it.

My aim through this doctorate has been to develop and test a systematic and evidence-based framework that synthesises the vast body of scientific and the musicological research to date. In this dissertation I have sought to explore and discuss a comprehensive body of literature regarding the findings of key scholars in the field of music and the mind to create a tangible, applicable tool for emotional music creation.

This dissertation positions the Compositional Toolbox for Emotional Evocation (CTEE) as a starting point for composers aiming to create music for emotional effect. Because it is based on the findings of scholars who investigated existing music and found trends, the CTEE can also be used as an analytical tool. Although the studies described here were not conducted in a healthcare environment, is it clear that it has the potential to be used by composers to evoke emotions that will facilitate calm, peace and relaxation in healthcare and medical contexts – in hospital waiting rooms for emotionally heightened caretakers, to lessen white-coat anxiety in patients, to soothe the overworked nurse, and to excite once more the patient in palliative care.

Because of the growing prevalence of mental-health strains on the Australian population, especially due to the recent COVID-19 pandemic (Black Dog Institute, 2020), I chose initially to focus on specifically evoking calm and/or catharsis in listeners. It is because I am a composer that I believe artistic outputs are some of the most powerful, and most underutilised, tools for wellness and healing.

This dissertation utilised two pilot studies to lay the groundwork for the testing of the Compositional Toolbox for Emotional Evocation.

The Wellness Project aimed to ascertain how 10 pieces of music written using the Toolbox portrayed perceived calm and/or catharsis in adult listeners. It observed correlations between calm and catharsis, and happiness and sadness, by interpreting data reported on an arousal and a pleasure scale. The study showed associations between high levels of excitement and high levels of pleasure in music listening, and also confirmed that the musical pieces written for this study using the Toolbox were effective emotionally evocative stimuli. Overall, the study pieces written with the Toolbox were perceived as more pleasurable and calmer than those written without the Toolbox, and the majority of the pieces achieved the perceived emotional reaction that they were compositionally intended to evoke with statistically significant results to support this.

Music and Video for Calming Children in Medical Circumstances was the second pilot study of this dissertation – testing pairings of music and video for their ability to encourage in children calm and happiness over time. The music was again created using the CTEE, and the videos were created using principles of Ecological Valence Theory and other visual and affect ideas. The study aimed to observe any noteworthy trends surrounding the pairing of stimuli for this purpose, and to gauge the efficacy of the Toolbox as a framework for emotional composition. The premise of the study was to validate the music and video samples for their use in a potential successive study that aims to placate children experiencing white-coat anxiety in

pathological settings, using a virtual reality game. The results from Music and Video for Calming Children in Medical Circumstances suggested that the pairing of visuals and audio is a more effective means of emotional change (specifically regarding arousal/excitement) than the utilisation of each stimulus alone. It also showed a general increase in pleasure and excitement over time for the videos that were paired with music written with the Toolbox , and, interestingly, an increase in pleasure but a decrease in arousal for the music alone – showing that the music left participants happier and calmer overall.

The most significant outcome of the studies described in this dissertation is the fact that music composed using the CTEE was largely successful in evoking the desired emotional responses in the target audiences. Although the purgation of emotion was not specifically shown, the ability to excite using the CTEE, and to calm using the CTEE, was supported by the studies. This is an important contribution to composition as it provides an evidence-based approach to the design and creation of targeted musical interventions in wellbeing and health care settings. For instance, when designing new healthcare facilities, architects and designers could work with composers and the CTEE framework as well as visual artists to create new and novel environments that place patient and staff wellbeing at the centre of the design process.

Both studies resulted in the creation of a suite of compositions that can be used for future similar applications and research. As a part of my compositional practice over the duration of this project, I have also composed – and professionally recorded with leading Australian and international performers – a large suite of pieces that use the CTEE to evoke a variety of emotions predominantly calm and/or catharsis. These act as templates for future reference. Importantly, the CTEE is not limited to classical or art music composition. The framework can be readily applied to other forms of music generation, be that electronic, ambient or other forms. This is of particular relevance when considering sonically activating otherwise sterile environments.

Despite generating very positive outcomes, the current studies had some limitations. The most critical was the number of participants. Future studies would seek more effective recruitment strategies. Another external limitation was the lack of social activity during COVID-19, which occurred during the entire course of this project.

In terms of actual study design, The Wellness Project could evolve to feature shorter musical excerpts that might produce more streamlined results than those of the two-to-three-minute length that were used. It is hypothesised that shorter excerpts would reduce participant attrition and barriers to self-assessment. It is unclear for example, whether participants listened to the whole piece or just selected "samples". In addition, the length of the works meant that the intended emotive affect was not necessarily maintained. Future studies in similar areas would do well to utilise platform design that can be programmed to require participants to complete the listening of a sample fully, before reporting, to control this variable.

In the context of catharsis, this study utilised a non-standardised measurement. Further investigation is required around a more established, normalised framework for measurement, potentially in conjunction with the fragmentation of musical excerpts, to delve more deeply into the participant's emotional state. Anecdotal feedback from both studies suggested that participants might have felt limited in their response options on the two scales provided. The use of visual analogue scales in future might provide the potential for a more diverse range of results and more accurate reporting for both studies, and provide the possibility to eliminate the limitation of responses to predisposed labels such as "neutral", "happy", etc. The studies in this dissertation conflate the evocation of emotion with perceptibly expressed emotion, and future studies would work to identify which components of the CTEE evoke and which express.

Music and Video for Calming Children in Medical Circumstances requested participants to self-report on how they were feeling. The minimum study age resulted in a somewhat double-

edged sword regarding initial study design and decisions surrounding emotional reporting. On one hand, it is possible that children may not have the developed sense of emotional awareness necessary to articulate how they are feeling, and on the other hand, it is possible that children may have a less developed sense of how to articulate how "someone might feel" as a result of musical experience. Future studies would take this into account with more explicit questionnaires. Another limitation to this study was the limited data we had regarding the ability of sample 1 to change how a child is feeling. Although we had results that indicatively supported our aims with this sample, it is not possible to gauge from the quantitative data alone whether the emotive affect was new, or whether it was what the participant was feeling before they commenced the study. Qualitative interview data, analysed using thematic analysis, did provide some helpful nuance around this for the five participants who were interviewed, but future similar studies would benefit from the inclusion of a simple preliminary question for participants: "How are you feeling now, before participating in this study?" Again, the interview data was very beneficial in illuminating this and other nuanced information, and is recommended for all future, similar studies.

Future research regarding musical experience and affect needs to consider the influence of external variables on the accurate reporting of emotions. Examples of such interference include surrounding stimuli, limited reporting options in surveys, an individual's aptitude for mood disturbance, or study designs that fail to differentiate affective behaviour from affect itself (e.g., studies that assume tears as a sign of sadness). Studies in future might, as is done in this dissertation, continue to pair musical experience with controlled multi-sensory experiences, request participants to stipulate how a stimulus might make "someone" feel (as was executed in The Wellness Project), find ways to extricate expression versus evocation of emotions in music, and/or develop alternate means of managing these variables. These precautions and considerations in study design will necessitate the continuance of extensive

interdisciplinary collaboration, which I believe is crucial for the success of continuing research in this field.

The arts, and specifically music, are fundamental to and effectively ubiquitous in wellness and healing. There is, however, significant untapped potential in terms of how we can use our understanding of the physiological and psychological mechanisms that underpin the effects of music on the human body. These sciences, together with the science of music, can and should be used to design new interventions in health and wellbeing. This dissertation has, it is hoped, made a small but notable contribution to this emerging area of interdisciplinary collaboration in a time of increasingly personalised approaches to health and wellbeing.

Appendix A – Portfolio

The following URL leads to a folder that contains the accompanying recordings of the portfolio of works being submitted with this dissertation. The scores and recordings include all works used in the two studies (including the video versions for both studies), and the adjacent works written for the purposes of future study, using the Compositional Toolbox for Emotional Evocation.

The scores are contained in Volume II of the dissertation, where the below link is also listed.

https://www.dropbox.com/sh/rgqhpqkux49isl6/AAC9fmB8fSWgQ_I2GZk2WWaXa?dl=0

Appendix B – Interview Quotes from The Wellness Project

In the qualitative thematic analysis conducted on the interviews in The Wellness Project (section 3.7.2), codes were drawn from the data that represent recurring comments from interviewed participants (listed under their respective aforementioned themes). The participant's direct quotes drawn from the thematic analysis (and some post-hoc inferences) are provided here:

General Emotional Change

- 'Happy' is any emotion that doesn't make you cry
    - N "why do you think it made you feel happy?" P26 "It's because … It's not like those sad music that makes a tear go down your eye"
    - Participant 26, aged 8 made this comment. This provides insight into a child's potential lack in emotional maturity that prevents their awareness of gradations of emotion beyond happy and sad. Is this an issue in our data?
- Sad after study is complete
    - N "how do you think you feel now after the study has finished?" P26 "I'm kind of sad … it is just actually kind of fun"
    - This comment was made by Participant 26 who had answered 1 (very sad) for affect, for sample four (video and music). By this stage, researchers hoped to evoke happiness (4-5). It shows that for P26, the sample itself did not make them feel very sad but rather they felt sad due to an alternate factor. A similar occurrence is detailed in the below code.
- Happy to have reached end of game
    - N "Are you saying like, your journey's ending makes you feel calm and happy?" P4 "Yeah … I think cause you've like experienced everything on the journey. And now you're safe and you can kind of look back at how far you've come and what you did on the journey"
    - [responding to being asked how they felt after the experience] P15 "happy to see you're at the end of the game"
    - These comments were made by Participant 15 and Participant 4. P15 said they felt happy because they had reached the end of the game (a goal for most video games is to reach the final level/end/etc.), and P4 said that they felt

happy because they had led the cats to safety. P4 is reacting directly to stimulus in the sample as intended, but for P15, similarly to P26, the participant felt happy because of an alternative factor (the affect was not imbued in the samples themselves but rather the effect of completing the task).

- How participants feel before study is varied
- "Neutral" means no emotions
- "Very Calm" is associated with sleeping
- Happy music is uplifting and hopeful
- How participants feel after the study is similar
    - N "how do you think you feel now after the study has finished?" P26 "I'm kind of sad… it is just actually kind of fun"
    - N "How do you think you feel now at the end of the experience?" P4 "I think I feel like… a lot more happy. Like, I'm listening to the music and watching the cute kitties… Yeah so I think that was really good."
    - P21 "Oh, like I don't feel like "I feel like.. oh my god this is so crazy I'm gardening!"… like no. It's just a LITTLE bit of excitement. But like after it, you fee like, accomplished. I would have felt calm"
    - The general opinion for this code was largely shared. Participants suggested that they felt "accomplished", "calm", that they were "happy to see (they're) at the end of the game", and that they felt "a lot more happy" overall. P26 who reported that they felt "sad" after the study was finished, also noted that it was "actually kind of fun", indicating the overall enjoyment of the experience by said participant.
    - This is an overwhelmingly supportive response for the overall effectiveness of the game in attempting to make children feel calm/neutral and happy/neutral after interacting with experience.
- "Neutral" means calm
    - N "on the calming side of the scale, you said neutral. Talk to me about that." P4 "I think I said neutral because it's calming, but it also kind of, kind of builds up and like I said, it's hopeful for the future, but then it's not too overwhelming as well."
    - This comment made by P4 suggests a child's inability to discern the difference between not feeling excited, and feeling calm. An aptitude for a child's ability to self-emotionally analyse should be taken into account for future studies.

Music & Game Production Effectiveness

- Video stood out over music
    - P21 “I definitely feel like there’s more happening in the video than there is in the song.”
    - N “what do you think stood out for you more here, the video or the sound?” P26 “the video”
    - N “And what do you think stood out more for you?” P4 “I would say probably the visuals because of how it changed. Like cause that’s like driven but also the music like played a big part in it as well.”
    - Three instances of comments were made that the video stood out from the music in certain cases (particularly associated with the presence of cats in the clips). Whereas;
- Music stood out over video
    - P21 “There was more going on in the music than there was in the video”
    - P21 “although in the video there was like, you know, stuff happening, the song on the other hand …”
    - P21 “There’s something to follow. LIke yeah, especially if I’m trying to get my mind off like stuff like, I don’t know if it’s white coat anxiety, like needles or whatever – because trying to get my mind off what’s happening in real life – I’m gonna want to see something I can like follow.”
    - Participant 21 commented that the music stood out from the video in three other cases.
        - A 3:3 ratio is equitable, which tells researchers that they have achieved an ideal balance between the music and video when observing the interview responses.
- Cats in video stood out – good
    - P15 “the cats are really nice”
    - P4 “I think kind of like, the kitties! They were so cute”
    - Participants gratified researchers’ use of cats in the visuals in four different instances. A notable response for future use.
- Game/study is fun
    - N “Why you think you might have felt very excited and very happy?” P26 “I just realised that it’s a video game!”
- Game reminds participants of movies/other activities

    - P26 “sometimes … it reminded me of sad parts in movies”
    - N “Does it remind you of anything?” P21 “Um oh, an activity that's like, nothing huge. But when you finish it, you still feel accomplished? Like gardening!”
    - P4 “it reminded me of kind of like … meditation and also like … it kind of reminded me of like, like butterflies …”
    - N “and did it remind you of anything at all?” P4 “like the sky … um yeah… it was like a sunny sky, cause it was pretty positive”
    - N “And did it remind you of anything?” P15 “…like meditation music”
    - P4 “it kind of reminded me of like, like a fairy … kind of like woods or something like that. Like fairytale land or something. yeah, and it was … it seemed like a really nice place.”
    - P4 “Yeah, I think it just reminded me of any like experience of like, coming home after like a journey …”
    - This comment arose on seven occasions from four different participants. It shows relatability and relevance of the visuals used, for children interacting with games today.
- Music and visuals are well matched
- Game isn’t familiar
    - One participant noted the game wasn’t familiar, but still enjoyed the experience overall.

Musical Features associated with Emotions

The musical features written into the pieces were emotionally interpreted much in the way they were intended – the following codes strongly support the technical musical facets that helped base the foundations of the CTEE:

- “Catchy” music makes you excited
    - N “Why do you think it made you feel excited?” P26 “… it starts to get a bit catchy”
    - This comment alludes to researchers that music that rhythmically entrains a listener can affect perceived arousal levels, as was anticipated. It supports the Rhythmic Unity tool from the CTEE.
- Music that’s not catchy is neutral
- “Sad” is associated with soft and low pitches

- Slow tempo is calming
- Fast tempo = exciting and happy
- Higher pitches = exciting and happy
- "Neutral" for "arousal" scale when tempo is moderate
- "Happy" and "excited" for "pleasure" scale when speed is fast/upbeat
- Instruments associated with calm
    - Are stringed instruments, piano and marimba.
- Rhythmic drive = exciting
- Textural build = exciting
- Meditation/calm = happy
    - N "Why do you think it might have made you feel happy?" CP4 "I think it made me feel happy because it was like, it was pretty, like comforting. It wasn't too kind of slow, and … I just liked how it was like building up a bit." N "why do you think it made you feel very calm?" P4 "… it reminded me of like meditation and … like the kind of string bit … and that's sort of reminded me of humming … kind of like harmonising with the rest of the melody that was more great"
    - This interestingly shows that children associate calm with happiness, despite the two being inextricable.
- Crescendo = exciting
- Repetition and lack of change in music = neutral
- Major = happy, minor = sad (harmony)
    - This finding supports theories of tonality and their correlative affect (as is depicted in the CTEE).

Videographic Features Associated with Emotions

(are interpreted much in the way they were intended)

- Warm colours = positive
- Darker colours = sad
- Bright colours = exciting
- Emotions follow the journey of the story – belonging/coming home
    - Participants noted that their emotions followed both the literal movement of the characters in the game: C4 "I think the reason I said neutral for like the video aspect is just because they were just walking.", or the narrative of the

characters and their journey: "…the kitties! Like they were so cute, but it was also kind of sad. I don't know how… like it was sad in a way… I don't know… because they were like, missing… like, lost or something?".

- Nature/background
    - Participants frequently noted their reactions to the sets of the videos as convergent with researchers' aims. For example for the final scene (of sample four), where researchers aimed to depict a calming, happy set, P4 noted "it kind of reminded me of like, like a fairy … kind of like woods or something like that. Like fairy tale land or something. yeah, and it was …. it seemed like a really nice place."

Meditation and Music (and Associations with General Music for Calm)

- Happy music is associated with meditation music
    - Again, a comment was made by participants in regards to associating happiness and calmness.
- Track three = meditative
    - P4 "it reminded me of kind of like … meditation and also like … it kind of reminded me of like, like butterflies or kind of just like harmony as well"
    - Two participants (P4 and P15) frequently associated their responses of 'calm' from samples, to meditation. They both noted that track three was meditative in nature. Track 3 was statistically significant in that it was the saddest and calmest sample of all 8 samples. Interestingly, the same participants had earlier associated calm with happiness, and yet the quantitative data suggests it scored the lowest on the pleasure scale. It would be interesting to observe how said participants self-assessed on the pleasure scale for track 3 compared to how they described it in their interviews. Perhaps said participants coincidentally were not those who ranked track 3 as "sad"/"very sad", or perhaps this supports the notion that a child's capacity for self-emotional assessment has limitations.

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