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Aesthetic Experiences in Music and Visual Art:  
Implications for Emotion, Well-being, and Identity

By

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A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

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Committee in charge:

Professor Dacher Keltner, Chair

Professor Iris Mauss

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## Abstract

# Aesthetic Experiences in Music and Visual Art: Implications for Emotion, Well-being, and Identity

By

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Doctor of Philosophy in Psychology

University of California, Berkeley

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In this dissertation, I primarily present work on the aesthetic experiences of music and visual art and the connection between engagement with these two media, various facets of well-being, and personal identity. Across studies, I use methods such as daily diaries, intervention, and cross-sectional surveys to support the thesis that there are unique connections between the individual and art. Art influences individuals' sense of well-being, and individual beliefs also influence art engagement. First, using daily diary data, I tested for relationships between daily music listening activity, emotions evoked by music, and subjective well-being. Study 1 revealed unique correlations between daily positive and negative emotions and sense of social connectedness. In Study 2, I developed a live music concert-based intervention centered around the emotion of awe and an effective, new paradigm for sustaining immediate well-being improvements beyond the concert experience. In Study 3, I present a previously published study co-authored with Dr. Eftychia Stamkou, Dr. Dacher Keltner, Dr. Eda Aksoy, and Dr. Alan Cowen. In this study, we created a dataset of 1457 visual artworks from diverse cultural and historical periods. We collected emotion and aesthetic responses to arrive at a high-dimensional space of aesthetic experiences associated with visual art. Finally, in Study 4, cross-sectional data revealed how moral beliefs influence the perception of moral thematic content in artwork and aesthetic responses to artworks.

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As I write these acknowledgements the earned fatigue of six tumultuous, wonderful, identity-shaping years is heavysset in my eyes and bones. Yet, as I have been able to persist through these years thanks to the mighty community in these acknowledgements, I persist in writing this for them because they deserve the praise.

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## **Aesthetic Experiences in Music and Visual Art: Implications for Emotion, Well-being, and Identity**

“The arts have the ability to transform you like nothing else. They can help move you from sickness to health, stress to calm, or sadness to joy, and they enable you to flourish and thrive. They can lead you to profound altered states, changing your very physiology. The arts have always offered the highest form of hope, and science is now providing new knowledge that each of us can immediately use... Are you ready? You are the curator of your life.” – Susan Magsamen and Ivy Ross

Every day, there are countless opportunities for experiences of the arts; experiences defined by beauty, enjoyment, and being moved. This can take many forms including but not limited to, engagement with music and visual art. These mediums are accessible and powerful in communicating, promoting meaning-making, and understanding ourselves (Dissanayake, 2007; Oliver & Raney, 2011; Sherman & Morrissey, 2017). To begin, I will provide a brief introduction to the field of aesthetics. Principles from this section such as aesthetic judgment and aesthetic emotions will be relevant to the following sections on music and visual art. Directly following the section on aesthetics, I will move into scholarship on music. The study of music is expansive, including entire dedicated fields such as ethnomusicology; as such, I will focus my review of the literature on findings in neuroscience, personality, emotion, and well-being. I will then present my current work on music in two studies: the first, a daily diary study investigating listening to music, emotion, and well-being, and the second, a live music concert intervention focused on awe and well-being. The next section will review empirical work on visual art, with foci being findings in neuroscience, emotion, and identity. I will then present a recently published manuscript I worked on early in my exploration of visual art as a focal point of my research program. Lastly, I will present my current work on visual art that examines the perception of moral themes in visual art and how this relates to one’s own moral beliefs and aesthetic experiences.

### **Introduction to Aesthetics**

Modern scholarship around aesthetics was born from centuries of philosophical theorizing. Modern definitions of aesthetics can be attributed to a number of scholars throughout history. Starting from German eighteenth century philosopher Alexander Baumgarten, who understood it as “the science of how things are cognitively constructed by means of the senses” to Immanuel Kant whose definition of aesthetics zeroes in on the experience of beauty, the sublime, and artistic judgment (Kant, 1790). Aside from the sensory experience of beauty, scholars such as Elaine Scarry delve into the relationship between beauty and goodness, exploring this in terms of justice, perception of goodness, and morality (Scarry, 1999). For a simplified definition which is most applicable to the work I will be discussing, I will refer to aesthetics as the study of art and the diverse experiences that come from it.

The Oxford Handbook of Aesthetics provides some definitions of art including that of a perceptible form, vehicle for expression and communication, representation of the external world, opportunity for play, appreciation of beauty, and demonstration of skill (Levinson, 2003). This reference also provides the following list of aesthetic properties of experience, and the stimuli that elicit aesthetic experiences: beauty, ugliness, sublimity, grace, elegance, delicacy, harmony, balance, unity, power, drive, elan, ebullience, wittiness, vehemence, garishness, gaudiness, acerbity, anguish, sadness, tranquility, cheerfulness, crudity, serenity, wiriness, comicality, flamboyance, languor, melancholy, sentimentality (Levinson, 2005). Note that these

properties include terms which are positive and negative in valence (beauty versus ugliness), low and high intensity (delicacy versus power), and traditionally emotion and non-emotion related terms (sadness, cheerfulness versus ebullience and flamboyance). Given the vast and diverse definitions of art, I will focus my work on art, specifically in the music and visual art mediums, as a cultural artifact that is produced and understood to be art within a given context (Carroll, 2012; Stamkou & Keltner, 2020; Becker, 2023).

At the core of this scholarship, especially relevant to psychological science, is the aesthetic experience. An aesthetic experience occurs when one attends to the sensory and formal qualities of an object or phenomenon, such as the visual elements of an artwork (Kant, 1790). Aesthetic experiences can be characterized by responses such as interest, pleasure, and being emotionally touched or moved (Nadal & Vartanian, 2022). Aesthetic responses can range from “wow” moments to everyday minutiae (Shimamura & Shimamura, 2012), entering an art museum and being arrested by a larger-than-life sculpture which captures our entire attention, or scrolling through Instagram and giving a ‘like’ to an image that pleases the eye for a few seconds before moving on to the next image.

In the third volume of her highly influential work, *Feeling and Form* (1953), American philosopher Susanne Langer elegantly connects the aesthetic experience to the field of psychological science in one simple question: “Shall we judge a work of art as an utterance, giving vent to its author’s feelings, or as a stimulus, producing sentiments in the spectator?” This question prefaces modern investigations into aesthetic experiences where scientists continue to investigate the capabilities of art to express and evoke emotion. Some decades later, anthropologist Ellen Dissanayake makes the argument that art engagement and thusly, aesthetic experiences, are fundamental to human behavior (1992).

Key figures in psychophysics, personality psychology, and perceptual psychology produced seminal works in aesthetics which laid the foundation for contemporary empirical research in the field. Gustav Fechner, a founding scientist in psychophysics, was drawn to the study of the “objective nature of beauty or to develop the system of aesthetics”, believing that aesthetic responses and preferences were observable and quantifiable. In order to develop this systematic understanding of aesthetic response, he employed novel methods for the time including subjective or self-report (asking participants how pleasant they found visual art and imagery) and behavioral (measuring how long participants gaze at the image and soliciting forced-choice responses between two images; Fechner, 1876). This work contributed methods which are still in use today and importantly, began to link the psychological phenomenon of aesthetic experience to engagement with arts.

Some 50 years later, Spranger (1928) proposed 6 value types including the aesthetic value type. In *Types of Men: The Psychology and Ethics of Personality*, he approaches the topic of “the aesthetic attitude” which he defines in terms of three stages. The first, *impression*, refers to the “physical” experience of an object’s emotional significance; we may understand this as the significance or meaning that the object, for example a poem, holds in of itself. Second, *expression* refers to one’s own psychological experience of the object. Third, *form* is the union of impression and expression, which importantly is a product of harmony between the objective and subjective experiences of the object. For example, form refers to the occurrence where the poem’s objective matter melds with the subjective experience of the poem by the viewer. Spranger goes on to highlight a key issue in future scholarship in aesthetics, “to investigate more accurately the borderline between the object as such and the attributes with which my soul endows it.”

Rudolf Arnheim drew inspiration from Gestalt psychology, which was founded on the idea that “the whole is greater than the sum of its parts”, in his theorizing on aesthetics and visual perception. He emphasized the role of “form”, or the visual structure and composition of an artwork, predicated on the theory that humans process visual information as a whole, and not in isolated parts. Moreover, he viewed the form of art as functionally expressive and communicative. Applying his theory of visual perception as an active cognitive practice, as opposed to passive, he thus proposed that engagement with art was dependent on the active cognitive processing of the visual form of the artwork (Arnheim, 1954). In short, only by engaging with the formal elements, are we able to draw meaning and appreciation. This theorizing, while crucial to the understanding of the role of visual processing in the aesthetic experience, is perhaps dismissive of the role of content and context in arts engagement. Importantly, Arnheim leaves many questions unaddressed, for example about how subjective interpretations of the content of art (what is depicted, what emotions are perceived) may affect the aesthetic response. We will return to this discussion with modern investigations into these questions in the music and visual art sections.

### *Neuroaesthetics*

Early inquiry into the psychological principles and key methodological practices in the study of aesthetics ushered in contemporary investigations spanning multiple areas of science, most notably neuroscience and emotion science. Research in neuroaesthetics, or the study of the biological/neural bases of aesthetics, has propelled the field of aesthetics forward with crucial investigations into the mechanisms underlying the brain’s processing of forms of art in various areas of life including art (Chatterjee, 2011; Chatterjee, 2014). Neuroaesthetics research is rooted in fMRI imaging studies focused on beauty, specifically the beauty of the human face and visual art (Magsamen & Ross, 2023). Notably, several studies reveal that the aesthetic response is associated with activation of reward centers in the brain, including the orbito-frontal cortex, nucleus accumbens, and amygdala, when viewing attractive faces (Kirk et al., 2009; Zhang et al., 2016; Zhao et al., 2020; Rui & Gu, 2021). The procedure for these studies typically involves participants viewing various stimuli while in an MRI (magnetic resonance imaging) machine, leading to inferences about areas which show activity during the experimental conditions (in the case of facial beauty studies when stimuli including faces are shown). Many studies also include stimuli which they believe will produce activation in distinct areas from facial stimuli such as moral stimuli; this comes by way of drawing a comparison between aesthetic judgments and moral judgments (Decety & Porges, 2011; Pöppel et al., 2013; Eres et al., 2018). In one study, participants were scanned while making judgments of attractiveness and goodness (for faces and moral vignettes, respectively). Participants demonstrated increased activity in the medial orbitofrontal cortex when their attractiveness and goodness ratings were higher; thus, when participants perceived the stimuli as more attractive and more good this area of the brain was more highly activated. Moreover, the activity in this region when judging a face as attractive correlated highly with the activity displayed when making a moral judgment of goodness, providing evidence for not only the same region being activated but also similar patterns of activation across the two stimulus types (Tsukiura & Cabeza, 2011).

In another study, participants were shown beautiful vs common faces and drawings depicting morally beautiful or neutral information. The example stimuli given in the paper show drawn images of an adult and a child holding hands for the neutral scene and a child helping a seemingly visually impaired person down a flight of stairs for the morally beautiful scene (Heinzelmann et al., 2020). Participants once again demonstrated activation in the orbitofrontal

cortex when viewing beautiful faces *and* scenes of moral beauty, however another reward region of the brain, the putamen, was only activated when beautiful faces were viewed. This finding demonstrates some consensus for the regions of the brain involved in the aesthetic response associated with beauty while highlighting the potential variability of neurological response dependent on the type of stimulus.

Research in neuroaesthetics also explores the brain structures and functions which correlate with aesthetic emotions. Vessel, Starr, and Rubin (2012) found that particularly intense feelings elicited by visual art, such as being moved, are accompanied by a reuptake of neural activity in the default-mode network or DMN, a type of activation which can be compared to a “resting” state. Further work supports activation of cortical areas in response to objective beauty and also evaluation of artwork, and distinct brain areas in response to subjective beauty as well (Di Dio et al., 2007; Ishizu & Zeki, 2011; Chuan-Peng et al., 2020).

I incorporate neuroscientific evidence in this review of aesthetics as an interdisciplinary foundation for the theoretical framework, and to bolster the empirical validity of the arguments presented throughout the succeeding sections. Research in this area demonstrates distinct neural correlates for aesthetic experiences. Given that neural processes are fundamentally linked to physical and psychological well-being, this work informs my investigation into how engagement with art may be associated with well-being. Moreover, responses to beauty perceived in art and moral situations show similar patterns of activation, providing a basis for my work exploring the links between morality and aesthetic responses.

### *Aesthetic Emotions*

Another area of research which is crucial towards understanding the aesthetic experience is in the study of emotion. In particular, aesthetic emotions which are distinct and discrete emotions that, importantly, always include some aesthetic evaluation or appreciation for the eliciting objects or events (Menninghaus et al., 2019). In order to distinguish aesthetic emotions from other emotions, one may consider them context-dependent emotions which involve the perception or contemplation of aesthetic experiences.

Some ready examples of aesthetic emotion can be understood as the feeling of being moved or fascinated, however experiences of aesthetic emotions are not always at this level of intensity; in fact, there are many other aesthetic emotions which can be thought of as less intense. In order to understand the terms used to classify aesthetic emotions, we may conceptualize them as containing familiar general emotion terms (joy, amusement, nostalgia, boredom, disgust, anger) and qualities which can be attributed to aesthetics. It is important to note that these classifications do not only reflect emotional reactions to stimuli but also the emotional content and evaluations of the stimuli.

Aesthetic emotions can further be distinguished from emotions that are not related to an aesthetic response by means of their deep intertwinement with aesthetic judgment (Schindler et al., 2017). We can further understand aesthetic emotions by coming up with simple comparisons to non-aesthetic emotions. For example, a great matcha latte can elicit joy but is unlikely to *move* us. Another example of this distinction comes from Menninghaus et al. (2019) who states that an elicitor of negative aesthetic emotion like a dreadfully long novel, can be readily put down and never returned to if we don’t find the experience satisfactory, however it is less simple to exercise this kind of control over non-aesthetically driven negative emotions.

Of course, the simplest method for measuring aesthetic emotion is the same as measuring general emotion: self-report (*see* the Aesthetic Emotions Scale; AESTHEMOS; Schindler et al., 2017). Beyond specifically aesthetic emotions, work on positive and negative emotions alike

have employed this method to assess distinct emotions evoked by visual art. For example, one study interested in anger and disgust in response to artworks measured these emotions by asking participants to indicate how much they agree with the following statements: I find this picture disgusting, This picture makes me angry (Silvia & Brown, 2007). The authors of this study make a powerful point towards the end of their paper that it may very well be pointless (their exact words were “unanswerable and unproductive”) to distinguish emotions from aesthetic emotions, instead it is more valuable to consider which emotions should be explored by researchers in aesthetics next. There remains much work to be done in the area of emotion and visual art; key issues to be addressed include more rigorous psychophysiological investigation, the clear demarcation of whether emotion is being assessed as expressed by artwork or felt by the perceiver, and de-emphasis of experimenter instructions in pursuing evidence of emotional experience (Konecni, 2015). One recent work in this area addresses the problem of indiscriminate reports of emotion in response to visual art by assessing both emotional responses and aesthetic qualities (Stamkou et al., 2024). In this study, researchers make a clear distinction between the two by asking participants what emotions the artworks make them feel, and separately, what descriptions apply to the artworks. They then utilize these two factors to examine the high-dimensional space of aesthetic experiences of visual art which include judgments of pleasantness, general emotions such as sadness and joy, and qualities of the artwork such as vibrant and ornate.

#### *Functions of Aesthetics*

Lastly, there are some theorized functions of aesthetics. We will focus on representation, expression, and social functions. The goal of representation in art and aesthetics is to depict real life themes and occurrences (Wallach, 1959). Beyond creating realistic depictions in art, the function of art as representation is to observe the world and create artistic representations of nature, society, human form, and behavior (Levinson, 2007). Art as a method of expression necessitates that artists select the message, emotions, and experience they wish to share with the perceiver in creating the artwork. This is a function of art whose consideration dates back to the Ancient Greeks, who believed one of the key purposes of art was self-expression.

Social functions of art include connecting with others and encouraging prosociality, desire to socialize, and ability to communicate (Stamkou, 2022). Dissanayake (2008) lays out key arguments for the social function of art. The first, that arts engagement is observable in some way across cultures regardless of how technologically advanced they may be. Secondly, arts engagement is rudimentary and easily identifiable in behavior. Just look at the way young infants and toddlers move and sing to music and make distinct marks on any surface they can drag their marker across (including themselves). Lastly, that arts serve the purpose of “reinforcing sociality”; or making us more social by encouraging cooperation and cohesion. Moreover, art is long theorized to contain a moral value which transcends the mediums in which it is contained (Carroll, 1995; Skov & Nadal, 2020).

A recent study interested in the relationship between arts engagement and prosocial traits and behaviors employed national datasets to test these relationships (Kou et al., 2020). Researchers theorized that it was dependent on the program type that they would see such correlations. For example, a program focused on learning about famous art historians and memorizing their names and contributions would not be as impactful as a program which incorporates topical social justice themes, allowing participants to think deeply about the real-world ramifications of the art they interact with. Results indicated that all types of arts creation and consumption had significant correlations with the prosocial behaviors of donation, counter

work, and informal helping behaviors. Each of these prosocial behaviors was also associated with more general arts consumption *seven years later*! These results contend that the long-term effects of arts participation on prosocial behaviors appears to be a stronger pathway than the reverse (effect of prosocial behavior on arts participation).

Another study explored the relationship between arts engagement and prosocial behavior, specifically with interest in *social connectedness* as the mechanism behind prosocial behaviors (Van de Vyver & Abrams, 2018). The researchers theorized that if social connectedness truly drives prosocial behavior, then another source of social connectedness (in this case sports engagement) should behave similarly to arts engagement. Results revealed that prosocial behaviors (charitable giving and volunteering) were more strongly predicted by arts engagement than sports engagement.

In conclusion, we may understand that aesthetic experiences are prevalent throughout many types of daily-life encounters such as interacting with art or making aesthetic judgments over the facial beauty of a passerby. There is strong evidence that aesthetic experiences have neural bases (for additional work see Cela-Conde et al., 2013; Chatterjee, 2014; Wald, 2015) and have distinct emotional correlates (Menninghaus et al., 2019). Not only this, but they serve the purpose of representing the world, creating space for personal expression, and connecting us to others. In the next section we will discuss how the principles of aesthetics have been applied to studies of music specifically.

## **Introduction to Music**

### *Defining Music*

Music is a diverse art form which encompasses the use and production of the voice (i.e., singing), mechanical tools, and/or instruments toward a product which may contain harmony, melody, or other formal elements. Music has been used as a way to communicate, express emotion, and share social and cultural traditions since early humanity (Savage et al., 2015; 2019). Anthropology, archeology and philosophy alike provide support for this idea, that music is an ancient phenomenon that emerged as early hominids became modern humans (Cross, 2012). In fact, the earliest artifact associated with music, an instrument identified as a bone pipe, is dated to 36,000 BP (Conard, Maria, & Munzel, 2009). Scholars have surmised that the existence of such an instrument likely comes later in the chronology than other musical acts such as singing or creating music by moving the body and interacting with surroundings. Music is central to human evolution and human social life.

### *Key Terms*

The following are definitions of the formal elements of music which may appear in or be relevant to our discussion of music: Rhythm, Melody, Harmony, Timbre, Dynamics, Texture, and Form<sup>1</sup> (Randel, 2003). Rhythm is the pattern of movement in time, and consists of beat, tempo, and meter. Simply put, the beat can be thought of as the pulse of the music, that which you can tap your foot along to for example. Tempo refers to the slow or fast speed at which the beat flows and meter is the pattern of beats within any one piece of music. Melody is the coherent succession of pitches, in which pitch refers to the individual sounds that make up a melody. Harmony is the relationship of pitches as they sound simultaneously. Timbre is the character of a sound distinct from its pitch, length, or intensity; one might think of this as the color of musical tones. Timbre is a product of different factors which impact the final sound of a piece, such as the materials the instruments are constructed from, the intensity of the playing (i.e. sustained notes and vibrato) and the articulation of certain sounds (whether they sound sharp or

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<sup>1</sup> The provided definitions are from the Harvard Dictionary of Music and are cited in-text and in references as such.

soft). Dynamics refers to varying degrees of loudness within a piece. Texture refers to the pattern of sound created by the interaction of musical voices and/or instruments. Lastly, form refers to the shape of a musical composition as defined by new and repeated segments; metaphorically, one might think of this as the roadmap of a piece of music.

As we move through scholarship on music in psychological science it is important to distinguish between musical activities, most importantly, listening to music and practicing music. Listening to music refers to behaviors that involve actively or passively hearing music; an example of active listening is to select a piece of music and play it on your mobile device, paying attention to the song, whereas passive listening is more akin to the experience of working at a coffee shop and listening to the music that happens to be playing in the background without paying much attention to any specific songs. Practicing music refers to behaviors in which one creates music using the voice, mechanical tools (software, electronically generated sounds), or instruments. This act of creation is typically denoted as “practicing music” due to the notion that music is both a skill and a mastery which can be built upon and improved through repeated engagement, or practice<sup>2</sup>.

### *Functions of Music*

Different cultures and societies may develop music and music-oriented practices in culturally specific ways. At the same time, it is argued that music is a human universal, suggesting that the meaning we derive from it and how we practice it has some degree of universality across cultures (Merriam 1964, 227; Mehr et al., 2019). There are important distinctions to consider within this possible profile of universal behaviors and responses to music. Music is uniquely imbued with ritual; however, these rituals promote very different psychosocial and cultural values depending on the context - whether it is shared in joyful celebration and love or deep reverence and respect (Dissanayake 1996; 2009). The use of music in ritual highlights the many functions of music, including to display what is considered admirable and beautiful, at times, interestingly, by displaying the exact opposite. Other key functions defined by Dissanayake are to build up seemingly innate associations with certain types of music commonly used in ceremony or ritual (like the Pomp and Circumstance marches of graduation), physiological synchronizing or “entraining” to music, and manipulating emotions (Dissanayake, 2009).

To further understand the cross-cultural perspective of the study of music, Patrick Savage et al. gathered and analyzed 304 global music recordings for what they deem “absolute musical universals”. They found that while there were no single unifying musical traits that could define all the music pieces, there were several common features both within the musical formative elements (pitch, rhythm) and social context which could be of use to understand the cross-cultural variations present in music. For an example of a formal element, the use of non-equidistant scales emerged as a unique practice to Southeast Asia, South Asia, and Oceania. In the social context, they found that music is predominantly performed in groups across regions. The work concludes with the notion that the unifying statistical universals unearthed in this work could be useful towards further investigation on the motivations behind the structures and functions of music (Savage et al., 2015).

### *Music and Social Bonding Hypothesis*

Now, let us review an essential framework on the function of music. Patrick Savage and colleagues constructed the Music and Social Bonding (MSB) hypothesis built upon the following key arguments. The first, that humans are predisposed to musicality, or the biological capacity

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<sup>2</sup> “How do you get to Carnegie Hall?” “Practice, practice, practice.” - Jack Benny

for perception and production of music. This is separate from the product of music defined earlier and does not necessarily denote any mastery or practice of music; this thesis simply asserts that the ability to engage with music on any level is innate.

Second, music serves the function of promoting social bonding. Social bonding can be understood as the creation, development, and maintenance of affiliative connections with other members of our social ecosystem. In particular, Savage et al. argue that music is unique in its capacity to enhance social bonding, citing that at times it can be more effective than simple spoken language and that it is scalable in a way that other evolutionary behaviors are not such as grooming in primates. For example, the practice and sharing of music may serve as an expression of social harmony due to the capacity for humans to synchronize to music and can involve many members of a society, including unrelated others, such as in a group setting where there is music or when participating in music-related rituals such as dance. Lastly, the music and social bonding hypothesis is rounded out by the argument that music's adaptive effects on social bonding promoted selection of prosocial traits. Specifically, the interest, ability and motivation to create music which is specifically attuned to social bonding, or in other words, that can be used for communication, promoting harmony, and sharing.

Savage et al. then go on to define specific features of musicality that promote bonding such as repetition, synchronization, and harmony. Repetition refers to the prevalence of repeated sounds and structures within music. Synchronization is the process by which processes are aligned such as toe-tapping to the beat of a song or breathing patterns matching the intense swells and drops in a piece of music. These tools are especially useful for promoting bonding in the large scale and across different relationship goals, including the creation of new relationships such as friendships and the deepening of existing close relationships by sharing knowledge of music. For example, if one demonstrates familiarity with a particular piece of music, this may inspire others who are also familiar with that music to engage in conversation and later, friendship. This type of formation of new social bonds can also happen within contexts that involve multiple others; imagine that the encounter described previously takes place at a gathering where others may also be taking note of their familiarity with the music playing, making the experience one shared between two individuals and within the larger group.

To touch on the formal elements of music which contribute to the music and social bonding hypothesis, Savage et al. (2015) highlight the tendency for humans to synchronize to rhythm and harmony. Within this context, as humans synchronize to the music, they also synchronize with each other, which can be a pleasing experience akin to dancing of course which requires coordination between people within a musical setting and is also thought to promote social bonding (Repp, 2006; Overly, 2012; Mogan et al., 2017). To summarize, this theorizing elegantly illustrates the likely universal ways in which our unique capability for musicality promotes social bonding in relationships of varying sizes.

As we move into further exploration of empirical work in music and psychology let us acknowledge the wide expanse of research that exists, spanning from musicology to neuroscience (Levitin & Tirovolas, 2009; Vuust et al., 2022). There are numerous chapters and entire books dedicated to this scholarship (including Hallam et al., 2009; Thompson, 2015; Hodges, 2019). We will touch on some of the sub-areas of music and psychology such as findings in personality and neuroscience research. However, much of the focus will be on those areas relevant to the current line of inquiry, specifically toward emotion and well-being.

*Music in the Brain*

One area of scientific advance in the study of music is in the examination of the role of the brain in the experience of music (for a recent review, see Vuust et al. 2022). The most commonly used method in music and neuroscience research is functional magnetic resonance imaging (fMRI). fMRI is a brain imaging technique which involves the use of an MRI scanner or machine to detect brain activity via changes in the blood oxygen levels in the brain. fMRI provides excellent spatial resolution, meaning that the specific areas of the brain which are activated can be distinguished with some degree of precision.

One seminal study in the area of music and neuroscience used fMRI to identify neural correlates of the emotional processing of music (Koelsch et al., 2006). Participants listened to “pleasant” and “unpleasant” music excerpts while undergoing an MRI scan. The researchers selected “joyful instrumental dance-tunes” for the pleasant excerpts and electronically manipulated those same excerpts to be off-pitch in either direction (above or below the original pitch) for the unpleasant excerpts. Results show activation of the amygdala, hippocampus, parahippocampal gyrus, and temporal poles in response to unpleasant music. Distinct brain regions (inferior frontal gyrus, anterior superior insula, ventral striatum, Heschl’s gyrus, Rolandic operculum) were activated while listening to pleasant music. Interestingly, in the case of unpleasant music, the same areas that showed activation also showed *reduced* activation during the pleasant music. These findings suggested that upregulation and downregulation of emotional states may be possible using music and illuminated the potential for use of music stimuli to study emotions in the brain.

Another method of study in this area is electroencephalogram (EEG). EEG records brain activity via small sensors attached to the scalp that record electrical signals in the brain with a great deal of temporal resolution. This means that brain activity can be observed down to the millisecond. A key study using EEG methods also investigated emotion, specifically emotion recognition when listening to music (Lin et al., 2010). Participants listened to excerpts from film soundtracks which were pre-rated for the following emotion states: joy, anger, sadness, and pleasure. The researchers identified the frontal and parietal lobes of the brain as contributing the most to the stable localization of emotion activation in the brain. These methods set the stage to explore creative questions involving not only the processing of music in the brain but potential outcomes on brain structures and development of music engagement and also employ other brain imaging techniques.

Within music processing in the brain, one line of work investigates the neural correlates of formal elements of music, namely rhythm or the systematic structure of music which is a culmination of pattern, meter, and tempo. Thaut, Trimarchi, & Parsons (2014) explore the potential for the individual factors of rhythm having unique neural substrates. Their study used positron emission tomography (PET), a scanning method where a radioactive tracer is ingested and collects in areas where there is significant chemical activity. Participants, including musicians and non-musicians, were tasked with identifying whether pairs of musical excerpts were the same or different in terms of their pattern, meter, and tempo. Results reveal similar activation patterns in the following areas for all three elements: frontal, cingulate, parietal, prefrontal, temporal, and cerebellar cortex. However, each element also expressed some unique neural substrates, for example, tempo processing activated the posterior insula and postcentral gyrus.

Recent work demonstrates the potential salutary properties of playing music, specifically for healthy brain development. Habibi et al. (2018) investigated the potential for music training during childhood to affect vital brain structures. Six-year-old children from similar

socioeconomic backgrounds were recruited from existing sports and music programs. Each child received two MRI scans, one at the beginning of the study period and one at the end of the study, two years later. It was determined through analyses of the brain scans that children who practiced music for two years had undergone significant structural changes in the development of the superior temporal gyri, a region of the brain involved in speech and sound processing, and in the corpus callosum, which facilitates communication between the hemispheres and contributes to high level cognitive development including social and emotional functioning, when compared to non-music practicing age and socioeconomic-matched controls. This study and many others support the immense potential for music interventions especially during childhood (Burris & Strickland, 2001; Dumont et al., 2017; Chen-Hafteck et al., 2018; Habibi et al., 2018). Studies such as these provide crucial evidence that the benefits of music are in fact observable in neurophysiological shifts and hopefully encourage future work to connect other measures of musical experience, for example in self-report questionnaires or emotional reactions, to physiological and neurological data.

#### *Music and Personality*

One of the most well-known ideas in the study of music in psychology is that of personality differences affecting the kind of music people prefer. One could readily imagine that neurotic people gravitate towards more moody or angry rock music, or extraverted people preferring high energy pop music. Many researchers have investigated correlates of music preferences and personality (Schäfer & Mehlhorn, 2017; Vella & Mills, 2017). In early work on this theme, Rentfrow & Gosling (2003), conducted a series of studies examining how the structural properties of personality correlate with music preference. They began by asking people about their general attitudes towards music and other forms of media, with items such as “Music is very important to me” and “My music preferences say a lot about who I am”. People reported that they generally think of music as important to their daily lives and report frequent music listening activity, on average. With this evidence towards the ubiquity and importance of music in daily life, the researchers constructed the Short Test of Music Preferences (STOMP; Langmeyer et al., 2012). Their process included a panel of 5 judges compiling music genres, web-scraping online music stores for music genres, and compiling an initial pool of genres for use in a pilot study where participants indicated their preference for the genres. Results of the pilot supported the use of broader genres (e.g., pop, rock & roll, country) as opposed to more specific genres (e.g., polka, baroque) for use in the final preference measure.

In the following study, participants completed the STOMP. Rentfrow and Gosling conducted an exploratory factor analysis (EFA) to unearth 4 distinct dimensions of music preference as follows: Reflective and Complex, Intense and Rebellious, Upbeat and Conventional, and Energetic and Rhythmic. These dimensions mainly account for the thematic content present within music, structural differences (simple versus complex structure), and valence (in terms of affective responses that are positive/appealing or negative/unappealing). In the final studies, where participants complete the STOMP and BFI as the personality measure, these dimensions demonstrate several correlations to personality traits such as openness to experience correlating with preferences for reflective and complex music, and agreeableness with a preference for upbeat and conventional music. Interestingly, the majority of significant correlations with Big Five personality traits were positive, suggesting that the relationship between personality and preference (if we may liken it to liking) may be more detectable than

personality and dislike.<sup>3</sup> This work concludes with the recommendation to explore the relationships between the emotional valence of music and the listener's own emotional states at the time of listening. It could very well be that personality's effect on preference is most salient in specific situations (i.e., when music is being used for a specific purpose).

Building on this work, a 2017 meta-analysis of 28 studies revealed that personality traits may only reliably account for very small individual differences in music preference (Schäfer & Mehlhorn, 2017). Schäfer & Mehlhorn identified the Big Five and the sensation seeking trait as the most commonly used measures of personality across the featured studies. Since most studies on this topic investigated preferences for "types" or "styles" of music, but not all used the same categories (some examine genre specifically like pop or rock while others examine features of music like loudness and conventionality), the authors use Rentfrow, Goldberg and Levitin's (2011) MUSIC model<sup>4</sup> to define the dimension of music preference across studies featured in the analyses. The MUSIC model identifies five dimensions of music types (see *Figure 1*).

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<sup>3</sup> While my own extraversion and agreeableness may explain my preference for upbeat and conventional (pop, indie pop), and energetic and rhythmic music (k-pop, j-pop, electronic dance music (EDM)), it does not necessarily mean that I have an equal distaste for say reflective and complex music or intense and rebellious music.

<sup>4</sup> This model was validated through a series of studies where large samples of participants were tasked with providing information about the genres they prefer listening to and then asked to listen to exemplars (songs) from various genres and name the genre which was best exemplified in the song, and their degree of liking on a scale of 1-7. In an intermediate step, the researchers asked people's favorite genres and distilled responses to a final list of 26 genres for use in the study. They then performed a principal components analysis (PCA) to identify the final five factors for the model.

**Table 1**

*Categories in the MUSIC model and corresponding genres reproduced from Rentfrow, Goldberg, & Levitin, 2011.*

| Category      | Genre                        |
|---------------|------------------------------|
| Mellow        | R&B, pop, soft rock          |
| Unpretentious | country, rock & roll         |
| Sophisticated | classical, jazz, world music |
| Intense       | heavy metal, punk, rock      |
| Contemporary  | rap, electronic              |

Across the well-studied Big 5 traits and sensation seeking trait, small correlations ( $r < 0.1$ ) were identified between extraversion and preference for contemporary music, openness to experience and preference for mellow, sophisticated, and intense music, and agreeableness with unpretentious music.

One subsequent study cites that the issue with past studies in music preference and personality is the way in which music is categorized, alluding to the dimensions and qualities which were described by the MUSIC model. Flannery & Woolhouse (2021) circumvented this issue by focusing solely on the objective acoustic features of music, namely dynamics, mode, register, and tempo. Importantly, they did not rely on self-report methods of genre preference and only asked for preference ratings for the auditory stimuli presented to participants. For their stimuli, they used music composition software to modify three solo piano pieces by Bach, Beethoven, and Mozart to create two levels for each auditory feature as follows: Dynamics (Piano, Forte; where the forte contains sharper, higher-frequency sounds), Mode (Major, Minor; referring to the key of the music being raised from E flat to E natural), Register (High, Low), and Tempo (Slow, Fast). Personality was assessed using the Big Five Inventory of personality (Soto & John, 2017). Results revealed correlations between each of the 5 traits and preference for certain acoustic features. To name a few, low agreeableness and low extraversion both correlated with less preference for slow tempo; high neuroticism scores were associated with less preference for a low register; and high openness scores were associated with a preference for forte dynamics. While these results provide some evidence for preferences for auditory features and personality correlates, preference may only be a small part of the experience of music. Investigation into this topic may benefit from the integration of functions of music and other mechanisms which may explain music preference such as emotion and personal relevance or importance.

In the case that we self-select our musical experiences based on what we are currently feeling when we make the selection, or perhaps what we want to feel, what may personality have to do with these choices and subsequent experiences? We have gone through some examples of personality traits in relation to preferences for different types of music, but how much does this have to do with the disposition for certain emotional experiences? For example, when presented with a common exemplar of awe-inspiring music, Sigur Rós, people who possess more openness to experience demonstrate a greater awe response to music (Silvia et al., 2015). This finding

highlights the potential for personality relating not only to preference for certain emotional qualities of music, but to the *capacity* for intense emotional experiences of music.

Moreover, given the at times weak evidence for music preference and personality traits alone, it may be of particular interest to examine the interaction between personality and other salient aspects of identity such as culture, and whether this can predict musical preferences and perhaps preferential uses of music as well.

### *Music and Emotion*

Music is imbued with meaning and consequently, imbues life with emotion. The study of how music elicits emotion has a robust tradition of empirical work (Juslin & Sloboda, 2001; Juslin & Laukka, 2004; Juslin & Västfjäll, 2008; Konecni, 2008; Cowen et al., 2020). This work is germane to a debate in philosophy about which of these processes, music containing emotional content in of itself and music eliciting emotion in listeners, can best explain the relationship between music and emotion. How music expresses and elicits emotion has informed much of the psychological sciences' approach to the study of music.

Vladimir Konecni introduces two, empirically tractable central concepts in the study of music: emotion expression and induction (Konecni, 2007). Expression can be thought of as the emotional content that music expresses. In other words, a piece of music can contain emotion regardless of the listener's perception. Induction, on the other hand, can be thought of as the use of music to cause an emotional response in a listener. When emotion is induced using music, this means that the listener is feeling that emotion. He goes on to describe two distinct theories of music and emotion that are especially relevant to psychological science: the emotivist and cognitivist theories.

The emotivist theorist tells us that music expresses emotion in a wholly subjective manner. In other words, music can induce emotion but only to the degree that the listener is able to experience it. A song can express anger but the informed induction of this emotion of anger in a listener is only possible if the listener actually *feels* the emotion in response to the song— if they listen to the song and feel nothing, they will not judge the song as expressive of anger, despite any elements of the music itself that could be meant to represent anger.

A cognitivist theory of emotion and music posits that people are able to perceive the presence of emotions in music, even in the absence of experiencing those emotions. For example, I can hear a song and recognize the emotion of love, and label it as such, a “love song”, but the song itself does not necessarily have to lead to the experience of the emotion of love. In Konecni's own work testing the emotivist notion that induction of emotion is “direct”, he and his collaborators find that emotions felt through music are mediated by the personal history that listeners bring to the experience of the music (Konecni et al., 2008).

Many researchers have contributed to this work by using music as an inducer of emotion and correlating emotional responses with the emotion expressed in the music (*for reviews see* Schubert, 2013; Warrenburg, 2020). Successful cases of emotion induction support the fundamental notion that music can effectively make us feel emotion. To name a few, music has been shown to effectively provoke distinct emotional responses such as sadness (Curtis & Bharucha, 2010; Peltola & Eerola, 2016; Herdson, Eerola, & Javadi, 2023), happiness (Khalifa et al., 2005; Hunter, Schellenberg, & Schimmack, 2010; Schulreich et al., 2014), and fear (Koelsch et al., 2013; Aubé et al., 2015; Proverbio et al., 2015). Some scholars propose that there may be unique characteristics of emotion evoked by music— going so far as to coin the study of “musical emotions” (*for review see* Perlovsky, 2010; Juslin, 2013). The term “musical emotions” does not

allude to a specific set of emotions that are only relevant to music but instead any emotional state which is evoked by music.

The emergence of the study of musical emotions hearkens to the study of aesthetic emotions (Menninghaus et al., 2019), which are relevant to experiences which involve beauty, pleasure, and interest in art, most often, but also include complex emotions such as nostalgia and insight, and negative emotions such as confusion and disgust (Silvia, 2009). This tradition, I note, is less concerned with perceived emotions and more with *felt* emotions. In terms of felt emotions, Juslin (2013) argues that ‘everyday’ emotions such as happiness and sadness, are more prevalent in regular daily music consumption than the more complex aesthetic emotions; that is people may not be struck with nostalgia or awe in their regular daily listening as often as they have a general positive or negative emotional response from music. Many studies have focused on music and the emotions of sadness and happiness in relation with each other; for example, this work illustrates how sad music can make us feel positive or pleasant emotions (Kawakami et al., 2013). While this type of investigation of ‘everyday’ emotions and music is foundational, there is room to diversify the emotional experiences we study. More diverse emotional experiences could answer questions pertaining to yet unknown qualities of the experience of music and why it is such an impactful art form and form of media.

To this end, investigators have begun to chart the other emotions elicited by music. This includes studies of anger (Sezer, 2011; Sharman & Dingle, 2015; Susino & Schubert, 2017), with most work focusing on anger as an outcome of interest for music therapy (Jackson, 2010; Hwang & Oh, 2013; Bensimon et al., 2015; Hakvoort et al., 2015) and transcendent emotions such as awe (Pilgrim et al., 2017; Ji et al., 2021). Given advances in mapping higher dimensional spaces of emotional experience (Cowen & Keltner, 2017), it would be of particular interest to continue to identify and study more experiences including low arousal positive emotional states such as calm and contentedness (Faus et al., 2019; De Leeuw et al., 2022), and more complex emotional states such as nostalgia (Barrett et al., 2010; Sedikides et al., 2022). Cowen et al. (2020) provide a comprehensive taxonomy of distinct subjective experiences evoked by music in both Western and Chinese cultural groups. In order to achieve this the researchers considered both feelings or emotions within the listener *and* affective features of the music itself. Participants in the US and China listened to over 2,000 music samples and reported on their subjective experience of the music in terms of specific feelings such as anger and enjoyment and broad affective responses such as valence. With this work we arrive at a dimensional space of emotion where the listener and the music interact to produce emotional experiences which are diffuse and blended together.

Works such as that of Cowen and colleagues comes as a response to music researchers long in the field who have urged for more consideration for the mechanistic understanding of music and emotion. One particularly interesting mechanism by which music evokes emotion is in memory and personal relevance. Juslin (2013) provides an intriguing overview of the effect of memory on emotions evoked while listening to music. He explains the process of episodic memory as instances when personal memories tied to music lead to emotion induction in listeners; “When the memory is evoked, so is also the emotion associated with the memory.” Memories can drift back into focus via the emotion of nostalgia at the sound of a particular melody or chorus. Along with nostalgia are the emotions that we felt during those remembered times, visiting us once again. In this sense, music can induce a highly transcendent experience, insofar as memories guide the mind back and forth through time and space with music acting as the tether to the present.

Seeing as music is an elicitor of emotion, there is evidence for emotion regulation strategies that involve music as well (Moore, 2013; Saarikallio, 2016; Cook et al., 2019). Emotion regulation refers to strategies which are used to maintain, modify, or intensify emotions (Gross & Thompson, 2007). One study finds that certain music preferences are associated with the use of emotion regulation techniques - specifically in the upregulation and downregulation of emotional states (Cook, Roy, & Welker, 2019). Upregulation occurs when one tries to increase an emotion's prevalence or intensity. Downregulation occurs when one tries to decrease an emotion's prevalence or intensity. In the study, preference was assessed using the Short Test of Music Preferences (STOMP; Rentfrow & Gosling, 2003) and emotion regulation strategies were assessed using the following subscales from the Music Uses and Gratifications Scale (Lonsdale & North, 2011). They found that participants who reported using music to increase emotional arousal were more likely to also prefer pop, rap/hip-hop, soul/funk, and electronic/dance music. They also found that a preference for soul/funk music was positively correlated with a tendency to up-regulate positive emotions and down-regulate negative emotions.

There are several ways to regulate emotion using music that have been studied. These include increasing positive emotions, decreasing negative emotions (Tamir, 2009), and increasing emotional intensity and arousal (Lonsdale & North, 2011). One study investigated the effects of music on emotion regulation during a time of peak stress, the COVID-19 pandemic. Participants from four different countries (India, Italy, United States, United Kingdom) were surveyed about their uses of music including to manage emotions, and their current mental health. The survey included the Patient Health Questionnaire (PHQ; Kroenke et al., 2010), State and Trait Anxiety Index (STAI; Spielberger et al., 1971), Emotion Regulation Quotient (ERQ; Gross & John, 2003), Interpersonal Reactivity Index (IRI; Davis, 2010), and the Brief Music and Mood Regulation Questionnaire (B-MMR; Saarikallio, 2012). The Brief Music and Mood Regulation Questionnaire assesses the use of music for mood-regulation in 7 key ways: entertainment (creating a pleasant or happy atmosphere, maintaining or enhancing positive mood), revival (relaxation, receiving a renewal of energy from music particularly when stressed or tired), strong sensation (inducing intense emotions from music), diversion (distracting from unwanted thinking or stressors), discharge (releasing negative emotions), mental work (clarifying and understanding one's own emotional state), and solace (being comforted, accepted, and understood, especially during a sad or troubled time). These music-related strategies are related to strategies long studied in the literature on emotion regulation (Aldao et al., 2010). Emotion regulation theory posits the management and modification of emotional responses to better accommodate one's goals or needs. Importantly, participants also responded to items about their music listening activities such as "I have been turning to music listening or playing to take my mind off things" and "I have been listening to music more than usual to make myself feel better."

In this work, results demonstrated a link between the use of music-related regulation techniques and well-being. More specifically, people who reported the use of music for enhancing positive mood and reappraisal of situations consistently reported feeling better after listening to music. Notably, people who reported feeling more emotionally affected and situationally affected by the pandemic (in terms of risk and severity) and/or reported more intense symptoms of depression or anxiety reported a greater use of music for emotion regulation. These findings provide evidence for the tendency to turn to music in times of stress and the efficacy of music in promoting positive well-being. With respect to the findings concerning individual levels of COVID-19 impact, depression, and anxiety, one might wonder about further individual differences. It may be the case that emotion regulation using music

works better for some than others. One way we may begin to understand this is as a convergence of factors leading to well-being through music: how music is perceived, the emotions it draws out, and our own tendencies or dispositions toward music-related behaviors, including music as emotion regulation.

### *Music and Well-being*

Emotion can be perceived in and induced by music. Powerful experiences such as awe or nostalgia may require the right conditions such as a current emotional state that is open and amenable to a powerful experience, and what one needs or desires from the experience. As people are often aware of the effect of music on their own emotions, they can make informed decisions about the music that will match or modify their emotional state (Sloboda & O'Neill 2001, Juslin & Laukka 2004). With an understanding of the mechanism of personal relevance and memory we can investigate potential well-being benefits of music engagement. If emotional responses to music are more likely to occur in the right conditions, in this case that the music is personally relevant in some way, perhaps it is a question of alignment between the self and the music. If these conditions are met (self-relevance and emotional response) this may be the answer to music impacting significant downstream outcomes such as well-being.

There are a wealth of positive effects of music engagement for emotional, mental, and physical health (MacDonald, 2013; Sheppard & Broughton, 2020; McCrary et al., 2022) and subjective well-being (Creech et al., 2013; Weinberg & Joseph, 2017) that have emerged in the study of music. This notion, that music can enhance well-being, has emerged in studies of music therapy, music practice, and music listening.

There is ample evidence for practicing musical instruments being associated with greater well-being (for reviews Croom, 2015; Sheppard & Broughton, 2020). These benefits are especially well-known in the childhood and adolescent periods of development; music training benefits the developing brain, enhances communication and social skills, and promotes prosocial behavior (Schlaug et al., 2005; Hallam, 2010; Gerry et al., 2012; Schellenberg et al., 2015). Music practice is often thought to require great individual focus and discipline. While aspects related to attention, such as achieving a “flow state” (Nakamura & Csikszentmihalyi, 2002), could account for some of the benefits, the social and collaborative aspects of music practice could drive lasting improvements in well-being.

Recent work also explores the effects of music training on older adults' health and well-being. After participating in a 10-week group piano training program, older adults with no prior music training demonstrated improved visual-motor skills (MacRitchie et al., 2020). Utilizing qualitative methods such as daily journals and observation, researchers found that participants were highly motivated by the group learning environment, especially when the music they were playing was to their liking and when their group felt cohesive. These results support the importance of individual preference within music engagement and the supportive factors, such as social bonds, that accompany music practice and experiences. They also point toward the potential for well-being interventions surrounding music to benefit individuals in later phases of life than childhood and adolescence.

Like music, “well-being is a skill that can be practiced and strengthened.” (Davidson, 2016). In a review of music and well-being, everyday music listening is cited as one of the main forms of music engagement that occurs in daily life (MacDonald et al., 2003). The simple act of listening to music has demonstrated benefits toward affect and emotion regulation (Thoma et al., 2012a; Thoma et al., 2012b; Cook et al., 2019; Morgan & Marroquín, 2024). Notably, the majority of studies examining the use of music for regulating emotion have been cross-sectional,

consisting of surveys asking about people's music preferences, uses of music in daily life, and everyday situations. Moreover, this review highlights the importance of self-selection for music listening to have a meaningful impact; people respond positively to music that they are familiar with, and especially music they have chosen to listen to themselves.

To better understand the mechanisms behind music listening, Groarke and Hogan (2016) outlined models which examine the functions of music listening for older and younger adults. Among older and younger adults asked to report on the functions of music they use most, older adults reported seeking music listening to experience transcendent states and connect with the self. Younger adults, by contrast, used music primarily for feeling socially connected and reminiscing. Both older and younger adults reported emotion or affect regulation as one of their top uses of music listening.

Music listening can also be related to positive social well-being. One study examined the effects of music listening rituals on families and peer groups across traditionally collectivistic and individualistic cultures (Kenya and the Philippines, and New Zealand and Germany, respectively; Boer & Abubakar, 2014). Musical rituals were assessed using the subscales within the RESPECT-Music scale (Boer et al., 2011) which related to family-based functions of music and peer-based functions of music (example items are "Music allows me to have a common interest with my family.", and "I meet with friends and listen to good music." respectively). Results showed that across cultures, music listening is associated with greater cohesion within both families and peer groups. The researchers also found that in more collectivist cultures music listening rituals contributed to greater positive affect.

Another study examined the effects of everyday experiences with music engagement on subjective well-being (Weinberg & Joseph, 2017). In brief phone interviews, participants responded to questions regarding their general life satisfaction (single-item, "How satisfied are you with your life as a whole"), well-being (Australian Unity Well-being Index; Cummins et al., 2003) and music engagement (types of engagement such as listening to music, singing, dancing, playing an instrument, and when engagement was present, whether they engaged alone or with others). Participants who reported engagement with music through dancing or attending musical events also reported significantly higher subjective well-being. Moreover, these effects were even stronger when participants engaged with music in these forms with others, illuminating the potentially potent effects of sharing music with others.

### **Part I. Music Studies**

Today, music is uber-accessible and often within reach while expending very little effort and resources. When music can be accessed through a simple YouTube search or from one's streaming application of choice, it becomes an exciting candidate for well-being interventions with focus on accessibility and cost-effectiveness. Moreover, there is growing interest in music production as a hobby and third spaces for cultural gathering which include concerts and other musical programs. Given these developments, the field is primed for continued exploration of music and arts in general toward well-being.

To reflect on the literature on music and well-being, there is substantial support for music engagement being beneficial to well-being (MacDonald, 2013; Weinberg & Joseph, 2017; Daykin et al., 2018). There are multiple avenues for one to harness these benefits; most notably within past research practicing music (*for review see* Croom, 2015) and listening to music (Rickard, 2012; Groarke & Hogan, 2016) has been found to enhance well-being. An additional less studied avenue is live music experiences, with some initial studies providing support for live music concerts being a source of increased well-being (Daykin et al., 2018; Smith et al., 2021;

Koefler et al., 2024). Music is also known to evoke emotions ranging from ‘everyday’ emotions like sadness and anger to powerful experiences such as awe.

For the first investigation in my series of music studies, I was interested in investigating whether normal daily music engagement and emotions are associated with well-being. In order to test this, I utilized a daily diary method (Bolger et al., 2003; Merz & Roesch, 2011). The daily diary method in psychological research consists of daily surveys typically delivered electronically with a specific window for completion. This method allows us to assess normally occurring behaviors over time by utilizing repeated measures (the same scales and measures every day). With this study, I have two distinct aims: (1) to assess the degree to which listening to music versus not listening to music in daily life may be associated with greater well-being; (2) to assess how emotions evoked by listening to music are associated with well-being.

For the second music study, I collaborated with Carnegie Hall in New York City, NY to investigate the effects of a live music experience centered around awe on well-being. With this study I was particularly interested in the potential of sustaining well-being effects through the use of “reminders”: audio prompts from the live music experience. To test these effects, I designed a study consisting of two active conditions, in which participants attended a concert and either received or did not receive reminders in the following two weeks, and one control condition, in which participants did not attend a concert. With this study I again have two aims: (1) to deliver an intervention which focuses the live music experience on the emotion of awe and assess its impact on well-being over time; and (2) to test whether we may sustain any improvements in well-being with reminders of the experience.

### **STUDY 1 – Daily Diary Music and Well-being Study**

In Study 1, I hypothesized that daily music listening activity would be associated with improvements in subjective well-being. That is, I expected people who reported listening to any amount of music would demonstrate improvements compared to those who did not report any music listening activity. This aim supports prior work which connects music listening to experiences of emotion (Juslin & Laukka, 2004; Juslin et al., 2008; Juslin et al., 2016) and enhancing well-being (Rickard, 2012; Papinczak et al., 2015; Daykin et al., 2018). There are notable limitations to the prior work including the use of mainly cross-sectional methods and the potential for conflation of emotion states *perceived* in music and emotion states *caused* by music (e.g. “This is a sad song/I perceive this song to be sad” versus “This song makes me feel sad/When I listen to this song, it makes me sad”). I addressed these issues in the current study using daily diary methods to gather a larger swath of general listening behavior and well-being on average for this sample, and specifying that the emotion states I asked participants about were prompted by the music they listened to. Moreover, I expected that all emotions reported in response to daily music listening activity would be associated with differing patterns in well-being. Specifically, for participants who report listening to any music on a given day, I expected that reports of more positive social emotions such as awe, love, gratitude, connectedness, and compassion would predict higher scores on subjective well-being. This aim is based on recent theorizing that holds that music primarily serves to foster social bonding (Savage et al., 2021) which, in turn, positively impacts well-being (Gable & Bromberg, 2018; Tunçgenç et al., 2023).

Additionally, I expected reports of negative emotions such as anger, sadness, and loneliness elicited by music would predict lower subjective well-being. This hypothesis builds on research which demonstrates a connection between prevalent negative emotional states and decreased well-being (Fredrickson & Levenson, 1998).

Lastly, I was interested in the potential effect of sensory states such as chills and warmth evoked by music on subjective well-being. One might expect that reports of chills and warmth could be associated with greater subjective well-being. This aim builds on existing evidence of sensory reactions to music (Panksepp, 1995; Grewe et al., 2005; Craig, 2005; Konečni et al., 2007; de Fleurian & Pearce, 2021), seeking to identify physiological correlates that link music listening to well-being.

## Method

### Participants

UC Berkeley undergraduate students were recruited via the Research Participation program (RPP), which awards course credit to students for participating in research studies, to participate in a larger study investigating well-being and social behaviors. Responses from 95 students in the larger sample were analyzed. The reason for this is that only 95 participants from the larger sample consented to participating in the daily diary study. The mean number of responses to the 10 daily diary surveys sent to participants was 8.9. From this we can surmise that the drop-out rate for this study was relatively low. Participant demographics were as follows: Asian (59.1%), White (21.9%), Hispanic/Latinx (14%), Middle Eastern (2.9%), Black (1.7%), 71.7% Female, 18-46 years old ( $M_{\text{age}} = 21$  years,  $SD_{\text{age}} = 2.8$ )

### Measures

#### *Self-reports of Music listening.*

Each day of the study participants were asked to report the number of hours they spent listening to music on the day of the survey. The response options given were “No hours spent listening to music”, “1 hour”, “2-3 hours”, “4+ hours”. The response options were selected for potential exploratory analyses for different hours of music listening activity; however, for the analyses presented in this section, I aggregated the responses to a binary: No hours spent listening to music and any hours spent listening to music, as the distribution of responses was not normally distributed.

#### *Self-reports of Emotion.*

As assessments of the emotions related to the music listened to that day, participants were asked to provide a YouTube link to one song they listened to that day. They then reported on the following *positive emotions*: Awe, Love, Gratitude, Connectedness, Compassion. They also reported on the occurrence of the following *sensory states*: Chills and Warmth. Finally, they reported their experiences of the following *negative emotions*: Anger, Sadness, and Loneliness. I selected the positive emotions to reflect emotions that have been linked to social relationships (Awe; Stellar et al., 2017; Piff et al., 2015; Keltner, 2024, Love; Cacioppo et al., 2015, Gratitude; Algoe et al., 2013, Connected as a face-valid positive keyed option, Compassion; Nussbaum, 1996). I selected the sensory states to reflect sensations which have been linked to music listening (Chills; Konečni et al., 2007, Warmth; Zhou et al., 2012). I selected the negative emotions to reflect common negative emotion states studied in relation to music listening (Anger; Sharman & Dingle, 2015, Sad; Vuoskoski et al., 2011, Loneliness; Ter et al., 2017). Participants rated each item on a 1-5 scale from “1; not at all” to “5; very much so”.

#### *Self-reports of Well-being.*

The daily diary surveys included several other measures of interest. In order to contend with the limitations of daily survey methods, most crucially survey fatigue (Porter et al., 2004) due to repeated surveys, I chose items which could be assessed individually as global measures of satisfaction with life (SWL) and loneliness – two factors which have shown significant impact on well-being (Pavot et al., 1991; Golden et al., 2009; Groarke et al., 2020; Goodfellow et al.,

2022). I used the following items to measure life satisfaction: “I am satisfied with my life”, “The conditions of my life are excellent”, “My life is close to ideal in most ways.”. I used the following items to measure social connectedness: “I lacked companionship.”, “I felt close to people.”, “I felt left out.”, “I was able to connect with other people.” “I felt connected to the world around me.” “I felt understood by the people I know”. Participants rated each item on a 1-7 scale from “1; strongly disagree” to “7; strongly agree”.

### **Procedure**

Participants indicated their interest in the study through the participant pool management service, Sona, and received an initial survey via email asking them to provide consent and to answer demographic questions. All participants were emailed the first study survey on the same day at 8 p.m. local time and were asked to complete the survey before 12 a.m. that night. After completing the initial survey, participants received identical surveys for the following 10 days with the same time frame for completion. After completing the 10th study survey, participants were thanked for their participation and awarded credit based on percentage of the study completed.

## **Results**

### **Descriptives**

To assess music listening activity, participants were asked to report the number of hours they spent listening to music on each day of the study. These responses have been aggregated to a binary where 0 = no hours spent listening and 1 = at least one hour spent listening to music. Figure 1 demonstrates the large proportion of participants who listened to music on each day of the study. Moreover, descriptive statistics for daily emotions elicited by music, averaged across the study period are shown in Table 1. Finally, descriptive statistics for daily well-being measures, averaged across the study period appear in Table 2.

### **Music Listening and Well-being**

I conducted a mixed linear model (MLM) analysis to examine the association between music listening activity (whether or not participants listened to any music that day) and well-being outcomes. The analyses included a random intercept for each participant to account for repeated measures.

With regard to the well-being outcomes of social connectedness and life satisfaction, I found a significant relationship between music listening and social connectedness, such that listening to music on a given day predicted slightly greater levels of social connectedness on average. There was no significant relationship present for the life satisfaction outcome. I also examined each item within the social connectedness outcome to test whether there were any unique relationships with the items and music listening. In similar models examining individual items, no items in the life satisfaction outcome reached significance. See Table 3 and Table 4 for full results.

### **Emotions Evoked by Music and Well-being**

I conducted a mixed linear model (MLM) analysis to examine the effect of emotions evoked by music on well-being outcomes—social connectedness and life satisfaction. The analyses included a random intercept for each participant to account for repeated measures. In preparation for these analyses, means for each variable were calculated for each individual participant across the 10-day study period, such that the values utilized in analyses were aggregates of the total responses received in the daily surveys.

*Social connectedness.*

First, I created emotion composites to encompass positive emotions ( $\alpha = 0.91$ ), negative emotions ( $\alpha = 0.78$ ), and sensory states ( $\alpha = 0.61$ ; see Table 5). With regard to my second hypothesis, positive emotions evoked by music were indeed associated with improved social connectedness; namely, there was a positive and significant association between the daily positive emotion composite and participants' reports of social connectedness. The third hypothesis was also supported: there was a negative effect of daily negative emotions on social connectedness (see Table 6). The fourth hypothesis was not supported; the model examining the effect of sensory states on social connectedness did not reach significance.

With regard to distinct emotions, there was a positive effect of daily love, gratitude, connectedness, compassion, and warmth evoked by music on social connectedness. There was also a negative effect of sadness and loneliness evoked by music on social connectedness (see Table 7). The models examining the effects of awe, anger, and chills on social connectedness did not reach significance.

#### *Life satisfaction.*

I found support for my second hypothesis, that positive emotions evoked by music would be associated with increased life satisfaction; there was a positive effect of daily positive emotions on life satisfaction. The third and fourth hypotheses around negative emotions and sensory states were not supported relative to life satisfaction; the remaining two models did not reach significance (see Table 8).

There was a positive effect of daily awe, love, gratitude, and compassion evoked by music on life satisfaction. There was also a negative effect of anger and loneliness evoked by music on life satisfaction (see Table 9). The models examining the effects of chills, sadness, connectedness, and warmth on life satisfaction did not reach significance.

### **Discussion of Study 1**

In Study 1, I found partial support for the hypothesis that listening to any music would be associated with positive well-being outcomes (social connectedness and life satisfaction) when compared to no music. There was a significant relationship between music listening and the social connectedness outcome however there was no significant relationship present for the life satisfaction outcome. These results may indicate that the act of listening to music is only effective towards certain domains of well-being such that the effects are less pronounced when it comes to more personal aspects of well-being, as opposed to social well-being. To help further refine understanding of these findings, it may be useful in the future to assess the intentionality of music listening (revisiting a long dormant area of study; Plavnick, 1964; Fung, 2001) and potentially follow participants for a longer period of time to gain a more accurate measurement of their natural music listening behaviors.

The remaining hypotheses, that emotions evoked by music will be associated with better well-being, were also partially supported. For the first well-being composite, social connectedness, there was a positive effect of positive emotions such as love and gratitude. These results suggest that when positive emotions are evoked by music, they can potentially affect the perception of positive social well-being. The results also support the inverse relationship, where we found negative effects of negative emotions such as sadness and loneliness on social connectedness. Finally, there was a positive effect of positive emotions evoked by music on life satisfaction, with the emotion of awe demonstrating the strongest relationship. Given past work on awe and life satisfaction (Bai et al., 2021), this may suggest a unique relationship between awe evoked by music and the factor of life satisfaction specifically.

#### *Exploratory analyses*

Past work connects personality traits to the experience of music listening (preferring certain genres, specific emotional responses to music; Rentfrow & Gosling, 2003; Langmeyer et al., 2012; Pilgrim et al., 2017; Schafer & Mehlhorn, 2017; Vella & Mills, 2017; Flannery & Woolhouse, 2021). To better understand how personality related to my results, I ran two sets of exploratory analyses. First, to test whether personality could potentially moderate the relationships I examined between emotion states evoked by music and well-being outcomes (social connectedness and life satisfaction), I ran mixed linear regression models. Out of the 100+ tested models (10 discrete emotions plus 3 composites  $\times$  2 well-being outcomes  $\times$  5 personality facets), only four interaction effects revealed marginal significance or significance.

I found one significant interaction for the life satisfaction outcome. The relationship between feelings of awe and life satisfaction was moderated by conscientiousness ( $b = -0.707$ ,  $SE = 0.350$ ,  $p = .044$ , 95% CI  $[-1.394, -0.020]$ ). This suggests that the observed effect of daily awe experienced through music on life satisfaction may have been dampened for participants with higher levels of conscientiousness.

I found three marginally significant interactions for the social connectedness outcome. The relationship between feelings of connectedness and social well-being was marginally moderated by conscientiousness ( $b = -0.311$ ,  $SE = 0.160$ ,  $p = .052$ , 95% CI  $[-0.626, 0.003]$ ). Additionally, openness to experience also showed marginal moderation effects with both compassion ( $b = 0.210$ ,  $SE = 0.110$ ,  $p = .056$ , 95% CI  $[-0.005, 0.425]$ ) and warmth ( $b = 0.234$ ,  $SE = 0.123$ ,  $p = .057$ , 95% CI  $[-0.007, 0.476]$ ) in predicting social connectedness.

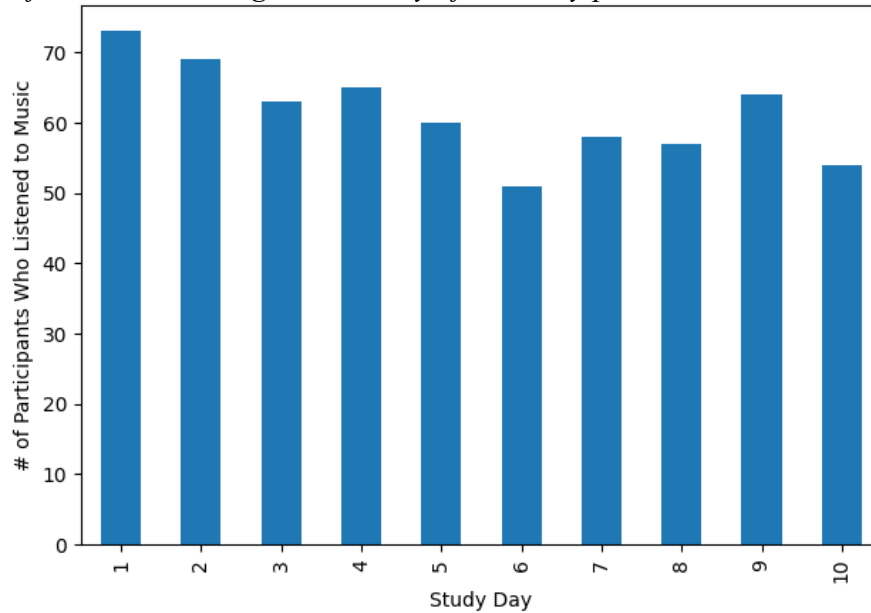
Overall, the extremely limited number of significant interactions indicates that the observed relationships between emotions and well-being may be relatively stable across personality profiles.

Next, to explore whether individual differences in personality may explain the relationships I found between emotions evoked by music and well-being, I ran exploratory models controlling for openness and extraversion, two traits connected to music engagement in past literature (Rentfrow & Gosling, 2003; Pilgrim & Hackathorn, 2017; Flannery & Woolhouse, 2021). Importantly, I found that negative emotion evoked by music persisted in significantly predicting social connectedness ( $b = -0.232$ ,  $p = 0.001$ ). However, positive emotion no longer significantly predicted either well-being outcome. These results suggest that the relationship between negative emotions evoked by music and social connectedness is robust.

These results suggest that negative emotions evoked by music are associated with decreased perceived social connectedness, regardless of the listener's personality traits. In contrast, individual differences in the listener's personality may partially explain the associations I observed between positive emotions evoked by music, social connectedness, and life satisfaction.

**Figure 1**

*Averages for music listening on each day of the study period.*

**Table 1**

*Descriptive statistics for emotions elicited by music across the study period.*

| Emotion       | Mean | Median | SD   |
|---------------|------|--------|------|
| Awe           | 2.36 | 2.0    | 1.31 |
| Love          | 2.43 | 2.0    | 1.32 |
| Gratitude     | 2.16 | 2.0    | 1.27 |
| Connectedness | 2.37 | 2.0    | 1.22 |
| Compassion    | 2.10 | 2.0    | 1.21 |
| Chills        | 2.09 | 2.0    | 1.22 |
| Warmth        | 2.45 | 2.0    | 1.32 |
| Anger         | 1.26 | 1.0    | 0.63 |
| Sadness       | 1.71 | 1.0    | 1.06 |
| Loneliness    | 1.64 | 1.0    | 1.01 |

*Note.* Range for items includes a minimum score of 1 and maximum score of 5.

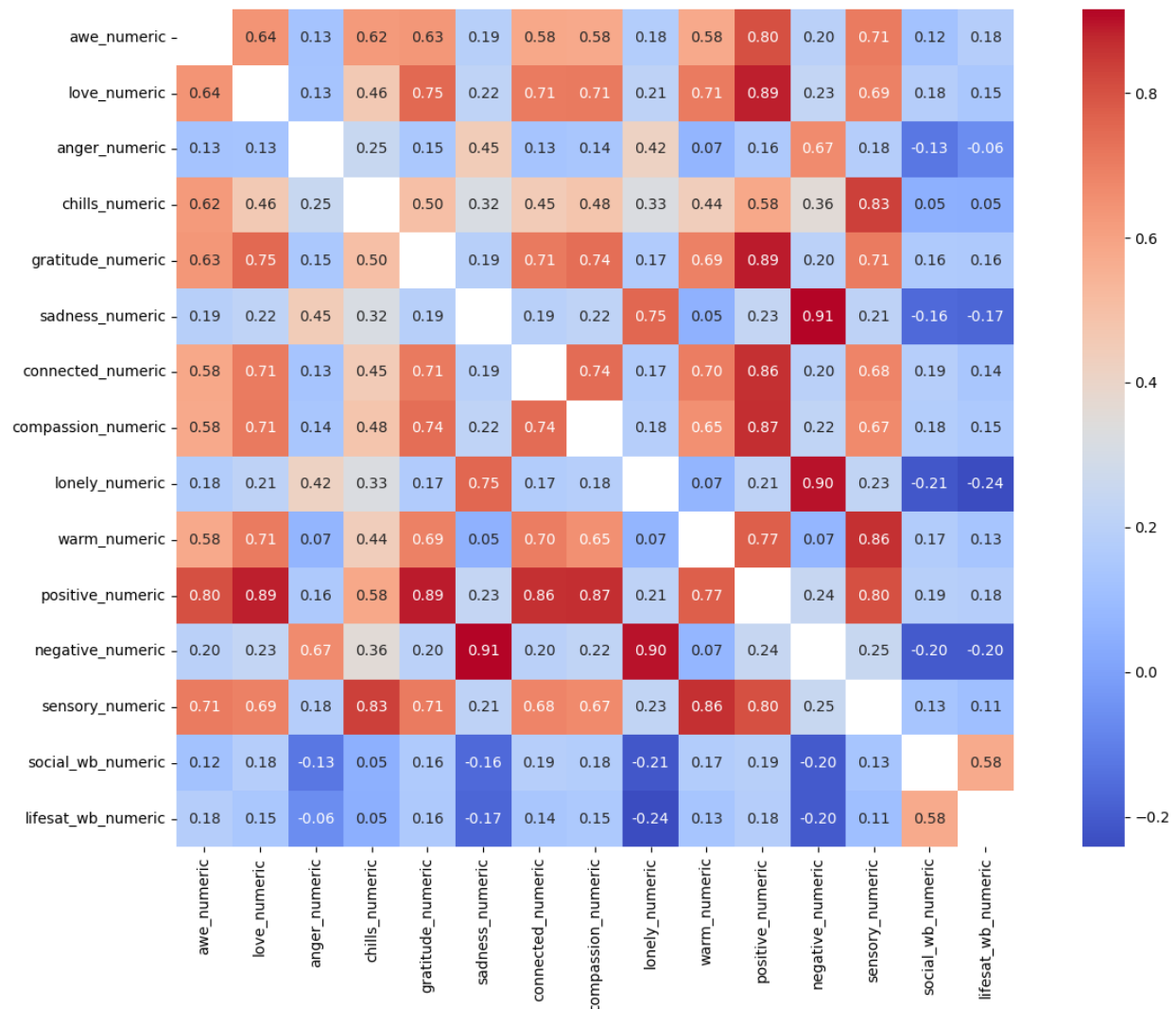
**Table 2***Descriptive statistics for well-being outcomes across the study period.*

| Well-being outcome   | Mean | Median | SD   |
|----------------------|------|--------|------|
| Social connectedness | 4.44 | 4.5    | 0.88 |
| Life satisfaction    | 4.55 | 5.0    | 1.52 |

*Note.* Range for items includes a minimum score of 1 and maximum score of 5.

**Figure 2**

*Correlation heatmap for daily emotions elicited by music and daily well-being.*



*Note.* Emotion variables include the composite variables of positive emotion, negative emotion, and sensory states. Following the gradient to the right of the correlation matrix, darker shades of red indicate stronger positive correlations and darker shades of blue indicate stronger negative correlations.

**Table 3***Mixed linear models testing the effect of daily music listening activity on well-being.*

| Well-being outcome    | <i>b</i> (Estimate) | Standard Error | <i>t</i> -value | <i>p</i> -value |
|-----------------------|---------------------|----------------|-----------------|-----------------|
| Social connectedness* | 0.123               | 0.061          | 2.017           | 0.044           |
| Life satisfaction     | 0.123               | 0.091          | 1.355           | 0.175           |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$ **Table 4***Daily music listening activity and daily social connectedness items in mixed linear models.*

| Social connectedness item                 | <i>b</i> (Estimate) | Standard Error | <i>t</i> -value | <i>p</i> -value |
|-------------------------------------------|---------------------|----------------|-----------------|-----------------|
| I was able to connect with other people.  | 0.12                | 0.11           | 1.02            | .306            |
| I am satisfied with my life.*             | 0.20                | 0.09           | 2.34            | .020            |
| I felt understood by the people I know.*  | 0.24                | 0.11           | 2.18            | .030            |
| I felt left out.                          | -0.08               | 0.12           | -0.65           | .518            |
| The conditions of my life are excellent.  | 0.11                | 0.09           | 1.23            | .201            |
| I felt close to people.                   | 0.01                | 0.12           | 0.06            | .951            |
| I lacked companionship.                   | 0.01                | 0.12           | 0.10            | .922            |
| My life is close to ideal in most ways.   | 0.07                | 0.09           | 0.74            | .460            |
| I felt connected to the world around me.* | 0.28                | 0.13           | 2.18            | .029            |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$ **Table 5***Composites of daily emotions.*

| Composite of emotion states | Emotion states                                  |
|-----------------------------|-------------------------------------------------|
| Positive                    | Awe, love, gratitude, connectedness, compassion |
| Negative                    | Anger, sadness, loneliness                      |
| Sensory                     | Chills, warmth                                  |

**Table 6***Mixed linear models testing the effect of daily emotion composites on social connectedness.*

| Emotions   | <i>b</i> (Estimate) | Standard Error | <i>z</i> -value | <i>p</i> -value | 95% CI           |
|------------|---------------------|----------------|-----------------|-----------------|------------------|
| Positive** | 0.164               | 0.062          | 2.634           | .008            | [0.042, 0.286]   |
| Negative** | -0.192              | 0.072          | -2.667          | .008            | [-0.332, -0.051] |
| Sensory    | 0.101               | 0.066          | 1.525           | .127            | [-0.029, 0.231]  |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$ **Table 7***Daily emotions evoked by music and daily social connectedness in mixed linear models.*

| Emotion     | <i>b</i> (Estimate) | Standard Error | <i>z</i> -value | <i>p</i> -value |
|-------------|---------------------|----------------|-----------------|-----------------|
| Awe         | 0.113               | 0.066          | 1.707           | .088            |
| Love**      | 0.167               | 0.063          | 2.666           | .008            |
| Anger       | -0.101              | 0.084          | -1.194          | .233            |
| Chills      | 0.028               | 0.069          | 0.404           | .686            |
| Gratitude*  | 0.146               | 0.065          | 2.234           | .025            |
| Sadness*    | -0.161              | 0.067          | -2.384          | .017            |
| Connected*  | 0.169               | 0.067          | 2.519           | .012            |
| Compassion* | 0.156               | 0.063          | 2.483           | .013            |
| Lonely***   | -0.209              | 0.059          | -3.516          | <.001           |
| Warm*       | 0.14                | 0.067          | 2.091           | .037            |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

**Table 8***Daily emotions evoked by music and daily life satisfaction in mixed linear models.*

| Emotions   | <i>b</i> (Estimate) | Standard Error | <i>z</i> -value | <i>p</i> -value | 95% CI          |
|------------|---------------------|----------------|-----------------|-----------------|-----------------|
| Positive** | 0.342               | 0.137          | 2.497           | 0.013           | [0.074, 0.610]  |
| Negative   | -0.237              | 0.151          | -1.575          | 0.115           | [-0.532, 0.058] |
| Sensory    | 0.247               | 0.152          | 1.624           | 0.104           | [-0.051, 0.544] |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$ **Table 9***Daily emotions evoked by music and daily life satisfaction in mixed linear models.*

| Emotion     | <i>b</i> (Estimate) | Standard Error | <i>z</i> -value | <i>p</i> -value |
|-------------|---------------------|----------------|-----------------|-----------------|
| Awe**       | 0.379               | 0.134          | 2.821           | .005            |
| Love*       | 0.306               | 0.138          | 2.212           | .027            |
| Anger*      | -0.127              | 0.058          | -2.177          | .029            |
| Chills      | 0.164               | 0.136          | 1.204           | .229            |
| Gratitude*  | 0.302               | 0.139          | 2.180           | .029            |
| Sadness     | -0.177              | 0.131          | -1.351          | .177            |
| Connected   | 0.269               | 0.142          | 1.891           | .059            |
| Compassion* | 0.298               | 0.139          | 2.145           | .032            |
| Lonely*     | -0.379              | 0.162          | -2.339          | .019            |
| Warm        | 0.264               | 0.141          | 1.879           | .060            |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

## **STUDY 2 – Music, Awe, and Well-being**

Music, and live music especially, can inspire powerful emotions within us. Notably, it can inspire the emotion of awe – a transcendent emotion which challenges our current mindset with feelings of vastness and a shrunken sense of self. Awe is of particular interest for this study, due to its benefits toward psychological and physical well-being (Bai et al., 2021; Monroy & Keltner, 2023), documented association with music (Silvia et al., 2015; Pilgrim et al., 2017; Keltner, 2024), and positive effects of experiencing awe through music (Ji et al., 2021). Music engagement also boasts of many benefits in terms of promoting greater well-being across the lifespan (Creech et al., 2013; Boer & Abubakar, 2014; Daykin et al., 2018). By using music engagement via live music concerts hosted by Carnegie Hall, I intend to harness the combined power of music and awe towards improving well-being; (1) in the moment, and (2) potentially sustaining those effects over time. Moreover, my study contributes theoretical and methodological refinement to music and well-being research by addressing the issue of studying more specific emotions elicited by music, in this case awe, and providing ecological validity through the assessment of a real-world live music experience.

The study involved three conditions: (1) an awe induction concert attending condition; (2) an awe sustaining concert attending condition; and (3) a non-concert attending control condition. We gathered measures of well-being and experiences prior to the concert, just after the concert, and once a week for two weeks after the concert. Our conceptual focus was on emotional, mental health, and social indicators of well-being. I tested the following hypotheses:

1. All concert attending participants (regardless of condition) will demonstrate improvements in pre to post concert well-being measures, such that following the concert, I expect increases in positive emotion and decreases in negative emotion.
2. Compared to the control condition, I expect participants in the two active concert-attending conditions (awe induction, awe sustaining) to demonstrate decreased stress and mental health symptoms and increased social connectedness and positive emotion in the two weeks following the concert.
3. Compared to the awe induction concert-attending condition, I expect participants in the awe sustaining concert attending condition to demonstrate greater magnitude of effects in the pre-post concert changes and in the measures of well-being two weeks following the concert.

## **Method**

### **Participants**

Participants were invited to participate in a study through advertisements from Carnegie Hall regarding their 2023-24 Well-being Concert Series on the concert event pages, via email, and in-person at some concert events.

The total N used for analyses was 94. 25 participants were excluded from analyses for not completing all focal measures or all surveys. See Table 1 for full participant completion rates across surveys. The mean reported age was 33 years old (SD=10.4). Reported gender identity of participants is as follows: 41% male, 55% female, 1% non-binary, 3% other (genderqueer, questioning). Reported ethnicity of participants was as follows: 48% White/Caucasian, 31% Black/African American, 16% Asian, 3% Latinx, 1% Native American, 1% Middle Eastern.

### **Design and Procedure**

We actively recruited participants from October 2023 to May 2024. Participants who expressed interest in the study provided their contact information via a Qualtrics online survey. Within this survey they indicated whether or not they would be attending a concert. If they were

attending a concert, they also indicated the concert date they were going to attend and then were invited to participate in the study as part of a concert attending condition and later randomly assigned to one of the conditions. If they indicated that they were not attending a concert, they were invited to participate as part of the non-concert attending control condition.

All participants completed an initial survey where they provided informed consent, information about demographics, personality measures, and well-being measures. The study design included both within-person and between-person measures. Each participant completed an initial survey and two weekly follow-up surveys. In addition, participants who attended a concert completed a brief pre-concert survey and post-concert survey related to experiences at the concert. The design also includes two concert attending (active) conditions and one non-concert attending (control) condition. The three conditions are as follows: (1) Awe induction, where participants receive a text-based awe prompt before they entered the concert, (2) Awe sustaining, where participants received the same text-based awe prompt before they entered the concert and also received an “awe reminder” in each follow-up survey, and (3) Control, where participants did not attend a concert and only complete the initial survey and two follow-up surveys.

*Concert attending.* Participants who were attending concerts were randomly assigned to one of the two active conditions. Random assignment occurred after the completion of the initial survey. In the first condition, which I will refer to as the awe induction condition, participants were given a prompt explaining the emotion of awe and then asked to consider this emotion during their experience of the concert. In the second condition, which I will refer to as the awe sustaining condition, participants received the same prompt about the emotion of awe before the concert. Participants who were attending concerts completed an additional questionnaire before the concert which I refer to as the “Pre-concert survey”. Participants had the option to complete the survey electronically via Qualtrics link, which was sent via email on the morning of the concert at 8 AM local time, or on-site at Carnegie Hall prior to entering the room where the performance would take place. They answered questions about their current state emotions, social experiences, and attendance.

The awe prompt was delivered at the end of the pre-concert survey. The prompt is as follows:

“For today's concert, we'll ask you to think about the emotion of awe and how this concert may inspire awe within you. Awe often shifts your attention away from yourself and helps you appreciate the wonder of the world around you. Awe can be found almost anywhere, including through music and art. You can feel awe when you walk by a beautiful sculpture in the city or attend a compelling performance. You may feel awe when you witness the act of courage and intimacy of a musician sharing a vulnerable self-expression in a space like Carnegie Hall. Feeling awe can come with bodily sensations like chills, goosebumps, and even the welling of tears. It can also make you feel as if time is passing more slowly or you are suspended from time.

First, focus on the sensations surrounding you and your body. As you move through the concert, take note of your senses: the music filling your ears, the warmth coming off of the people you share this space with, the cool chill and following goosebumps that come after a particularly moving musical passage. Notice how you and your neighbors may start to feel like a collective being, sharing this moment and experience together. Second, take a moment during your experience to ask: Am I in the presence of something greater than myself? How connected do I feel in this moment, to the audience, to this

community, to the universe and all things? Don't focus too much on the answers to these questions. Instead, use them to guide and center you in tonight's experience."

Participants also completed a questionnaire after the concert, which I refer to as the "Post-concert survey" with identical questions and some additional measures of their experience during the concert. The post-concert survey was to be completed directly after the concert and before midnight that night, at the latest. Finally, in our follow-up assessments, participants were sent a link to a follow-up survey once a week for two weeks. Each survey consisted of questions asking about their experiences, thoughts, and emotions over the past week, along with follow-up well-being measures. In addition to the weekly follow-up survey items, participants in the awe sustaining condition also received an "awe reminder". The awe reminder is an intervention I developed in which participants would receive an audio recording clip from the concert they attended. The reminders were developed based on prior theorizing about intensely positive experiences (IPE's) and their effects on momentary well-being potentially having longer-term benefits (Burton & King, 2004) and the proclivity for musical experiences to elicit feelings of nostalgia (Barrett et al., 2010; Sedikides, 2022). Along with each of the two follow-up surveys, participants received a unique clip; the first week they received an audio recording from the concert they attended, and the second week they received a different audio recording from the concert they attended. Each clip was around 2 minutes long and came with the following instructions:

"We will now share an audio clip to remind you of the Well-Being Concert you attended. Take a moment to listen and return to the experience. Think about how it felt to be there and any memories you may have of the concert. Take as long or as little time as you'd like. You may replay the clip. Once you're done listening, continue with the survey."

*Non-concert attending.* Participants who were not attending concerts were sent a link to a follow-up survey once a week for two weeks which consisted of identical questions to the follow-up surveys that concert attending participants received.

Participants received compensation for their participation based on the number of surveys completed. The maximum amount to be possibly earned was fifteen USD delivered electronically via Prezzy E-gift cards. Participants were also entered in a drawing for one of five fifty USD Prezzy E-gift cards. The drawing occurred after data collection concluded in May 2024.

## **Measures**

### *Initial survey.*

In the initial questionnaire, participants provided information about demographics, personality, well-being, and emotion. Items about well-being and emotion were posed as "in the last week." Personality was assessed using the 15-item Big Five Inventory-2-Extra Short Form (BFI-2-XS; Soto & John, 2017) on a 1 (*Disagree strongly*) to 5 (*Agree strongly*) scale. Mental health, as part of the well-being measures, was assessed using two items; one focused on anxiety and another focused on depression, with the following prompt: "How much have you been bothered by the following problem in the last week". For anxiety, a single item from the Generalized Anxiety Disorder 7-item (GAD-7; Spitzer et al., 2006): "Feeling anxious" on a 1 (*Not at all*) to 5 (*A great deal*) scale. For depression, a single item from the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977): "Feeling down, depressed, or hopeless" on a 1 (*Not at all*) to 5 (*A great deal*) scale. Additionally, stress was measured, as part of the well-being measures, using a single item from the Perceived Stress Scale (PSS; Cohen et

al., 1983): “How often have you felt stressed?” on a 1 (*Never*) to 5 (*Very often*) scale. Social connectedness was measured, as part of the well-being measures, using items from the UCLA Loneliness scale (ULS; Russell et al., 1978): “I felt outgoing and friendly.”, “I felt connected to others.”, and “I felt like being around other people.” on a 1 (*Not at all*) to 5 (*A great deal*) scale. Emotion was measured using the Specific Emotion Experience Questionnaire (SEEQ; Ocampo, 2024) on a 1 (*None at all*) to 5 (*A great deal*) scale. The SEEQ captures 20 distinct emotion states, including awe, elation, and gratitude, which have demonstrated unique associations with life satisfaction, social connectedness, and stress.

#### *Pre-concert survey.*

In the pre-concert survey, participants who attended a concert answered questions about their current state emotions, social experiences, and details about their attendance. Emotion was measured using the Specific Emotion Experience Questionnaire (SEEQ; Ocampo, 2024) on a 1 (*None at all*) to 5 (*A great deal*) scale. Social measures consisted of two face-valid items about social interaction: (“How much do you think you will enjoy your next social interaction?” and “How much would you like to interact with someone in the next few hours?”) on a 1 (*Not at all*) to 5 (*A great deal*) scale. Identification was measured using items from the Identification with All of Humanity scale (IWAH; McFarland et al., 2012) which asked how much participants identified with and how close they feel to the following groups: “people in my community”, “people in my country”, and “people all over the world” on a 1 (*Not at all*) to 5 (*Very much*) scale. Lastly, loneliness was measured using four items from the Revised UCLA Loneliness Scale: “I feel that I am “in tune” with the people around me.”, “I feel that I have a lot in common with the people around me.”, “I feel that there are people I can talk to.”, and “I feel that people are around me but not with me.” on a 1 (*Strongly disagree*) to 5 (*Strongly agree*) scale (R-ULS; Russell et al., 1980).

#### *Post-concert survey.*

In the post-concert survey, participants who attended a concert answered questions identical to those featured in the pre-concert survey. Additionally, they provided information about their experience of the concert. Awe was measured using the Awe Experience Scale (AWE-S; Yaden et al., 2019) on a 1 (*Strongly disagree*) to 7 (*Strongly agree*) scale. Participants were also asked about how meaningful they found the concert to be using a face-valid item, “How meaningful did you find this concert?”, on a 1 (*Not at all meaningful*) to 5 (*Extremely meaningful*) scale. Aesthetic experience of the concert was measured using items which asked about the music played at the concert: (1) how familiar it was, (2) how much they liked and enjoyed it, (3) how beautiful they found it, how moved they were by it, and (4) how self-relevant it was on a 1 (*Not at all*) to 5 (*Very much so*) scale. Lastly, two items were adapted for use from the Inclusion of Other in Self scale (IOS; Aron et al., 1992): “How close did you feel to the rest of the audience, both people within and outside of your party?” and “How close did you feel to the artists performing tonight?” on a 1 (Not at all overlapping circles) to 7 (Almost completely overlapping circles) scale.

#### *Follow-up survey.*

In the follow-up survey, participants who attended a concert and participants who did not attend a concert (Control) answered identical questions to those featured in the initial survey. No additional questions were asked in the follow-up survey.

### **Results**

In hypothesis 1, I expected concert-attending participants to show increased positive emotion and decreased negative emotion directly after the concert, compared to before the

concert. To test this hypothesis, I conducted paired samples *t*-tests to compare participants' emotional states before and after the concert.

The *t*-tests show significant shifts in emotional state, with increases in positive emotions and decreases in negative emotions. For full results see Table 2.

The analysis revealed that among positive emotions, awe showed the largest effect size ( $d = 0.893$ ; where *d* refers to Cohen's *d*), followed by compassion ( $d = 0.564$ ) and elation ( $d = 0.500$ ). For negative emotions, the most substantial decreases were observed in anxiety ( $d = -0.569$ ) and concern ( $d = -0.529$ ).

In Hypotheses 2 and 3, I expected participants in both the awe mindset (Condition 0) and awe sustaining (Condition 1) condition would show decreased stress and mental health symptoms and increased social connectedness and positive emotions in the two weeks following the concert, compared to the control group. I expected further that participants in the awe sustaining condition would demonstrate greater magnitudes of effects in each outcome.

To test these hypotheses, I conducted mixed linear model (MLM) regression analyses to examine the effect of time and condition on well-being outcomes. This method of analysis allowed me to account for repeated measures within individual participants. All models also included a random intercept to account for baseline levels of each well-being outcome. For full results see Tables 3-7.

### **Stress**

The hypothesis was partially supported. Results revealed a significant Time 1  $\times$  Condition 1 interaction ( $\beta = -0.686$ ,  $SE = 0.283$ ,  $p = .015$ , 95% CI [-1.240, -0.132]), indicating that participants in the awe sustaining condition experienced significantly lower stress levels in the week following the concert compared to those in the control group. There was no significant interaction with Time 2, indicating that these effects did not continue into the second follow-up, two weeks following the concert. While the awe sustaining condition showed significant effects at the first follow-up, we found no significant effects for the awe mindset condition on stress levels at either follow-up, as indicated by non-significant Time 1  $\times$  Condition 0 ( $\beta = -0.186$ ,  $p = .510$ ) and Time 2  $\times$  Condition 0 ( $\beta = -0.088$ ,  $p = .755$ ) interactions.

### **Mental health**

The hypothesis was partially supported. Results revealed a significant Time 1  $\times$  Condition 1 interaction ( $\beta = -0.580$ ,  $SE = 0.258$ ,  $p = .025$ , 95% CI [-1.086, -0.074]), indicating that participants in the awe sustaining condition experienced significantly lower frequency of mental health symptoms in the past week compared to those in the control group. There was no significant interaction with Time 2, indicating that these effects did not continue into the second follow-up, two weeks following the concert. While the awe sustaining condition showed significant effects at the first follow-up, we found no significant effects for the awe mindset condition on frequency of mental health symptoms at either follow-up, as indicated by non-significant Time 1  $\times$  Condition 0 ( $\beta = -0.380$ ,  $p = .141$ ) and Time 2  $\times$  Condition 0 ( $\beta = -0.275$ ,  $p = .288$ ) interactions.

### **Social connectedness**

The hypothesis was partially supported. Results revealed a significant Time 1  $\times$  Condition 1 interaction ( $\beta = 0.755$ ,  $SE = 0.267$ ,  $p = .005$ , 95% CI [0.231, 1.279]), indicating that participants in the awe sustaining condition experienced significantly higher perceived social connectedness in the past week compared to those in the control group. There was no significant interaction with Time 2, indicating that these effects did not continue into the second follow-up, two weeks following the concert. While the awe sustaining condition showed significant effects

at the first follow-up, we found no significant effects for the awe mindset condition on social connectedness at either follow-up, as indicated by non-significant Time 1  $\times$  Condition 0 ( $\beta = 0.288$ ,  $p = .281$ ) and Time 2  $\times$  Condition 0 ( $\beta = 0.137$ ,  $p = .608$ ) interactions.

### **Positive emotion**

The hypothesis was partially supported. Results revealed a significant Time 1  $\times$  Condition 1 interaction ( $\beta = 0.625$ ,  $SE = 0.201$ ,  $p = .002$ , 95% CI [0.231, 1.020]), indicating that participants in the awe sustaining condition experienced significantly higher positive emotion in the past week compared to those in the control group. There was also a significant interaction with Time 2 ( $\beta = 0.500$ ,  $SE = 0.201$ ,  $p = .013$ , 95% CI [0.106, 0.894]), indicating that participants continued to experience significantly higher positive emotion into the second follow-up, two weeks following the concert. While the awe sustaining condition showed significant effects at the first follow-up, we found no significant effects for the awe mindset condition on social connectedness at either follow-up, as indicated by non-significant Time 1  $\times$  Condition 0 ( $\beta = 0.288$ ,  $p = .281$ ) and Time 2  $\times$  Condition 0 ( $\beta = 0.137$ ,  $p = .608$ ) interactions.

### **Discussion**

In Study 2, I investigated the immediate and more enduring effects of a live music concert centered around adopting an awe mindset. Toward the goal of improving well-being over time, I designed a study surrounding the concert experience that involved two points of contact: (1) an awe prompt which taught concert-goers about the emotion and provided a context-specific set of questions to guide them through amplifying feelings of awe while at the concert; and (2) a text and audio-based, awe sustaining intervention, “reminders”, delivered via follow-up surveys to a subset of concert-attending participants consisting of a weekly audio recording from the concert they attended and instructions to take time to remember the experience.

Participants who attended a concert and were prompted to think about awe during the experience demonstrated strong increases in positive emotions (particularly awe, compassion, and elation) and decreases in negative emotions (especially anxiety and concern for self) following the concert, when compared to their emotions before the concert. These findings fit into previous research showing that awe-inspiring experiences can enhance positive emotions and reduce self-focused concerns (Bai et al., 2017). Moreover, this suggests that live music experiences, when framed with an awe-related mindset, may be a particularly powerful tool for eliciting these emotional benefits.

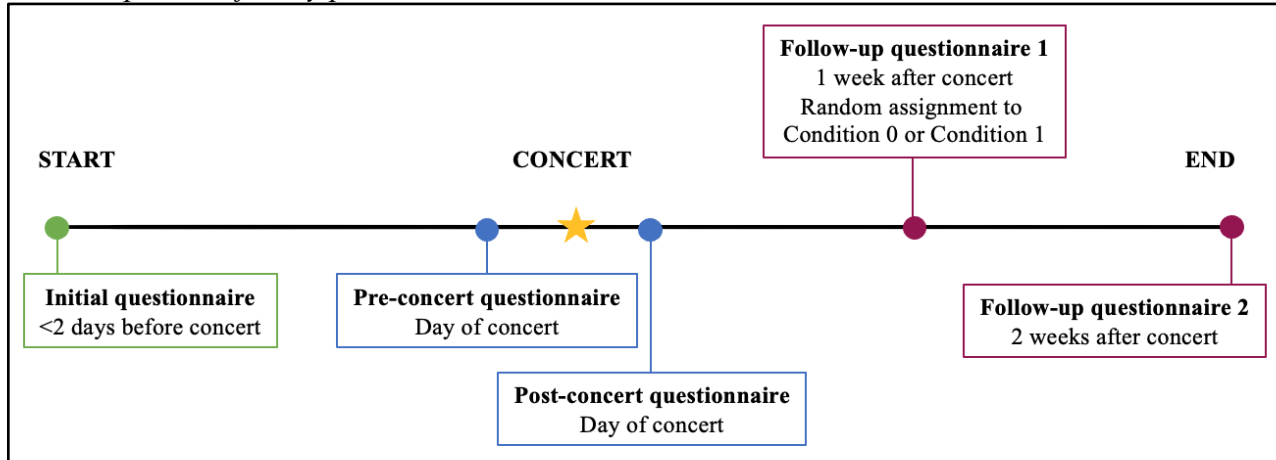
Moreover, participants who attended a concert and received the awe sustaining intervention, audio recordings from the concert they attended, demonstrated enduring benefits. One of the strongest effects of an awe-mindset toward music was on social connectedness, with concert-attending participants showing significant increases in feelings of social connectedness one week after the concert. Notably, significant increases in positive emotion also continued in the second week after the concert, demonstrating that music elevates positive emotions well after the concert. These findings contribute to the growing literature on the impact of musical experiences, especially those involving awe, which have been linked to emotional and social benefits (Boer & Abubakar, 2014; MacRitchie et al., 2020; Ji et al., 2021), and highlight the potential for extending those benefits beyond the immediate experience.

The awe sustaining intervention also showed promising effects on frequency of mental health symptoms, such that participants reported their feelings of depression and anxiety occurred less frequently throughout the week following the concert, compared to the control condition. These results are consistent with prior findings that awe experiences are associated with improved mental health (Anderson et al., 2018; Monroy & Keltner, 2023), thus supporting

the potential for music-based interventions to have meaningful downstream benefits for mental health.

The awe sustaining intervention, “reminders”, demonstrated the desired effects on well-being, especially during the first week following the concert, with most models revealing effects which did not persist through the second week of measurements. It is possible that effects did not persist as strongly in the second week due to the “reminder” paradigm losing some novelty over time. While I attempted to mitigate the potential for habituation by utilizing a unique audio clip from the concert for each week of reminders, the general experience of the music may have become more familiar upon the third exposure (first during the concert, second during the first follow-up measurement), making it less awe-eliciting.

Overall, there was a consistent pattern of results where interactions between Time 1 and Condition 1 demonstrated the most robust effect sizes across well-being metrics. This evidence suggests that the use of reminders after a live music concert may be an effective way to sustain well-being improvements beyond the positive feelings directly following the experience. Beyond this intervention, the key knowledge we gain from these findings is that the well-being benefits associated with music have the potential to be strengthened by repeated exposure, to an extent, and that they also may require the elicitation of powerful and transcendent emotions such as awe.

**Figure 1***Visual depiction of study procedure.*

*Note.* Participants in the control condition did not receive pre or post-concert questionnaires. Follow-up questionnaires were completed one and two weeks following the initial questionnaire. Condition 0 refers to the Awe Mindset condition in which participants only receive awe prompting before the concert. Condition 1 refers to the Awe Sustaining condition in which participants receive awe prompting before the concert and sustaining awe prompts during the follow-up questionnaires.

**Table 1***Raw counts of participants who completed each study questionnaire.*

| Condition   | Initial | Pre-Concert | Post-Concert | Follow-Up 1 | Follow-Up 2 |
|-------------|---------|-------------|--------------|-------------|-------------|
| Condition 0 | 75      | 48          | 50           | 44          | 39          |
| Condition 1 | 72      | 54          | 51           | 44          | 37          |
| Control     | 86      | --          | --           | 50          | 43          |
| Total       | 233     | 102         | 101          | 138         | 119         |

*Note.* Condition 0 refers to the Awe Mindset condition in which participants only receive awe prompting before the concert. Condition 1 refers to the Awe Sustaining condition in which participants receive awe prompting before the concert and sustaining awe prompts during the follow-up questionnaires.

**Table 2***Paired t-tests results for comparison of participants' emotions before and after the concert.*

| Emotion               | t      | p     | Pre M(SD)   | Post M(SD)  | d      |
|-----------------------|--------|-------|-------------|-------------|--------|
| Positive              |        |       |             |             |        |
| Awe***                | -6.552 | <.001 | 2.64(1.26)  | 3.75(1.24)  | 0.893  |
| Compassionate***      | -4.293 | <.001 | 3.43(1.11)  | 4.05(1.09)  | 0.564  |
| Elated***             | -3.944 | <.001 | 2.90(1.33)  | 3.58(1.38)  | 0.500  |
| Grateful**            | -3.572 | .001  | 3.77(1.09)  | 4.26(1.03)  | 0.464  |
| Contented**           | -3.184 | .002  | 3.45(1.03)  | 3.88(1.22)  | 0.379  |
| Proud**               | -2.862 | .005  | 3.08(1.22)  | 3.51(1.23)  | 0.356  |
| Love**                | -3.044 | .003  | 3.60(1.16)  | 3.97(1.12)  | 0.331  |
| Amused                | -1.805 | .075  | 2.95 (1.26) | 3.26 (1.37) | 0.238  |
| Interested*           | -2.329 | .022  | 3.85(1.10)  | 4.12(1.00)  | 0.264  |
| Negative              |        |       |             |             |        |
| Anxious***            | 4.150  | <.001 | 2.56(1.17)  | 1.90(1.14)  | -0.569 |
| Concerned for self*** | 4.941  | <.001 | 2.66(1.33)  | 1.99(1.20)  | -0.529 |
| Sadness               | 1.977  | .052  | 1.90 (1.18) | 1.68 (0.98) | -0.198 |
| Ashamed               | 1.455  | .150  | 1.58 (0.94) | 1.42 (0.96) | -0.173 |
| Disgusted             | 1.625  | .108  | 1.66 (0.90) | 1.43 (0.86) | -0.259 |
| Stressed*             | 3.166  | .002  | 2.37(1.16)  | 1.97(1.04)  | -0.357 |
| Afraid*               | 2.618  | .011  | 1.84(1.01)  | 1.53(0.81)  | -0.332 |
| Confused              | 1.454  | .150  | 1.72 (0.90) | 1.54 (0.98) | -0.187 |
| Pain                  | 1.815  | .073  | 1.77 (1.09) | 1.57 (1.01) | -0.193 |
| Jealous               | 1.466  | .147  | 1.61 (0.93) | 1.46 (0.93) | -0.164 |
| Angry*                | 2.404  | .019  | 1.80(0.97)  | 1.51(0.90)  | -0.311 |

\*\*\* p &lt;.001 \*\* p &lt;.01 \* p &lt;.05

**Table 3***Mixed linear model regression results for stress levels by time and experimental condition.*

| Variable                 | Coefficient | SE    | z      | p     | 95% CI           |
|--------------------------|-------------|-------|--------|-------|------------------|
| Intercept                | 2.824       | 0.151 | 18.663 | <.001 | [2.527, 3.120]   |
| Time 1                   | 0.353       | 0.193 | 1.824  | .068  | [-0.026, 0.732]  |
| Time 2                   | 0.088       | 0.193 | 0.456  | .648  | [-0.291, 0.467]  |
| Condition 0              | -0.024      | 0.221 | -0.106 | .915  | [-0.457, 0.410]  |
| Condition 1              | 0.076       | 0.221 | 0.346  | .729  | [-0.357, 0.510]  |
| Time 1 ×<br>Condition 0  | -0.186      | 0.283 | -0.659 | .510  | [-0.740, 0.368]  |
| Time 1 ×<br>Condition 1* | -0.686      | 0.283 | -2.429 | .015  | [-1.240, -0.132] |
| Time 2 ×<br>Condition 0  | -0.088      | 0.283 | -0.312 | .755  | [-0.642, 0.466]  |
| Time 2 ×<br>Condition 1  | -0.388      | 0.283 | -1.374 | .169  | [-0.942, 0.166]  |

*Note.* Condition 0 refers to the Awe Mindset condition in which participants only receive awe prompting before the concert. Condition 1 refers to the Awe Sustaining condition in which participants receive awe prompting before the concert and sustaining awe prompts during the follow-up questionnaires. \*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

**Table 4**

*Mixed linear model regression results for frequency of depression symptoms by time and experimental condition.*

| Variable                | Coefficient | SE    | z      | p     | 95% CI          |
|-------------------------|-------------|-------|--------|-------|-----------------|
| Intercept               | 1.000       | 0.191 | 5.239  | <.001 | [0.626, 1.374]  |
| Time 1                  | 0.118       | 0.200 | 0.589  | .556  | [-0.274, 0.509] |
| Time 2                  | -0.029      | 0.200 | -0.147 | .883  | [-0.421, 0.362] |
| Condition 0             | 0.400       | 0.279 | 1.435  | .151  | [-0.146, 0.946] |
| Condition 1             | 0.267       | 0.279 | 0.957  | .339  | [-0.280, 0.813] |
| Time 1 ×<br>Condition 0 | -0.318      | 0.292 | -1.089 | .276  | [-0.889, 0.254] |
| Time 1 ×<br>Condition 1 | -0.551      | 0.292 | -1.889 | .059  | [-1.123, 0.021] |
| Time 2 ×<br>Condition 0 | -0.237      | 0.292 | -0.814 | .416  | [-0.809, 0.334] |
| Time 2 ×<br>Condition 1 | -0.404      | 0.292 | -1.385 | .166  | [-0.975, 0.168] |

*Note.* Condition 0 refers to the Awe Mindset condition in which participants only receive awe prompting before the concert. Condition 1 refers to the Awe Sustaining condition in which participants receive awe prompting before the concert and sustaining awe prompts during the follow-up questionnaires. \*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

**Table 5**

*Mixed linear model regression results for positive emotion levels by time and experimental condition.*

| Variable                     | Coefficient | SE    | z      | p     | 95% CI          |
|------------------------------|-------------|-------|--------|-------|-----------------|
| Intercept                    | 2.676       | 0.133 | 20.110 | <.001 | [2.416, 2.937]  |
| Time 1                       | -0.059      | 0.138 | -0.427 | .669  | [-0.329, 0.211] |
| Time 2                       | 0.000       | 0.138 | 0.000  | 1.000 | [-0.270, 0.270] |
| Condition 0                  | -0.010      | 0.194 | -0.050 | .960  | [-0.391, 0.371] |
| Condition 1                  | -0.110      | 0.194 | -0.565 | .572  | [-0.491, 0.271] |
| Time 1 ×<br>Condition 0      | 0.259       | 0.201 | 1.287  | .198  | [-0.135, 0.653] |
| Time 1 ×<br>Condition<br>1** | 0.625       | 0.201 | 3.109  | .002  | [0.231, 1.020]  |
| Time 2 ×<br>Condition 0      | -0.000      | 0.201 | -0.000 | 1.000 | [-0.394, 0.394] |
| Time 2 ×<br>Condition 1*     | 0.500       | 0.201 | 2.485  | .013  | [0.106, 0.894]  |

*Note.* Condition 0 refers to the Awe Mindset condition in which participants only receive awe prompting before the concert. Condition 1 refers to the Awe Sustaining condition in which participants receive awe prompting before the concert and sustaining awe prompts during the follow-up questionnaires. \*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

**Table 6**

*Mixed linear model regression results for frequency of mental health symptoms by time and experimental condition.*

| Variable                 | Coefficient | SE    | z      | p     | 95% CI           |
|--------------------------|-------------|-------|--------|-------|------------------|
| Intercept                | 1.206       | 0.178 | 6.767  | <.001 | [0.857, 1.555]   |
| Time 1                   | 0.147       | 0.177 | 0.832  | .405  | [-0.199, 0.493]  |
| Time 2                   | -0.059      | 0.177 | -0.333 | .739  | [-0.405, 0.288]  |
| Condition 0              | 0.361       | 0.260 | 1.386  | .166  | [-0.149, 0.871]  |
| Condition 1              | 0.161       | 0.260 | 0.618  | .537  | [-0.349, 0.671]  |
| Time 1 ×<br>Condition 0  | -0.380      | 0.258 | -1.473 | .141  | [-0.886, 0.126]  |
| Time 1 ×<br>Condition 1* | -0.580      | 0.258 | -2.248 | .025  | [-1.086, -0.074] |
| Time 2 ×<br>Condition 0  | -0.275      | 0.258 | -1.063 | .288  | [-0.780, 0.231]  |
| Time 2 ×<br>Condition 1  | -0.341      | 0.258 | -1.322 | .186  | [-0.847, 0.165]  |

*Note.* Condition 0 refers to the Awe Mindset condition in which participants only receive awe prompting before the concert. Condition 1 refers to the Awe Sustaining condition in which participants receive awe prompting before the concert and sustaining awe prompts during the follow-up questionnaires. \*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

**Table 7**

*Mixed linear model regression results for social connectedness levels by time and experimental condition.*

| Variable                  | Coefficient | SE    | z      | p     | 95% CI          |
|---------------------------|-------------|-------|--------|-------|-----------------|
| Intercept                 | 2.324       | 0.174 | 13.353 | <.001 | [1.982, 2.665]  |
| Time 1                    | -0.088      | 0.183 | -0.482 | .630  | [-0.447, 0.270] |
| Time 2                    | 0.029       | 0.183 | 0.161  | .872  | [-0.329, 0.388] |
| Condition 0               | -0.390      | 0.254 | -1.535 | .125  | [-0.888, 0.108] |
| Condition 1               | -0.157      | 0.254 | -0.617 | .537  | [-0.655, 0.341] |
| Time 1 ×<br>Condition 0   | 0.288       | 0.267 | 1.078  | .281  | [-0.236, 0.812] |
| Time 1 ×<br>Condition 1** | 0.755       | 0.267 | 2.824  | .005  | [0.231, 1.279]  |
| Time 2 ×<br>Condition 0   | 0.137       | 0.267 | 0.513  | .608  | [-0.387, 0.661] |
| Time 2 ×<br>Condition 1   | 0.237       | 0.267 | 0.888  | .375  | [-0.287, 0.761] |

*Note.* Condition 0 refers to the Awe Mindset condition in which participants only receive awe prompting before the concert. Condition 1 refers to the Awe Sustaining condition in which participants receive awe prompting before the concert and sustaining awe prompts during the follow-up questionnaires. \*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

## Introduction to Visual Art

### *Defining Visual Art*

Visual art encompasses art forms which are distinctly concerned with visual presentations, including parts of the artwork which are mainly experienced through seeing. This form includes media such as painting, drawing, printmaking, sculpture, ceramics, photography, video, filmmaking, comics, design, crafts, and architecture. Anthropological discovery dates the oldest cave art to at least 45,000 years old, a representation of the Sulawesi warty pig (Brumm et al., 2021). As discussed in the aesthetics section, visual art serves important functions such as representing the real world, being a medium for expression of interior states, and connecting us to our social worlds.

### *Key Terms*

I will use the term “artwork” to refer to specific pieces of visual art such as a singular painting or sculpture. The following are definitions of the formal elements of visual art which may appear in or be relevant to our discussion of visual art: Line, Shape and Form, Tone/Value, Texture, Color, Space, and Pattern<sup>5</sup> (The Art Teacher, 2024). Line is a marking that can be straight, curved, thick, thin, horizontal, vertical, diagonal, dotted or dashed. Line helps define shapes and guide attention towards the focal point of the artwork. Shape describes two-dimensional enclosed figures that can be geometric like circles and rectangles, or organic as in an unspecified, irregular shapes. Form describes three-dimensional objects created using shading, perspective, and shadows to add depth and volume to a two-dimensional artwork. Tone/Value refers to the degree of lightness or darkness of colors used in an artwork. Texture is the surface quality or feel of an object created using different materials or techniques to add a tactile sense to the artwork. Color includes aspects of an artwork such as hues or the pure colors on the spectrum, tone/value, and saturation or intensity of the color. Space refers to the area surrounding objects or elements in an artwork, including negative space. Pattern is the repetition of objects or elements in an artwork which is recognizable and systematic.

### *Visual Art and Emotion*

In order to understand the experience of visual art it is important to give attention to the emotional experience. I have previously introduced aesthetic emotions, which are certainly relevant to visual art, so we shall focus on reviewing empirical work done on visual art and emotion for this section. To this end, it is important to acknowledge that aesthetic emotions need not be wholly separate from general or non-aesthetic emotions. The classification of emotions as “aesthetic” emotions serves the purpose of understanding simple or more complex interactions with art, and providing unique markers for aesthetic experiences. On the topic of visual art and emotion we will review studies which include aesthetic emotions and non-aesthetic emotions.

In the context of visual art there is some evidence for elicitation of emotional and affective responses (Silvia, 2005; Cheung et al., 2019; Stamkou et al., 2024). Work in this area often uses abstract artworks due to their de-emphasis on identifiable, realistic subject matter or thematic content such as storytelling (Rise Art, n.d.). Abstract art is useful for empirical inquiry into emotional responses to visual aspects of art as it allows for responses to be linked to formal elements of the artwork (often referred to as “low-level”), independent of any particular subject matter or narrative content. For example, in a series of two studies, Melcher & Bacchi (2013) identified consistent ratings of emotion from abstract artworks. In their first study, they examined potential priming effects of abstract artworks and faces, focusing on the basic

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<sup>5</sup> The provided definitions are from the Harvard Dictionary of Music and are cited in-text and in references as such.

emotions of “happiness” and “sadness”. Participants viewed two stimuli (either a face or artwork) and rated them as either “happy” or “sad”. Whichever stimulus was presented *first* served as the emotion prime, and consisted of exemplar artworks or faces considered to be strongly happy or sad; the second stimulus presented was neutral. The four conditions were as follows: three experimental (face followed by painting, painting followed by painting, painting followed by face) and one control (face followed by face). Results revealed that emotion priming was successful in all three experimental conditions, such that the neutral stimuli were systematically and significantly rated more highly in terms of the target emotion after the strong emotion stimulus, compared to the control condition. These results suggest that using visual art as an emotion-inducing stimulus demonstrates similar effects and could be as useful as the well-known stimulus of faces.

Study two focused on abstract artworks only with a simplified paradigm only involving participants rating 100 artworks. In a unique setup, participants wandered around a gallery-like setup at their own pace and rated artworks verbally on a scale from 1 to 7 (1 indicating negative emotion and 7 indicating positive emotion). Results revealed that the majority of the artworks were given a neutral rating with the most negative ratings averaging to 1.95 and the most positive ratings averaging to 6.2. Analysis of the artworks themselves show some consistencies with regard to the formal elements; the most positively rated artworks featured bright colors and regular shapes and forms, and the most negatively rated artworks featured dark colors and irregular forms and lack of discernible patterns. Another study explores emotional responses to abstract artworks from the Abstract Expressionism and Geometric Abstraction movements (Van Paaschen et al., 2014). Participants with novice art experience (no art background or training) rated a total of 340 artworks on emotional valence and arousal on a likert scale ranging from ‘calm’ to ‘excited’ for arousal and ‘sad’ to ‘happy’ for valence. Ratings demonstrated high consistency across observers for artworks from both movements. In contrast with the previous work we discussed, ratings were spread consistently across the full range of responses for both arousal and valence. This indicates that agreement was not due to the artworks being perceived as neutral. With regard to the formal elements, participants were more likely to rate artworks as more highly arousing when complex lines and dark colors were present and less positively valenced than works with brighter colors and regular, geometric shapes. Taken together, work done on abstract artworks and emotion perception demonstrates evidence that emotion can be perceived via low-level aspects of visual art, and that these aspects are consistently interpreted. Notably, perceived emotion is shown to be consistent across raters in abstract artworks; however the door is left open as to the potential for variability in responses to non-abstract art, or art that features a dominant subject matter or narrative.

Within the realm of visual arts and emotion, there has been a question of how emotions expressed by the artist or creator are perceived by the viewer. Pelowski et al. (2020) elegantly outlined four potential pathways by which emotion might be transmitted from artist to viewer. The first is that the emotions intended by the artist through creating the artwork are the same as those felt by the viewer when engaging with the work. This is more akin to an experience of “emotion mirroring” (Freedberg & Gallese, 2007), where artist and viewer share the same affective state and not simply a case of the viewer inferring the emotional state of the artist.

The second pathway is slightly different; in this case, the viewer experiences emotions when engaging the artwork which mirror the emotions that the artist felt when creating the artwork but not necessarily with any intention on the part of the artist. In other words, the artist’s

naturally occurring emotional state is expressed in the artwork and this reaches the viewer, whether or not the artist intentionally meant for the artwork to express that emotion.

The third pathway, in contrast to the second, hypothesizes that viewers may perform an analysis of the emotions expressed in the artwork, devoid of any actual emotional experience within themselves.

The fourth pathway is distinct in that there is a disconnect in emotional experience between the artist and viewer. According to this account, the viewer's emotions are derived from their own lived history and expectations and not any intentions or emotions of the artist.

In order to explore these pathways, Pelowski and colleagues developed a unique paradigm where working artists record their emotional experiences while creating their art and viewers recorded their experiences viewing those same artworks. In the first part of the study, three Master's of Fine Arts (MFA) students were tasked with creating individual art installations over the course of one month. The installations were distinct with differing art styles and mediums in use, and general emotional valence of the complete work. Immediately after completing the installations, they reported on their felt emotions while creating the artworks. They also identified key emotions that they intended for the viewer of the artwork to experience. In the second part of the study, 37 participants viewed all three installations and completed surveys about their felt emotions, including ratings of general emotional valence and arousal. Parallel to the artists' survey they were also asked to identify any key emotions they thought were intentionally depicted in the artworks by the artists. Additionally, they completed the Questionnaire of Affective and Cognitive empathy (QCAE; Reniers et al., 2011). In this study, viewers consistently reported more emotions that the artist identified as intended to be felt than non-intentional emotions for 2 out of the 3 installations. Viewers reported emotions significantly correlated with those of the artists when creating their installations, even those which were reported by the artists as not intended to be experienced by the viewer. Across all 3 installations, viewers demonstrated a significant ability to infer the emotions the artist had intended with the works. These results provide preliminary evidence for the pathways to emotion involving sharing or mirroring emotion and inferring emotions intended by the artist accurately. In conclusion, emotion sharing, by way of feeling the same emotions as the artist and understanding their emotions, emerges as a key component of engaging with art in a real-life setting.

Another recent work builds upon studies of visual art and emotion in ecologically valid settings, specifically within the context of museums. Museums are typically considered to be public gathering spaces where visitors may interact with and learn about culture, the arts, and the natural world. There are various types of museums including art museums, and within the scope of art museums there are museums dedicated to different types of art such as modern art museums and ancient art museums. Additionally, art museums may be dedicated to specific cultures and identities such as the Museum of African Diaspora (MoAD) and the Smithsonian American Art Museum (SAAM).

Rodriguez et al. (2024) investigated the emotional experience of visitors to contemporary art museums in a field study. Two hundred and ninety-eight participants made up the sample including nearly equal groups of passive visitors (157) and undergraduate students recruited to participate in the study (141). Participants visited the Weatherspoon Art Museum in North Carolina, and completed self-report questionnaires before and after their visit. The survey asked about their emotional experiences using the following items: happy, sad, interested, disgusted, awe-inspired, angry, bored, relaxed, curious, and annoyed. To analyze the emotional experience of the visitors following their visit, researchers calculated two factors: emotional diversity which

represented the number of unique emotions experienced, and emotional balance which represented the relative even spread in ratings between emotions or the dominance of any one emotion. Results on emotional diversity showed that participants on average experienced 7 out of the 10 possible emotions during the visit with ratings per emotion ranging widely from 3 to 10. Results on emotional balance indicate that people experienced emotions evenly with no singular emotion dominating the experience. These results support rich and diverse emotional experiences within museum spaces, a context which may be more representative of real-life experiences of visual art than work utilizing single works presented in a uniform and largely uncured manner.

Additionally, my own work in this area provides further evidence for the highly diverse emotions experienced when engaging with visual art<sup>6</sup> (Stamkou et al., 2024). There is a wide expanse of possibility for other mechanisms to emerge beyond the composition of the piece. It is possible that the visual elements of the composition impact the complex experiences which accompany art engagement. Furthermore, it is important to consider the extent to which a viewer of an artwork would consciously connect lines, for example, to feeling ‘disoriented’ or ‘whimsical’. We can begin to see where visual elements of artwork convene with aesthetic emotional states in Stamkou et al. (2024), which provides a high-dimensional space where aesthetic experience lies across several gradients of felt emotion and perceived artwork qualities. Harkening back to earlier discussion of the functions of art, Stamkou (2022) argues that emotions evoked by visual art serve the purpose of socialization and cultural integration by providing a common “vocabulary” for people to communicate and understand their cultures. Simply put, engagement with visual art prompts specific emotional experiences and these experiences help us to identify patterns of emotion and become more knowledgeable about their cultural contexts.

### *Visual Art and Identity*

Art contains representations of real-world contexts and issues. In this way, art helps us to understand life and ourselves as we move through it. Through our interactions with art, we gain a culturally-relevant understanding of morals and values (Stamkou, 2022), which in turn may motivate our own personal beliefs. When an experience of art is particularly powerful we can latch onto it - pondering on its meaning after the experience is over, connecting it to our lived history, and ultimately, even making it a part of our identity. Identity encapsulates the sense of self as made up of personal and interpersonal characteristics, affiliations, and roles in society (Howard, 2000). Since identity is multifaceted, there is the potential for each one of our identities to impact experiences with visual art.

Perhaps one of the most salient is cultural identity. Bao et al. (2016) conducts a cross-cultural investigation of identity and aesthetic preference, examining specifically Western and Chinese art. Due to the distinct stylistic qualities of artworks produced by Western and Chinese artists (Kubovy, 1986; Delahaye, 1993; Masuda et al., 2008), the researchers surmise an alignment between the perceivers’ own cultural identity and that of the artwork style/artist. They find exactly this, a greater preference for artworks which are reminiscent of one’s own cultural group; such that people with Western backgrounds report greater liking of artworks which feature realistic depictions of forms and meticulous attention to detail, while people with Chinese

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<sup>6</sup> Stamkou, E., Keltner, D., Corona, R., Aksoy, E., & Cowen, A. S. (2024). Emotional palette: a computational mapping of aesthetic experiences evoked by visual art. *Scientific Reports*, 14(1), 19932. Material from the manuscript is included in-text directly following this introductory section along with an introduction including a brief description of my contributions and theorizing around this work, a transitional note, and my own concluding remarks.

backgrounds prefer artworks with rich symbolism and unique perspectives. One may consider the mechanisms behind this preference: familiarity with the art style, feelings of pride or respect for artists from one's own culture, the degree of salience of the visual elements of the artworks which resonate with one's lived experience within their culture, to name a few particularly exciting hypotheses.

Moving to other facets of identity which may impact aesthetic experience, it is traditional, at least in Western culture, that taste in art and especially preference for high art goes hand in hand with high class status, wherein those who possess refined taste also possess more education, wealth, and as a result, capacity for art appreciation. Van Eijck (2012) responds to this idea by considering what other equally salient aspects of identity may impact appreciation for visual art: religious and social orientation. Participants in their study reported their religious orientation along with social orientations (utilitarian and expressive individualism, solidarity, communitarianism, social isolation, and social disorientation). They were then shown artworks from classical and modern art styles (e.g., late-renaissance/baroque, surrealism) and asked to rate how much they appreciated the style of art depicted in the work. Results on religious orientation find that this facet of identity accounts for very little explained variance in aesthetic response to both classical and modern art styles. However, there is an observed distinction in appreciation for classical works of art, such that Catholic and Atheist people reported higher appreciation than people from other religious groups. In the case of social orientation, it is revealed that solidarity and social disorientation are related to greater aesthetic appreciation of classical art styles while expressive and utilitarian individualism has the inverse relationship. The remainder of the results, while mixed, suggest that further exploration of the horizontal factors of social identity may be useful toward an understanding of art and larger cultural engagement.

Visual art is ubiquitous to daily life, in every ad we see, in murals, public art, and graffiti, and in the palm of our hands on our mobile devices as well. How we interact with art and are affected by it is still generally understudied, but especially so when it comes to the role of identity in these interactions. There is a significant need for empirical research on the relationship between identity and visual art, especially within the field of psychology. This area would benefit from considering highly salient aspects of identity (culture, class, gender) in tandem with less obvious aspects such as beliefs about the world (morality, values) and orientation towards arts (e.g., whether one holds an instrumentalist view of art, what people consider to be art, and of course, identification as an artist). It could also be informative to investigate the impact of visual art on identity formation during different phases of life such as adolescence and late adulthood but also across the lifespan. Furthermore, this hypothesis that identity impacts the experience of visual art calls into question whether it is the formal elements of visual art (aspects of the composition, style) or those aspects of art such as story, narrative, and thematic content which correlate with identity. While current research in this area mainly focuses on the former, there is endless possibility for work exploring the subjective content of visual art and how this relates to our emotional response, aesthetic experience, and identities.

## **Part II: Visual Art Studies**

To revisit current literature on visual art, recent work demonstrates art's capacity to produce emotional reactions across various mediums (Cowen et al., 2020; Stamkou et al., 2024). Emotional responses to visual artwork especially may explain the prevalence of art which includes significant social commentary or even art which may be considered "deviant" with the goal of bringing attention to societal issues (Stamkou et al., 2018).

However, this work has not yet documented the relationship between a viewer's emotional response to art, a focus in this dissertation, and appraisals of the art work's moral content. The objective of these studies are to expand the current understanding of our perceptions of visual art and the connection these perceptions have to our own beliefs about the world. Moreover, we are interested in how these perceptions of art as moral may affect aesthetic appreciation (liking, finding the artwork beautiful). Growing research at the intersection of psychology and aesthetics is generating interest toward understanding human reactions to complex and at times challenging stimuli (Cheung et al., 2019). There is little work, however, systematically exploring the connection between people's perceptions of visual art and their own belief systems, i.e. moral values. This is a less common approach than comparing people's preferences for art to their personality traits, for example. Recent work in neuroscience supports the connection between moral judgments and aesthetic judgments (Heinzelmann et al., 2020; Cheng et al., 2021). It is of interest toward real-world applications of aesthetics such as public facing institutions to examine the effect of moral content on the aesthetic experience. Moreover, this work largely begins the investigation on how identity may relate to the perception of thematic content in visual art and aesthetic judgments of visual art.

For the first investigation in my series of visual art studies, we were interested in providing evidence for a multi-dimensional space of emotional experiences of visual art. This study utilized computational methods to identify patterns of aesthetic qualities and emotions in response to a diverse set of nearly 1500 artworks. For the second investigation in my series of visual art studies, we assess perceptions of moral thematic content in visual art. Specifically, we are interested in the effect that one's own moral beliefs may impact their perception of morality in art, and how this relationship may impact their aesthetic experience. For the third proposed study, we aim to manipulate the salience of moral beliefs in order to test for effects on perception of morality in visual art and aesthetic experiences. Taken together, this work has significant implications for the emotional and aesthetic experience of visual art, potential avenues for understanding the mechanisms underlying these experiences, and opportunities for how we may deepen these experiences.

### **STUDY 3 – Emotion and Visual Art**

In the following section I include a paper in which my collaborators Dr. Eftychia Stamkou, Dr. Dacher Keltner, Dr. Eda Aksoy, and Dr. Alan Cown, and I investigated the wide expanse of aesthetic experiences evoked by visual art.

A primary line of questioning I wanted to pursue through this study was the connection between the formal elements of visual art and aesthetic responses. While some work exists linking features of abstract artworks to emotional responses (Rose, 1991; Melcher & Bacchi, 2013; Cohen et al., 2016), prior to this work there was yet to be any studies which systematically mapped out emotional and aesthetic responses to a diverse and large enough set of artworks to connect responses to formal elements such as color, pattern, and form. By utilizing a diverse set of stimuli, nearly 1500 artworks, and machine learning powered visualization techniques, we

were able to begin to identify formal elements which correlate with emotional and aesthetic responses.

Moreover, this study provides a foundation for future work investigating how aesthetic judgments of visual art correlate with thematic content. Within past research on visual art, much of what has been done focuses on low-level processing, most often of abstract artworks (Van Paasschen et al., 2014; Damiano et al., 2023). In the few cases where higher-level processing is explored it is in the context of creating art, and not simply viewing artworks (Oatley, 2003; Gruber & Oepen, 2018). Due to the diverse stimulus set utilized in this study, we can begin to examine the thematic content of the artworks, or what is depicted and what viewers perceive as the prevalent themes present within the artwork, and the potential patterns of aesthetic and emotional response associated with differences in thematic content. This allows for two avenues of investigating the question of thematic content. The first, in which we ourselves analyze the artworks within the stimulus set for content such as presence of animate beings, nature, etc. and identify any patterns of response. The second would involve asking participants the extent to which they perceive thematic content within the artworks and then asking about their aesthetic responses to those artworks.

My primary contributions to this work were in conceptualizing the study, denoted by the aforementioned aims, preparing the stimulus set, and providing support for the other authors during the revision process of the manuscript. In preparation for this work, the team met during the Summer of 2020 to discuss the aims and potential methods for the study. We then worked asynchronously to gather artworks for the stimulus set using the Google Arts & Culture online database. The objective was to create a dataset of artworks which were diverse in region, art movement, period, and genre. We met across several weeks to discuss the collection of stimuli. This dataset will provide stimuli for all of the visual art studies presented here and future research in the field of visual art and aesthetics to come from the laboratory. Once the formation of the dataset was complete, the data was collected utilizing Amazon Mechanical Turk (mTurk) and the team met to discuss data analysis and subsequent results. In the time leading up to publication, I worked closely with Dr. Eftychia Stamkou to produce the supplemental materials, namely the index of aesthetic emotions, necessary for the final publication.

Immediately following this transitional sentence, I will present the introduction, method, and results sections from the final manuscript<sup>7</sup>, followed by concluding remarks on how the findings fit into my research program as presented in this dissertation.

### **Start of Manuscript Material**

Central to human culture and evolution is our capacity to create art. Recent archeological evidence suggests that humans have been creating visual art—cultural artifacts that appeal primarily to the visual sense—for at least 40,000 years<sup>1</sup>. Human capacities for music and dance are likely older<sup>2</sup>. Why did humans become such an aesthetic species? One answer is that the arts represent emotion and become central to how members of a culture share in the experience and expression of emotions that enable collective living<sup>3</sup>. Through the creation of art, cultures store conceptualizations and practices related to emotion, and through the experience of art, individuals come to a shared understanding of emotions and their place within culture<sup>4</sup>.

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<sup>7</sup> Stamkou, E., Keltner, D., Corona, R., Aksoy, E., & Cowen, A. S. (2024). Emotional palette: a computational mapping of aesthetic experiences evoked by visual art. *Scientific Reports*, 14(1), 19932. This is the author's accepted manuscript of the article published in *Scientific Reports*, 14(1), 1-12. The final version is available at <https://doi.org/10.1038/s41598-024-69686-9>. © 2024 Nature Portfolio. Reprinted with permission.

Brushstrokes, colors, lines, symbols, and themes are used by artists to elicit rich aesthetic experiences in viewers.

Early philosophical accounts and recent theoretical models posit that visual art can broadly impact our neurophysiology, feelings, judgments, and social behavior, recognizing that emotional and cognitive processes play a crucial role in these experiences<sup>5-7</sup>. Although empirical research has begun to explore the emotions we feel and the qualities we perceive in response to visual art, a comprehensive taxonomy of the specific aesthetic experiences associated with visual art remains elusive. What is the structure of aesthetic experiences associated with visual art? Do people's emotional responses differ from the feeling qualities they perceive in the artwork itself? Do aesthetic experiences have clear boundaries, or are they blended to create intermediate feeling states? To what extent do the emotions people feel in response to visual art correspond to the emotions of daily living? Answers to these questions are critical to understanding the processes by which visual art engenders aesthetic experiences.

### **Aesthetic experiences: The cultural archive hypothesis**

In her influential books<sup>4,8</sup>, philosopher Suzanne Langer advances the thesis that the arts' "purpose is to objectify feeling". Each artwork, she details, is a unique kind of *representation* of emotion. In making visual art, members of a culture archive beliefs about what Langer called "life's patterns": concerns or themes of social living that are central to the human experience, like the nature of suffering, loss, unfairness, infidelity, the rise and fall in power, and life and death<sup>9</sup>.

Advances in the understanding of cultural evolution converge with this thinking. Culture can be thought of as an ever-evolving repository of shared knowledge, practices, and experiences that enables individuals to adapt to the challenges and opportunities in the natural, human-designed, and social environment<sup>10</sup>. Acts of imaginative culture, like the visual arts, evoke aesthetic experiences of emotion, enabling individuals to become sophisticated practitioners of emotions, and how they structure judgment, action, and social interactions<sup>3,11,12</sup>.

In keeping with this thesis, with forms of *representation* in the arts, members of a culture portray emotionally rich interactions, like those involving courage or jealousy or power, in stories, legends, myths, and visual artworks<sup>13</sup>. Members of a culture use visual techniques in paintings, figurines, and carvings to portray or represent profound interactions like childbirth, sexual relations, power dynamics (e.g., enslavement), and combat, and dramatize bodily expressions of emotion in dance, dramatic performance, and masks<sup>14-16</sup>. These cultural representations serve as memorable ways of eliciting shared emotional and cognitive experiences, inviting individuals into the understanding and practice of the patterns of a culture<sup>17</sup>.

The cultural archive hypothesis has been extended to select empirical studies of visual art. In an early study, art students were assigned to produce nonrepresentational line drawings conveying one specific expressive meaning, such as femininity, energy, depression, illness, anger, joy, or tranquility<sup>18</sup>. Another group of students then rated the extent to which the drawings conveyed the intended expressive content. Results showed agreement among judges, with 30-50% of raters reliably judging the meaning expressed by the art students in their nonrepresentational drawings. A more recent study showed that viewers spontaneously reported feeling similar emotion patterns, such as sadness and confusion, reported by the artists when making a piece of art, regardless of whether these had been intended<sup>19</sup>. Visual art seems to communicate emotions, which viewers routinely receive and understand.

These studies suggest how the arts might allow members of a culture to develop a shared understanding of the emotions, ideas, and perceptions that constitute the moral stances of their culture<sup>20</sup>. Through such emotional enculturation, people learn how to engage in vital interactions, such as negotiating status, redressing injustice, or tending to someone who is suffering, and embody their roles and identities within a culture's pattern of relationships. The arts archive human emotion and the social patterns that unfold in their experience. Yet, which aesthetic experiences artworks elicit, and how they do so in viewers, is not well understood.

### **Past efforts to understand aesthetic experiences in response to visual art**

The cultural archive hypothesis centers upon the questions we address in the present investigation: How do emotions archived in artworks elicit experiences in viewers? What is the nature of these aesthetic experiences? Past studies have begun to offer answers to these questions. One common approach has been to focus on broad evaluations of artworks, such as the individual's felt pleasure/displeasure or mere liking/disliking<sup>21</sup>. Within this tradition, the animating idea is that hedonism, or broad feelings of pleasure, is core to aesthetic experience. Relevant empirical studies have captured the global evaluation of the work but not experiences of specific emotions, like anger, love, and compassion, or specific qualities attributed to the artwork, like peaceful, elegant, and warm.

Another tradition has focused on a small set of emotions, such as “joy”, “sadness”, “anger”, “fear”, and “interest”, providing key insights on experiences of basic emotions<sup>22–24</sup>. However, the space of emotional experience is now known to be much richer (see<sup>25</sup> for a review). Advanced computational techniques applied to the study of facial–bodily expression, vocal bursts, prosody, the feelings evoked by music and video, and brain patterning triggered by emotional videos provide convergent evidence for at least eighteen distinct states found across all modalities and media, in addition to modality- or media-specific states, such as pride and shame in the face/body and the feeling of dreaminess in response to music<sup>14,26–30,45</sup>.

Past approaches to measuring aesthetic experiences in response to visual art have also focused on discrete or modal emotions with clear boundaries between categories. However, much of human emotional life is complex, involving states of mixed feeling, such as “nostalgia” and “craving”, and of a nuanced nature, such as “entrancement”, “horror”, and “grief”<sup>27</sup>. Although it is possible to experience pure emotions, we are likely to feel a mix of aesthetic experiences in response to a single artwork, such as a blend of awe, love, and reverence when viewing religious renaissance artworks, or variants of sadness in response to different subjects depicted in different artworks. Studying the full richness, blends, and gradients of aesthetic experiences requires sampling a wide range of experiences, a central focus of the present research. Studying a diverse set of artworks further enables this effort to more fully characterize the semantic space of aesthetic experiences in response to visual art. A concern of past studies is the reliance upon a limited number of artworks presented to viewers—5 to 75 pieces of art—which does not capture the great variety of cultural styles, eras, and regions that constitute the long history of visual art. Recent studies that examine a large and widely varying set of stimuli consistently show that categories of emotions traditionally seen as distinct are connected by gradients of blended experiences and expressions. For example, pure expressions of awe, surprise, and fear are interconnected by gradients of composite facial, bodily, and vocal displays that consistently convey intermediate meanings<sup>26,27,29,45</sup>.

Two studies of visual art that have sampled a wider range of feelings—upward of 75 feeling states—have relied on factor analysis<sup>31,32</sup>, which, for reasons we detail in the Results section,

potentially mask the high dimensionality, or richer variety and blends, of aesthetic experiences. As a result, studies that used this analytical technique have usually identified no more than seven factors describing people's aesthetic experiences, including pleasing emotions (e.g., joy, relaxation), epistemic emotions (e.g., interest, surprise), negative emotions (e.g., boredom, confusion), and prototypical aesthetic emotions (e.g., awe, being moved).

Studies have also largely ignored mental states associated with the imagination, states like mysterious or dreamy, a critical oversight given that some of the oldest visual artworks represent much more than ordinary life situations, such as a male figurine with a lion head or cave art scenes of hunters with bird and reptile features<sup>1,33</sup>. A central function of art is to portray alternatives to reality, what is hypothetical, beyond the senses, and even not possible or true<sup>34</sup>. Here, we consider the experiential aesthetic space beyond the feelings commonly elicited by everyday life events<sup>35</sup>.

Finally, while artworks elicit emotions that directly affect the viewer, they are also objects for perception and reflection, fostering cognitively mediated aesthetic experiences focused on artwork qualities, such as “disorienting”, “provocative”, or “mysterious”. Previous theories highlight the need to take both an artwork-oriented approach (modeling effects of the qualities of a piece of art) and a viewer-oriented approach (modeling the felt emotions) to understand experiences with visual art<sup>36</sup>. For example, recent empirical work using semantic network analysis shows that the language people use to describe their aesthetic experiences includes both artwork-descriptive features, such as beautiful and controversial, and the cognitive-affective impacts on the viewer, like enraptured and challenged<sup>37,38</sup>. People often blend felt emotions and perceived qualities in describing art, where emotions may derive from perceived qualities (e.g., a *moving* landscape makes us *feel moved*) or diverge from them (e.g., a *tragic* scene makes us *feel love*). It remains unknown whether aesthetic qualities perceived in the artwork constitute a core aspect of the aesthetic experience, or overlap with emotional responses, as previous studies have conflated their measurement or studied them as separate processes.

In sum, most previous studies of aesthetic experience have primarily been *concept driven*. Namely, scientists have tended to present participants with a limited set of artworks, captured experience with a limited array of items, such as pleasantness/unpleasantness or a small number of emotion terms, have not systematically examined perceived artwork qualities, and used outdated statistical techniques. The empirical results are often low dimensional, for instance, that visual art elicits a narrow range of emotions, that are typically clustered in a few categories, including pleasure, negative emotions, epistemic emotions, and prototypical aesthetic emotions, potentially under-representing the breadth and blending of aesthetic experiences in response to visual art. The present study aspires to fill these lacunae by taking a computational approach to aesthetic experience enabled by Semantic Space Theory.

### **Understanding aesthetic experiences: A Semantic Space Theory approach**

Guided by Semantic Space Theory, here we take a data-driven approach to mapping aesthetic experience<sup>25</sup>, departing significantly from the concept-driven methods of past studies. Semantic Space theory offers a computational approach that uses wide-ranging naturalistic stimuli and open-ended statistical techniques to capture systematic variation in emotion-related behavior across modalities (face, body, voice, neurophysiology, language<sup>25</sup>). New quantitative approaches to partitioning variance enable the examination of three properties of semantic space of experience: dimensionality, distribution, and conceptualization. The dimensionality concerns the categorical structure of the semantic space or the number of distinct experiences, which

determines the complexity of the semantic space, ranging from a few coherent categories (low dimensional) to many different categories (high dimensional). The distribution examines whether the boundaries between the identified dimensions are sharp or overlapping, for example, determining if emotional experiences can be categorized in clusters with clear boundaries (e.g., anger and disgust) or exist along a continuum that allows for blended experiences (e.g., an intermediate state between anger and disgust). Conceptualization concerns the nature of the concepts that most directly account for variation in how people represent their subjective experiences, for instance, whether emotion concepts, like “awe”, “fear” and “serenity”, or aesthetic qualities, like “mystical”, “intricate” and “striking”, drive the representation of aesthetic experience.

In the present investigation, first, we build upon previous studies to survey a wide array of experiences, which enables mapping the complexity of aesthetic experiences: Participants reported on their experiences in terms of 103 items, comprising several dozen states in the expanding science of emotion<sup>28</sup>, variants and blends of emotions, states related to the imagination, and perceptual attributes of visual art. Second, experiences are evoked with a diverse set of stimuli, without assuming a one-to-one mapping between stimuli and specific experiences. Past studies have presented participants with up to 75 pieces of visual art. Here, we study 1,457 artworks that cover a broad range of styles, eras, geographic regions, and cultures<sup>39</sup>. Drawing on such variation is critical to mapping the structure of aesthetic experiences. Third, new statistical techniques reveal the *patterns of relations between experiences*. These techniques depart from univariate approaches, such as correlations, *t*-tests, and factor analytic and principal components analyses (PCA), and model the latent structure of large-scale, multidimensional data, while preserving dimensions of meaning that are nuanced yet reliable<sup>25,27</sup>. We extend Semantic Space Theory to visual art, testing the following hypotheses:

*Hypothesis 1: Dimensionality.* The semantic space of emotion-related behavior appears to be rich, including multiple states across modalities in addition to modality-specific states, as evidenced by research on facial–bodily expression, vocal bursts, prosody, and brain patterning triggered by emotional stimuli<sup>14,26–30,45</sup>. We, therefore, expect aesthetic experiences in response to visual art to be high- rather than low-dimensional, eliciting a much wider array of distinct categories of experiences than typically thought.

*Hypothesis 2: Conceptualization.* Felt emotions and perceived qualities are widely theorized to represent different foci of our engagement with visual art—one viewer-focused and directly affective, the other artwork-focused and cognitively mediated. Given theoretical and empirical accounts of their distinctions<sup>36,37</sup>, we expect felt emotions and perceived qualities to be independent and integral aspects of aesthetic experiences as evidenced by their commensurate prediction of overall aesthetic appreciation of artworks.

*Hypothesis 3: Distribution.* Although there may be pure aesthetic experiences of clearly defined states, much of emotional response is found to be systematically blended rather than discrete. Recent studies examining a large and varied set of stimuli consistently demonstrate that traditionally distinct emotional categories are connected by gradients of blended experiences<sup>26,27,29,45</sup>. Therefore, we expect categories of aesthetic experiences to lie along continuous gradients of experience rather than within discrete clusters.

## Methods

To test these three hypotheses, we created a diverse stimulus set of visual artworks, which were rated in terms of emotions felt in response to the artworks (hereafter aesthetic emotions) and

perceived artwork qualities (hereafter aesthetic qualities). We also assessed aesthetic appreciation of the artworks (liking) as an overall evaluative judgment. The experimental procedures were approved by the Institutional Review Board at the University of California, Berkeley, and all methods were performed in accordance with the relevant guidelines and regulations.

### **Participants**

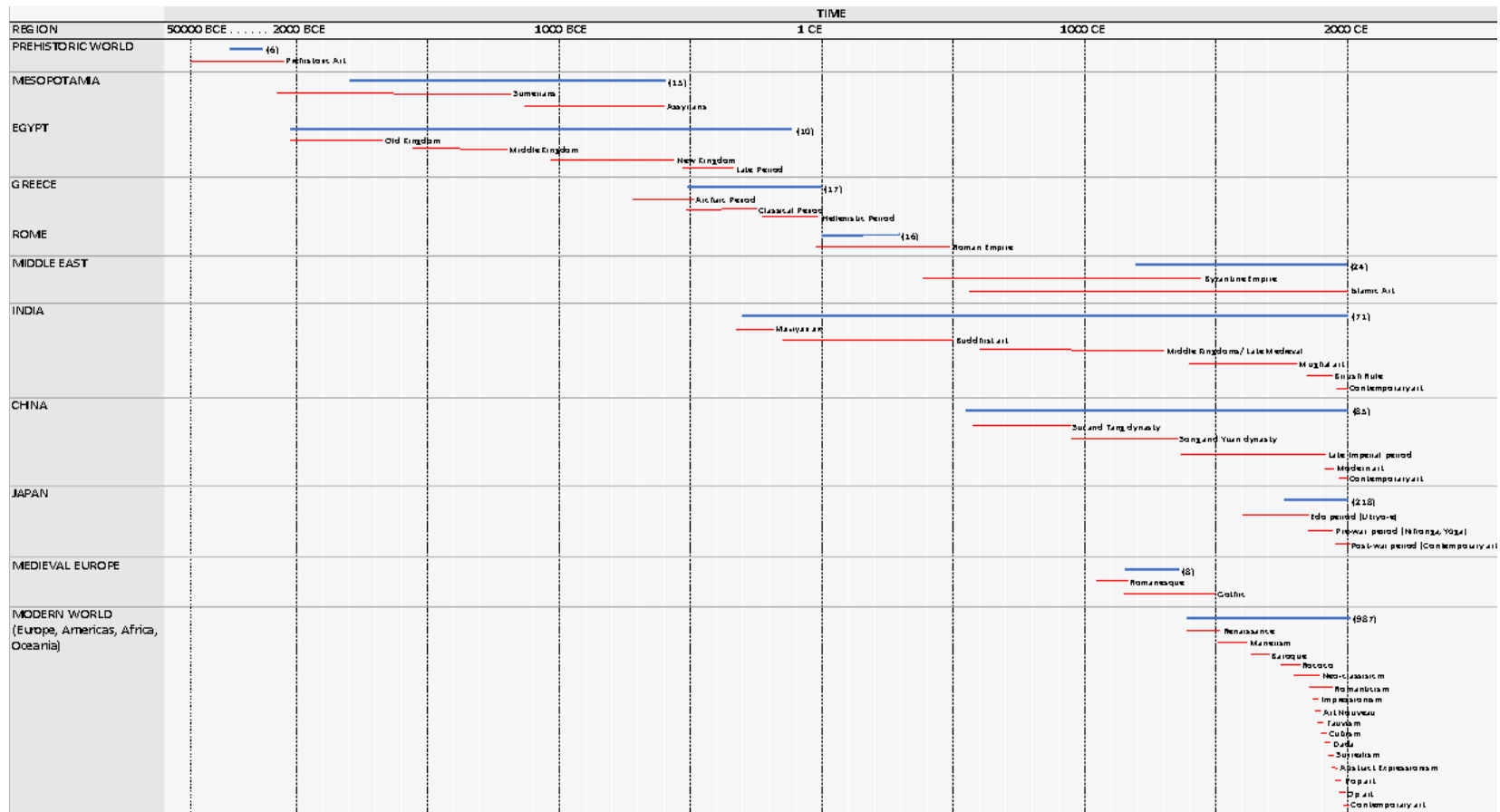
Judgments of the visual artworks were obtained using Amazon Mechanical Turk from a total of 1,173 participants (540 male, 568 female, 65 other/unreported,  $M_{age}=34.5$ ,  $SD_{age}=13.3$ ). Participants were registered within the U.S. and self-reported their country of origin. We excluded data from participants whose registration location and country of origin did not match. All participants gave their informed consent and received \$4.50 for their participation.

### **Artwork collection strategy**

We assembled a diverse collection of 1,457 visual artworks (paintings, reliefs, and drawings) selected from the Google Arts & Culture online platform. Departing from past studies' concentration upon a small collection of artwork samples and informed by the crucial dependence of multidimensional analytic results on sample size<sup>40</sup>, we collected widely varying stimuli that were representative of different cultural-historical regions, art movements, and the feelings conveyed in the artworks. Our selection strategy was guided by a historical taxonomy of art<sup>39</sup> and aimed to cover all major art movements from the Upper Paleolithic to the Contemporary Era, all cultural-historical regions from prehistory to the modern world, and several countries across all continents. Figure 1 provides an overview of the art movements and artworks sampled from each region, and Supplementary Figure 1 illustrates the coverage of 77 countries across continents (see also Supplementary Methods 1). Furthermore, the visual artwork samples were selected based on their likelihood to convey a wide range of aesthetic experiences found in studies of visual art<sup>22–24,31,32,41</sup>. Although different eras, regions, and countries could not be equally represented due to the limited availability of earlier artworks, the current collection is the richest and most inclusive stimulus set of visual artwork samples ever studied with regard to aesthetic experiences.

### **Aesthetic experience surveys**

Participants rated each artwork in terms of aesthetic emotions, aesthetic qualities, and overall aesthetic liking. The aesthetic experiences were derived from an extensive review of past studies of aesthetic responses to visual art, consumer products, and natural and built environments. We first created a comprehensive list of aesthetic experiences previously studied, removed duplicates and synonyms, and added aesthetic experiences of interest in emotion science (see Supplementary Table 1 for a full list of the source articles of the aesthetic experience surveys).



**Figure 1.** Cultural-historical eras represented in the artwork collection. Regions correspond to cultural-historical units rather than present-day countries. Time ranges from the Upper Paleolithic to the Contemporary Era. Red lines represent the period covered by significant art movements per region. Blue lines represent the period covered by our artwork collection per region. Numbers within brackets represent the number of artworks in our collection per region. BCE = Before Common Era. CE = Common Era.

Each participant viewed 28 randomly selected artworks for at least 8 seconds, before responding to the aesthetic experience survey questions. Participants were asked to choose the aesthetic emotions evoked by each artwork sample from 45 categories in response to the instructions “Select all emotions this artwork makes you feel”. The emotion categories were: Admiration, Adoration, Amusement, Anger, Anxiety, Awe, Boredom, Calmness, Chills, Compassion, Confusion, Connectedness, Contemplation, Craving, Cringe, Curiosity, Desire, Disgust, Distaste, Dread, Ecstasy, Empathic Pain, Entrancement, Excitement, Fascination, Fear, Feeling Moved, Gratitude, Grief, Harmony, Hope, Horror, Inspiration, Joy, Love, Nostalgia, Pride, Sadness, Serenity, Shame, Shudder, Surprise, Wonder, Tears, and Triumph.

Participants then rated the artwork in terms of aesthetic qualities from 58 categories in response to the instructions “Select all descriptions that apply to this artwork”. The categories of aesthetic qualities were: Absorbing, Absurd, Beautiful, Brooding, Cerebral, Chaotic, Charming, Cosmic, Crisp, Dark, Deviant, Disorienting, Disturbing, Dreamy, Dreary, Dynamic, Eerie, Elegant, Empowering, Expansive, Familiar, Far out, Funky, Glamorous, Grotesque, Humorous, Imposing, Impressive, Intimate, Intricate, Irreverent, Ironic, Lively, Majestic, Mystical, Mysterious, Ominous, Orderly, Ornate, Palpable, Peaceful, Perverse, Powerful, Provocative, Psychedelic, Rhythmic, Sensual, Spiritual, Strange, Striking, Sublime, Tense, Tragic, Unsettling, Vibrant, Violent, Whimsical, and Warm.

Finally, participants rated their overall aesthetic liking of each artwork in response to the question “On a 1-9 scale, how much do you like this artwork?” (1= “dislike a lot” to 9 = “like a lot”). Supplementary Figure 2 illustrates the surveys used to collect categorical judgments of aesthetic emotions and qualities, and ratings of aesthetic liking.

Based on past estimates of reliability of observer judgment<sup>29</sup>, for each visual artwork sample, we collected an average of 22.4 responses from separate participants. Participants made forced-choice categorical judgments of the 103 emotions and qualities, leading to a total of 254,519 categories selected. They also provided ratings of aesthetic liking, leading to a total of 32,604 ratings. Data were analyzed using custom code in Matlab.

## Results

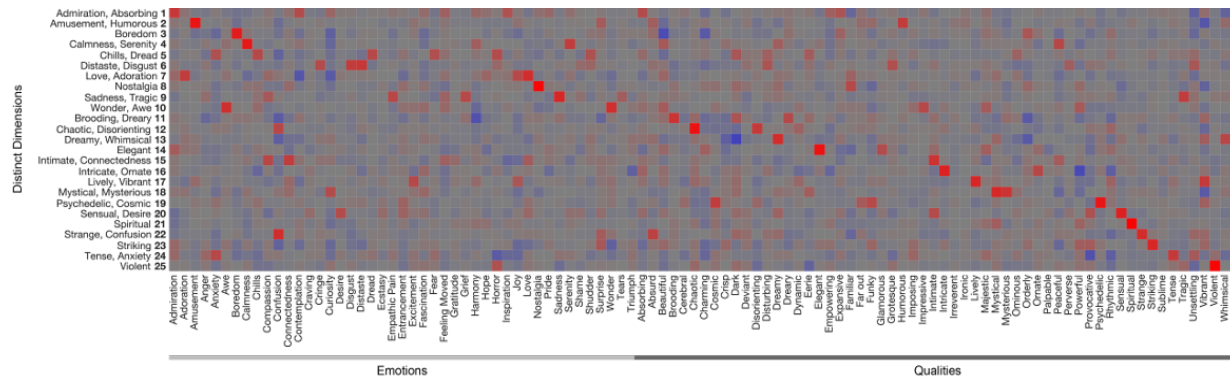
### **Dimensionality: Visual art evokes a high-dimensional space of aesthetic experience (hypothesis 1)**

Hypothesis 1 predicted that visual art would elicit a wide array of distinct dimensions of experience. To compute the number of distinct dimensions of aesthetic experience, previous research has applied traditional dimensionality reduction methods, such as PCA or factor analysis<sup>32</sup>. We depart from this analytical approach and instead use a principal preserved component analysis (PPCA), because traditional dimensionality reduction methods are ill-equipped to interrogate the semantic space of subjective experience for two reasons. First, they cannot identify whether an individual category (e.g., ‘fear’) is reliably distinguished from every other category (e.g., ‘horror’) because they test the number of significant factors based mostly on correlations or covariances between judgments, without considering the reliability of reports of individual items. Second, they do not explicitly separate signal from noise variance, because they assume that high variance components contain signal, whereas low variance components contain noise—an assumption that is not always valid<sup>42</sup>. In contrast, PPCA extracts linear combinations of attributes (here, judgments of aesthetic emotions and qualities), that maximally covary across two sets of data that measure the same attributes (here, randomly split judgments for each artwork). Thus, PPCA allows uncovering latent dimensions of experience that have high

agreement across raters (see Supplementary Methods 2-4 and Supplementary Movie 1 for details on PPCA).

We used a generalized version of PPCA to determine the number of dimensions (eigenvalue decomposition of the across-subject covariance matrix). We kept the dimensions that were both significant ( $p < .01$ ) and interpretable in our data, which was defined as  $>1/3$  of the variance being between artworks vs. between subjects. This yielded 25 dimensions that reliably differentiate the experiences evoked by a broad range of visual artworks, thereby providing support that the structure of aesthetic experiences is high-dimensional (see Figure 2 for a list of the 25 dimensions). These results depart from assumptions that visual art simply evokes core experiences of pleasure/displeasure or a limited array of basic emotions<sup>21,22,24,31,32,41</sup>.

Some of these dimensions have been consistently reported by previous studies of visual art, such as “sadness/tragic”, “violent”, “tense/anxiety”, “chills/dread”, “distaste/disgust”, “brooding/dreary”, “boredom”, “strange/confusion”, “striking”, “amusement”, “wonder/awe”, “admiration/absorbing”, and “calmness/serenity”<sup>22–24,31,32,41</sup>. However, several of the dimensions we found have not been documented in studies of visual art, including “chaotic/disorienting”, “mystical/mysterious”, “psychedelic/cosmic”, “lively/vibrant”, “sensual/desirous”, “spiritual”, “dreamy/whimsical”, “love/adoration”, “intimate/connectedness”, “nostalgia”, “intricate/ornate”, and “elegant”. Thus, aesthetic experiences elicited by visual art are widely diverse, often nuanced, and of mixed nature.



**Figure 2.** Twenty-five dimensions capturing dimensionality. Red indicates a positive association and blue a negative association.

### Conceptualization: Aesthetic emotions and aesthetic qualities separately predict aesthetic liking (hypothesis 2)

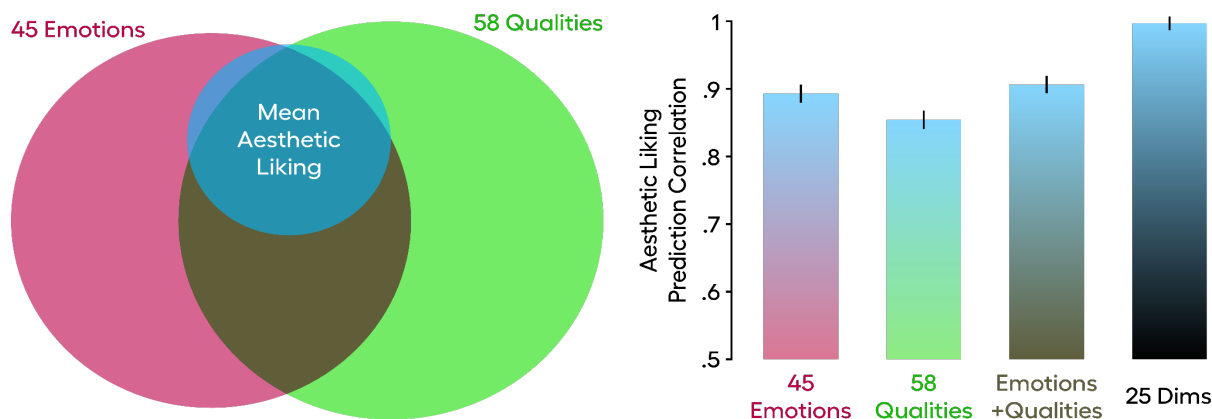
Hypothesis 2 predicted that aesthetic emotions and aesthetic qualities will both predict aesthetic liking of artworks (will be non-redundant). To explore the conceptualization of emotional experiences in response to visual art, we compared reports of 45 aesthetic emotions, 58 aesthetic qualities, and overall aesthetic liking.

First, we tested whether the 45 aesthetic emotions and 58 aesthetic qualities were non-redundant; could one set of judgments be entirely explained by the other? Using nonlinear regression ( $k$ -nearest neighbors) we predicted the aesthetic quality judgments from the aesthetic emotion judgments, and vice versa, finding that each could explain less than half of the explainable variance in the other ( $r^2 = .49$  [ $SE = .01$ , bootstrap] in emotions explained by qualities;  $r^2 = .44$  [ $SE = .01$ , bootstrap] in qualities explained by emotions; Figure 3, left panel). Thus,

viewers' experiences of aesthetic emotion and the qualities they perceive in works of visual art are related yet not redundant processes<sup>43</sup>.

Second, we explored whether aesthetic liking could be predicted by aesthetic emotions, aesthetic qualities, or a combination of both using nonlinear regression. Aesthetic emotion judgments predicted liking with a correlation of  $r=.89$  ( $SE=.011$ , bootstrap), aesthetic quality judgments with  $r=.85$  ( $SE=.014$ , bootstrap), and all emotion and quality judgments together with  $r=.91$  ( $SE=.011$ , bootstrap). However, by first extracting the reliable dimensions from both aesthetic emotion and aesthetic quality judgments using PPCA, then using the 25 resulting dimensions to predict aesthetic liking (a means to prevent overfitting), we achieved a correlation of  $r=.99$  ( $SE=.0068$ , bootstrap; Figure 3, right panel). The relative degree of these correlations demonstrates that the 25 dimensions (that combine emotions and qualities) predict aesthetic liking better than either the 45 emotion judgments, the 58 quality judgments, or all 103 judgments together. Thus, aesthetic emotions and qualities had an overlapping but distinct role in predicting participants' liking of an artwork.

Together, these findings suggest that we conceptualize our experiences in response to art not only in terms of emotion concepts (awe, fear, serenity) but also in terms of complex aesthetic qualities of the visual art (mystical, striking, disorienting). These findings also confirm that the 25 dimensions extracted through PPCA capture the aesthetic experiences evoked by visual art with high fidelity.



**Figure 3.** Aesthetic liking as a function of aesthetic emotions, aesthetic qualities, and the 25 dimensions. 45 aesthetic emotions and 58 aesthetic qualities have distinct but overlapping roles in predicting aesthetic liking. Along with aesthetic emotion and aesthetic quality judgments, participants reported overall aesthetic liking. Aesthetic emotion judgments were used to predict aesthetic quality judgments, and vice versa (left panel). Aesthetic emotion judgments, aesthetic quality judgments, the combination of emotion and quality judgments, and the 25 dimensions extracted from PPCA were separately used to predict mean aesthetic liking (right panel).

### **Distribution: Aesthetic experiences lie along continuous gradients rather than within discrete clusters (hypothesis 3)**

Hypothesis 3 predicted that categories of experience evoked by visual art will lie along continuous gradients<sup>28</sup>. To explore the distribution of aesthetic experiences, we generated a chromatic map of the scores of each of the 1,457 visual artworks within the 25-dimensional space derived from PPCA using t-distributed stochastic neighbor embedding (t-SNE)<sup>44</sup>. t-SNE is

a method that preserves local distances between data points while separating more distinct data points by longer distances. Thus, t-SNE naturally groups visual artworks that convey similar experiences and can capture smooth, continuous variations within the 25-dimensional space despite being limited to two dimensions. The resulting map consists of spatial coordinates and colors for each artwork (see Figure 4 and its interactive version <https://barradeau.com/2021/emotions-map/>). To generate coordinates for each artwork, t-SNE was applied 100 times to the data matrix, using default Matlab settings (1,000 iterations, perplexity = 30, learning rate = 500, theta = 0.5), and the map with the lowest loss (Kullback-Leibler divergence) was further refined through an additional 1,000 iterations for fine-tuning purposes. Of course, some information is lost in this process—this is why it is important to simultaneously view a second, independent channel of information, conveyed through the color assigned to each artwork. The color assigned to each artwork corresponds to a weighted average of the unique colors representing its top three scores on the 25 categorical judgment dimensions, unless fewer than 3 categories would be frequently selected for a given artwork.

The combined color representations and structure of the map reveal the smooth gradients that traverse many categories, such as the gradients between “love/adoration” and “calmness/serenity” or “distaste/disgust” and “chills/dread”. Replicating recent studies of experiences evoked by music and GIFs, and representations of emotion in the face, body, and prosody<sup>26,29,45</sup>, the experiences evoked by visual art lie along continuous gradients between categories rather than within discrete clusters. These gradients are evident when we visualize smooth variations in the categorical judgment profiles of the 1,457 visual artwork samples in the interactive version of the map. Critically, not all categories of aesthetic experience can be evoked simultaneously by a visual artwork sample. Aesthetic experiences are blended in a systematic rather than random fashion (e.g., no visual artwork sample was categorized as both “distasteful” and “adorable”). Thus, the feelings associated with visual art are neither entirely discrete nor arbitrarily blended but rather are distributed along specific gradients of aesthetic experience, which can be modeled using appropriate analysis methods (see Supplementary Methods 5 for details on t-SNE).



|                 |                 |                 |                        |                        |
|-----------------|-----------------|-----------------|------------------------|------------------------|
|                 | Disappointment* | Disappointment* | —                      | —                      |
|                 | —               | Shame           | —                      | —                      |
|                 | —               | Doubt           | —                      | —                      |
|                 | —               | —               | Boredom                | Boredom                |
|                 | —               | —               | —                      | Brooding/Dreary        |
|                 | —               | —               | —                      | Chaotic/Disorienting   |
| <b>Positive</b> | Amusement       | Amusement       | Amusement              | Amusement              |
|                 | Desire          | Desire          | Sexual Desire          | Sensual/Desirous       |
|                 |                 |                 | Craving                |                        |
|                 | Adoration       | Love            | Adoration              | Love/Adoration         |
|                 |                 |                 | Romance                | Intimate/Connectedness |
|                 | Awe             | Awe             | Awe                    | Wonder/Awe             |
|                 |                 |                 | Admiration             | Admiration/Absorbing   |
|                 | Interest        | Interest        | Interest               |                        |
|                 | Surprise        | Surprise        | Surprise               | Striking               |
|                 | Elation         | Elation         | Joy                    | —                      |
|                 | Ecstasy         | Ecstasy         | Excitement             | —                      |
|                 | Relief*         | Relief*         | Relief*                | —                      |
|                 | Contentment*    | Contentment*    | Satisfaction*          | —                      |
|                 | Realization*    | Realization*    | —                      | —                      |
|                 | Sympathy        | Sympathy        | —                      | —                      |
|                 | Triumph         | Triumph         | —                      | —                      |
|                 | —               | Pride           | —                      | —                      |
|                 | —               | Concentration   | —                      | —                      |
|                 | —               | Contemplation   | Entrancement           | —                      |
|                 | —               | —               | Aesthetic Appreciation | —                      |
|                 | —               | —               | Nostalgia              | Nostalgia              |
|                 | —               | —               | Calmness               | Calmness/Serenity      |

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|   |   |   |                     |
|---|---|---|---------------------|
| — | — | — | Mystical/Mysterious |
| — | — | — | Psychedelic/Cosmic  |
| — | — | — | Lively/Vibrant      |
| — | — | — | Spiritual           |
| — | — | — | Dreamy/Whimsical    |
| — | — | — | Intricate/Ornate    |
| — | — | — | Elegant             |

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\* These emotions were not included in the current study because they did not emerge as distinct categories in previous studies of aesthetic experiences (see Supplementary Table 1).

### **End of Manuscript Material Conclusion**

In the presented manuscript, my co-authors and I found evidence for diverse and multi-dimensional emotional and aesthetic experiences of visual art. While these findings were robust and deepened my understanding of aesthetic experiences of visual art in general, they did not fully address why these responses occur. Ultimately, this initial work laid the foundation for my investigation of potential underlying correlates of aesthetic responses, such as those observed in the presented manuscript. While many facets of visual art could explain some variance in aesthetic responses, I focused this line of inquiry on the perceived thematic content of visual artworks. In Study 3, I examined the perception of moral content within visual art and how this related to individual moral beliefs and aesthetic responses, using a subset of visual artworks from the dataset constructed for the original manuscript.

#### **STUDY 4 – Morality and Visual Art**

Current literature on visual art is limited by a yet to be seen investigation into the presence and, importantly, *perception* of thematic content within artworks. The ways in which thematic content correlates with emotional and aesthetic responses are largely missing from this work so far. Moreover, another key piece which requires further investigation is the role of identity of the viewer in experiences of visual art.

Previous work importantly supports that the emotional experience of art is robust and high dimensional (Silvia, 2005; Stamkou, 2024). Very few studies examine the effect that visual art has on identity or the inverse, how identity affects interactions with visual art (Newman et al., 2012; Van Eijck, 2012; Bao et al., 2016). When encountering an artwork, the viewer evaluates formal elements such as line, color, and shape, and content, as well as the subject of the artwork, or what is depicted. These evaluations, however, do not occur in a vacuum; viewers bring their lived histories, personal traits, and identities along with them to the experience of art. To this end, who the viewer of the art is should inform the extent to which they perceive thematic content within visual art, especially when it is more ambiguous thematic content such as moral virtues or violations, and how much this affects their aesthetic response.

In the current study, I aim to extend the work on how facets of personal identity affect aesthetic experiences by focusing on moral foundations, a core set of beliefs about what is right and virtuous which has been linked to political and religious identities (Sutton et al., 2020; Van Tongeren et al., 2021; even earning its own distinction of moral identity; Smith et al., 2014;

Dawson et al., 2021) and examining the effects on perception of moral content within artworks and subsequent aesthetic responses. I tested the following hypotheses:

1. Participants will perceive the presence of moral content within the presented visual artworks.
2. Participants' moral beliefs (scores on MFQ) will predict whether they perceive the presence of moral content in artworks.
3. Participants will report stronger aesthetic responses to artworks which are perceived to contain moral content.
4. Participants with extreme (high, +2 SD, or low, -2 SD) scores on MFQ would demonstrate significant differences in aesthetic responses to artworks.

## **Method**

### **Participants**

Participants were invited to participate in a study through Prolific. They were compensated at a rate of 10 USD per hour for their participation. The total N used for analyses was 289 ( $M_{age}=45$ ,  $SD_{age}=15.8$ ). Reported gender identity of participants is as follows: 51% female, 49% male. Reported ethnicity of participants is as follows: 64% White/Caucasian, 16% Black/African American, 8% Asian, 9% Latinx, 3% Native American.

### **Procedure**

In preparation for the study, I selected 375 artworks from an existing dataset of 1500 artworks (Stamkou et al., 2024) organized by genre, artist, region, artistic movement, and theme. In order to reduce the number of artworks for use in the current study, I focused on artworks containing themes which were most likely to contain sentient beings (humans or animal-like beings). The themes are as follows: everyday life, death/adversity, absurd/deviant, religious, and military/war. From this reduced pool of 800 paintings, the subset of artworks to be used in the study were randomly selected.

Participants completed the study survey via Qualtrics. In the artwork viewing portion of the survey, 25 randomly selected artworks from the set of 375 were shown to participants. For each individual artwork shown, participants answered a set of questions about moral content within the artwork and their aesthetic experience of the artwork. After the testing phase, participants answered questions about their moral beliefs, experiences with art, personality, and cultural orientation, followed by demographics (ethnicity, age). Following the survey, their completion of the study survey was verified and they received compensation via Prolific.

### **Measures**

#### *Moral foundations.*

Moral foundations were measured using the entire Moral Foundations Questionnaire (MFQ; Graham et al., 2008) on a 1 (*Not at all relevant (This consideration has nothing to do with my judgments of right and wrong)*, *Strongly disagree*) to 5 (*Extremely relevant (This is one of the most important factors when I judge right and wrong)*, *Strongly agree*) scale.

#### *Moral content in visual art.*

To assess perception of moral content in visual art, participants were asked to select all that apply from a list of items derived from the moral foundations as part of the artwork viewing portion of the study (see Table 1). In order to contend with the factors of moral foundations theory (Graham et al., 2013) being paired based on contrasting constructs (e.g., harm vs care, liberty vs oppression), half of the sample was presented with positive-keyed options and the other half with negative-keyed options. The positive-keyed options are as follows: care, fairness, equality, loyalty, respect for authority, purity, sacred, liberty, justice, benevolence, and

obedience. The negative-keyed options are as follows: harm, unfairness, inequality, betrayal, disrespect for authority, profane, sacrilegious, oppression, injustice, malevolence, and subversion. All of the options were presented and participants were asked to click the box next to all of those which they felt applied to the artwork they were viewing.

#### *Aesthetic responses to artworks.*

Aesthetic responses to the artworks were assessed using the following questions: “How much do you like the artwork?” (to assess liking), “How interesting do you find the artwork?” (to assess interest), “How much aesthetic value do you feel this artwork has?” (to assess aesthetic value), “How emotionally touched were you by this artwork?”, “How moved were you by this artwork?” (to assess embodied states; Pelowski et al., 2017), and “How likely would you be to recommend this artwork to be featured in an exhibition at the Guggenheim museum?” (to assess behavior) on a 1 (*Not at all*) to 9 (*Very much so*) scale, as part of the artwork viewing portion of the study.

#### *Art experiences.*

Prior experience with art was assessed using the Vienna Art Interest and Art Knowledge questionnaire (VAIAK; Specker et al., 2020). Items in this scale encompass interest in art, “I enjoy talking about art with others”, arts background, “I come from a family that is interested in art”, and art behaviors, “How often do you visit art museums or art galleries on average?” and were rated on a 1 (*Not at all, Less than once per year*) to 7 (*Very much so, Once per week or more often*) scale.

#### *Personality.*

Personality was assessed using the open-mindedness domain scale from the Big Five Inventory-2 (BFI-2; Soto & John, 2017) and the entirety of the Big Five Inventory-2-Extra Short Form (BFI-2-XS; Soto & John, 2017) on a 1 (*Disagree strongly*) to 5 (*Agree strongly*) scale.

#### *Cultural orientation.*

Cultural orientation was measured using the Cultural Orientation Scale (COS; Sharma, 2010) on a 1 (*Never; definitely no*) to 9 (*Always; definitely yes*) scale.

## **Results**

### **Descriptive results**

To assess participants’ moral beliefs, they completed the Moral Foundations Questionnaire (MFQ). Descriptive statistics for MFQ scores showed that participants scored highest on the Harm/Care foundation ( $M = 22.39$ ,  $SD = 4.59$ ), followed by Fairness/Reciprocity ( $M = 21.05$ ,  $SD = 4.37$ ), Liberty/Oppression ( $M = 19.18$ ,  $SD = 4.62$ ), Authority/Respect ( $M = 16.70$ ,  $SD = 5.80$ ), Purity/Sanctity ( $M = 15.62$ ,  $SD = 7.41$ ), and In-group-Loyalty ( $M = 13.98$ ,  $SD = 5.79$ ). Full descriptive statistics for participants’ scores on the Moral Foundations Questionnaire are reported in Table 2. The distributions of participants’ scores on the Moral Foundations Questionnaire are depicted in Figure 2.

To assess participants’ aesthetic responses to the artworks, they answered the following questions: “How much do you like the artwork?”, “How interesting do you find the artwork?”, “How much aesthetic value do you feel this artwork has?”, “How emotionally touched were you by this artwork?”, “How moved were you by this artwork?”, and “How likely would you be to recommend this artwork to be featured in an exhibition at the Guggenheim museum?”. Full descriptive statistics for participants’ aesthetic responses are reported in Table 3.

### **Perception of Moral Content in Visual Art**

In hypothesis 1, I tested the manipulation of presenting participants with artworks which were intended to contain moral content (through use of specific content themes in the selection

of the artworks). I expected that participants would perceive moral content within visual artworks by assigning moral categorizations to the artworks presented in the survey, as opposed to selecting the “None of the above apply to this artwork” option. Across all responses to artworks given, 57.34% of responses included at least 1 moral categorization and 42.66% of responses consisted solely of “None of the above apply to this artwork.”

I also examined the perception of specific moral content corresponding to the moral foundations from the MFQ. Table 4 shows the frequency of moral foundations identified in the artwork responses. Count refers to the number of times the moral foundation was selected during the artwork viewing portion of the study such that each moral foundation is counted once per participant, regardless of multiple responses potentially given to the same foundation. This is to correct for the uneven number of items displayed relevant to the moral foundations (see Table 1 for full list of items utilized for the artwork viewing task). The percentages represent the proportion of all moral categorizations that fall into each foundation.

### **Moral beliefs and perception of moral content**

In hypothesis 2, I expected that participants’ moral beliefs would predict whether they perceive moral content in artworks. To test this hypothesis, I conducted logistic regression models utilizing scores on the MFQ as the predictor variable and presence of the corresponding moral category in the artworks (on a binary where 0 = no moral items in this categorization selected and 1 = at least one moral categorization selected) as the outcome variable; such that, for example, scores on the Harm/Care section of the MFQ predicted the presence of Harm/Care categorizations in response to artworks (Table 1). The hypothesis was partially supported. Three out of the six models demonstrated the expected relationship: In-group Loyalty ( $\beta = 0.0314$ ,  $OR = 1.03$ ,  $p < .001$ ), Authority ( $\beta = 0.0222$ ,  $OR = 1.02$ ,  $p < .001$ ), and Purity ( $\beta = 0.0201$ ,  $OR = 1.02$ ,  $p < .001$ ), indicating that higher scores on these foundations were associated with increased odds of perceiving corresponding moral content in artworks. The remaining three models were non-significant (see Table 5).

### **Moral beliefs and aesthetic responses to visual art**

In hypothesis 3, I expected that participants’ moral beliefs would affect their aesthetic responses such that participants with extreme (high, +2 SD, or low, -2 SD) scores on MFQ would demonstrate significant differences in aesthetic responses to the artworks. To test this hypothesis, I conducted independent T-tests comparing groups of low versus high scorers on each of the moral foundations on their aesthetic response scores. Participants did not report high scores on two out of the six moral foundations (Harm/Care and Purity/Sanctity) and thus were not included in the analyses (see Table 9). The hypothesis was partially supported. High scorers on Fairness/Reciprocity and Authority/Respect reported significantly greater aesthetic responses to artworks across all metrics, on average, compared to low scorers. High scorers on In-group Loyalty reported significantly greater aesthetic responses to artworks across all metrics except aesthetic value. Low scorers on Liberty/Oppression reported significantly lower aesthetic responses to artworks across all metrics except behavior. Overall, these results tend to support the effect of MFQ scores on aesthetic responses to the artworks presented in the survey.

### **Perception of Moral Content and Aesthetic Responses**

In hypothesis 4, I expected artworks that evoke moral categories to elicit stronger aesthetic responses. By examining the mean responses to the aesthetic response items (liking, interest, aesthetic value), it was revealed that artworks perceived to contain moral content received higher ratings compared to artworks without any moral associations. The embodied responses (feeling emotionally touched and being moved) demonstrated the largest differences

(see Table 7). To test whether these differences were statistically significant, I conducted Linear Mixed Effects Models due to the nested nature of the data wherein participants viewed multiple artworks and the artworks were potentially viewed by multiple participants. The models included random intercepts for participant and artwork to account for participant-level and artwork-level variance, which allows us to examine the fixed effect of perceived moral presence on aesthetic responses. Results from these analyses indicate that artworks which were perceived as containing moral content received significantly higher ratings on aesthetic response items, except aesthetic value, when compared to artworks which were not perceived to contain moral content (see Figure 3 for visualization; see Table 8 for full statistics).

### **Discussion**

In Study 4, I investigated individuals' perceptions of moral content within visual art and how this interacted with their own moral beliefs and aesthetic experiences. To understand how moral beliefs influence perception of moral content within artworks, I conducted a cross-sectional study where participants were asked to complete the Moral Foundations Questionnaire (MFQ; Graham et al., 2013) and complete an artwork viewing task where they viewed 25 randomly selected artworks and identified whether or not moral categorizations corresponding to the six moral foundations were applicable to the artwork. Participants also answered questions about their aesthetic experience of the artworks (liking, interest, aesthetic value, behavior, and embodied states). I expected that moral beliefs would interact with both the perception of moral content in artworks and aesthetic responses to artworks.

Across all responses to artworks in this study, a slight majority included at least one moral categorization, suggesting that participants were, to some extent, able to perceive moral content in the artworks. With this foundation in place, analyses revealed that participants' moral beliefs significantly predicted whether they perceive moral content in artworks, in relation to the moral foundations of In-group Loyalty, Authority, and Purity. These findings suggest that when people endorse some moral foundations more strongly, they are significantly more likely to perceive related moral content in artworks. The remaining three moral foundations (Harm/Care, Fairness/Reciprocity, and Liberty/Oppression) did not demonstrate the same relationships which may warrant further research into the granular nature of moral beliefs such that these three foundations may not be as readily identifiable in external stimuli regardless of endorsement of those beliefs.

Furthermore, the current study provided evidence that morality can be linked to aesthetic responses, in two ways. First, results revealed that artworks which were perceived to contain moral content were more highly rated in terms of aesthetic response than those which were not perceived to contain moral content, on average. This was especially true of the embodied responses (feeling touched and moved), which showed the largest difference between moral and non-moral artworks, suggesting that moral content particularly affects this type of emotional engagement. Second, when comparing participants with extremely high or low scores on certain foundations (Fairness/Reciprocity, In-group Loyalty, Authority/Respect) there was a consistent pattern such that participants with higher scores reported greater aesthetic responses to artworks, in general. It is interesting to note that the opposite relationship emerged for the Liberty/Oppression foundation where low scoring participants demonstrated greater aesthetic responses to artworks.

It is plausible based on prior research that experiences of visual art, and art in general, can be shaped by the multiple collective and personal identities and complex belief systems held by the viewer. The current study supports this notion by demonstrating the relationships between

one's own moral beliefs and how they perceive and experience visual art. Moreover, it is important to consider the viewers' perceptions of the thematic content portrayed in visual art, how salient certain themes may be to viewers, whether intentional or not, and the potentially very powerful impact on their overall experience of virtual art.

## Figure 1

*Sample artworks with greatest perceived moral content.*



*Note.* Top left: Massacre of the Innocents, 1565-67, Pieter Bruegel the Elder; Top right: The Anger of Achilles, 1819, Jacques-Louis David; Bottom left: Requiescat, 1888, Briton Rivière; Bottom right: The Hunted Slaves, 1861, Richard Ansdell

**Table 1***Moral foundations and corresponding items utilized for artwork viewing task.*

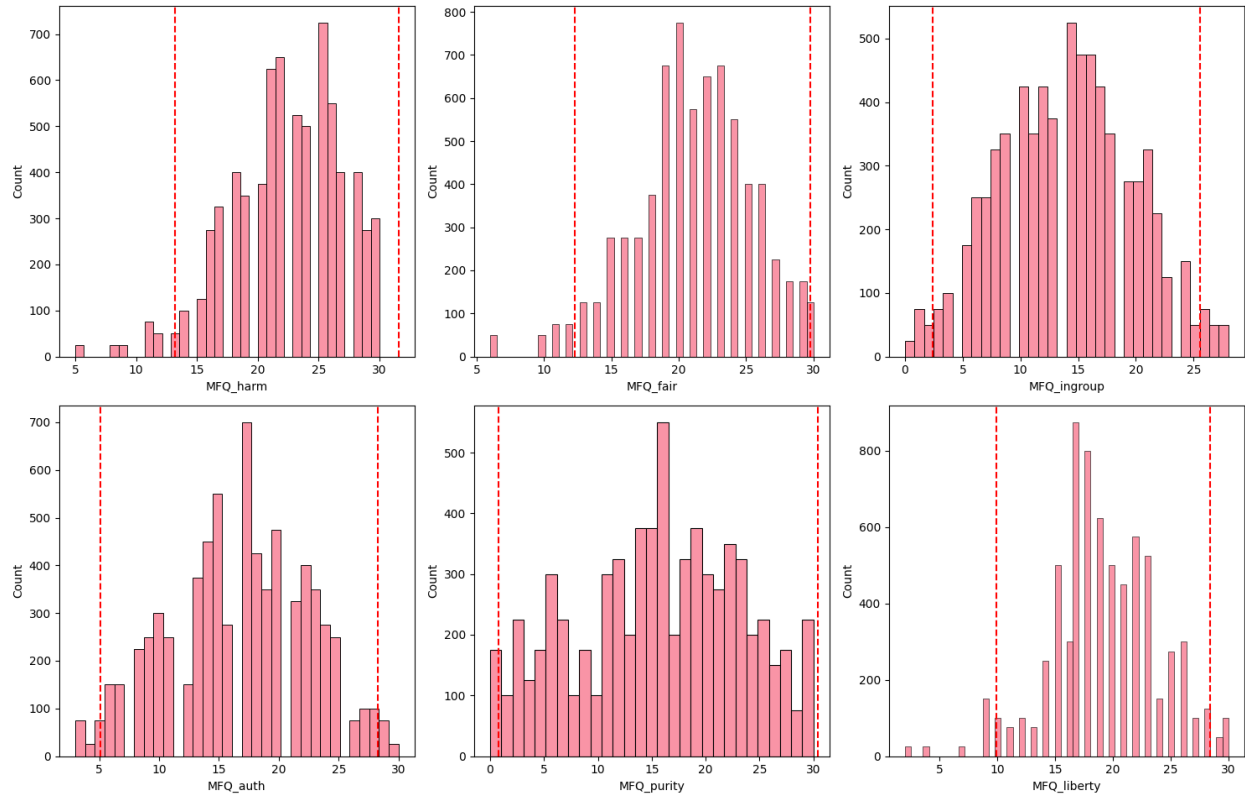
| Foundation           | Positive-keyed items                | Negative-keyed items                    |
|----------------------|-------------------------------------|-----------------------------------------|
| In-group-Loyalty     | Loyalty                             | Betrayal                                |
| Liberty/Oppression   | Liberty                             | Oppression                              |
| Harm/Care            | Care, Benevolence                   | Harm, Malevolence                       |
| Authority/Respect    | Respect for Authority,<br>Obedience | Disrespect for Authority,<br>Subversion |
| Purity/Sanctity      | Purity, Sacred                      | Profane, Sacrilegious                   |
| Fairness/Reciprocity | Fairness, Justice, Equality         | Unfairness, Injustice, Inequality       |

**Table 2***Descriptive statistics for scores on the Moral Foundations Questionnaire (MFQ).*

| Scores on MFQ  | Harm<br>/Care | Fairness<br>/Reciprocity | In-group<br>-Loyalty | Authority<br>/Respect | Purity<br>/Sanctity | Liberty<br>/Oppression |
|----------------|---------------|--------------------------|----------------------|-----------------------|---------------------|------------------------|
| Mean           | 22.39         | 21.05                    | 13.98                | 16.7                  | 15.62               | 19.18                  |
| Median         | 23.00         | 21.00                    | 14.00                | 17.0                  | 16.00               | 19.00                  |
| Std. Deviation | 4.59          | 4.37                     | 5.79                 | 5.8                   | 7.41                | 4.62                   |

**Figure 2**

*Distributions of Moral Foundation Questionnaire scores by foundation.*



*Note.* Distributions of scores are depicted according to individual moral foundations as follows: Harm/Care, Fairness/Reciprocity, In-group-Loyalty, Authority/Respect, Purity/Sanctity, and Liberty/Oppression. The red dashed lines depict the 95% confidence intervals for each set of scores.

**Table 3**

*Descriptive statistics for aesthetic responses across artworks.*

|                | Liking | Interest | Aesthetic Value | Behavior | Embodied: Touched | Embodied: Moved |
|----------------|--------|----------|-----------------|----------|-------------------|-----------------|
| Mean           | 5.40   | 5.51     | 5.92            | 5.47     | 3.77              | 3.74            |
| Median         | 6.00   | 6.00     | 6.00            | 6.00     | 3.00              | 3.00            |
| Std. Deviation | 2.30   | 2.28     | 2.17            | 2.46     | 2.40              | 2.46            |

**Table 4***Counts and percentages of Moral Foundation Questionnaire scores.*

| Foundation           | Count | Percentage |
|----------------------|-------|------------|
| Harm/Care            | 1763  | 24.40%     |
| Fairness/Reciprocity | 1575  | 21.80%     |
| Purity/Sanctity      | 1386  | 19.18%     |
| Authority/Respect    | 1170  | 16.19%     |
| Liberty/Oppression   | 1004  | 13.90%     |
| In-group-Loyalty     | 825   | 11.42%     |

*Note.* The sum is approximately 107% due to some responses identifying multiple moral foundations in a single artwork.

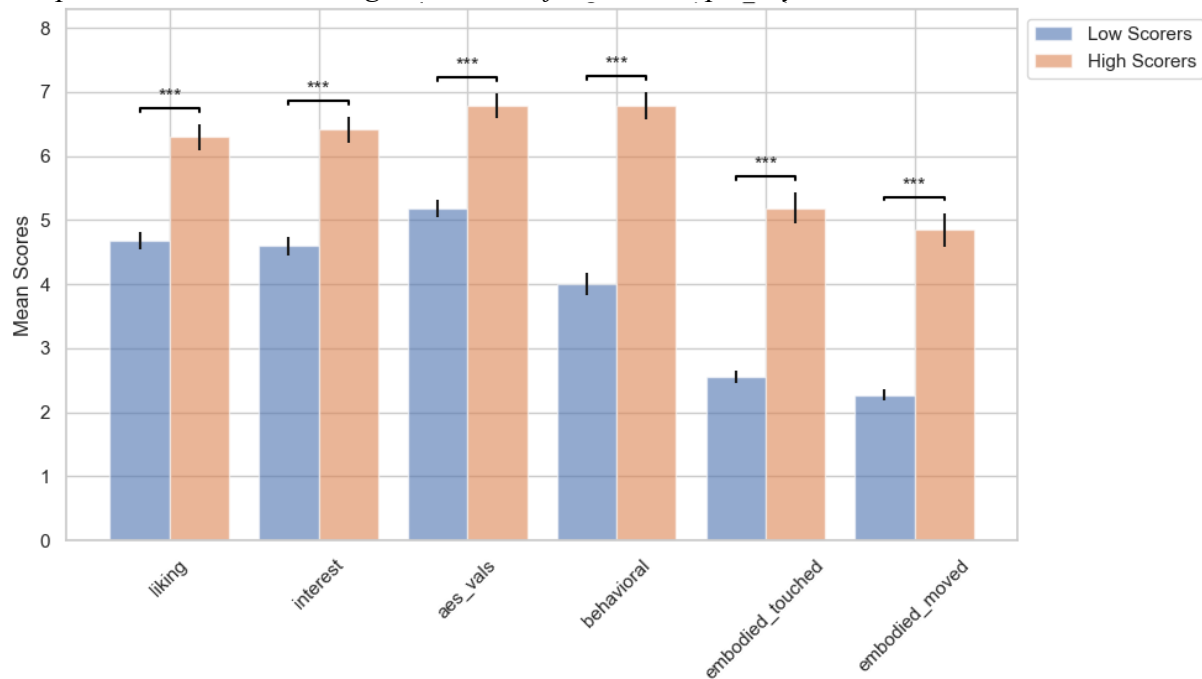
**Table 5***Logistic regression results predicting perception of moral foundation from own moral beliefs.*

| Foundation           | Estimate | SE    | z      | p-val  | 95% CI          |
|----------------------|----------|-------|--------|--------|-----------------|
| Harm/Care            | 0.007    | 0.006 | 1.154  | .249   | [-0.005, 0.019] |
| Fairness/Reciprocity | -0.002   | 0.007 | -0.259 | .796   | [-0.015, 0.011] |
| In-group-Loyalty***  | 0.031    | 0.006 | 4.871  | < .001 | [0.019, 0.044]  |
| Authority/Respect*** | 0.022    | 0.006 | 3.994  | < .001 | [0.011, 0.033]  |
| Purity/Sanctity***   | 0.020    | 0.004 | 4.867  | < .001 | [0.012, 0.028]  |
| Liberty/Oppression   | -0.001   | 0.007 | -0.066 | .948   | [-0.015, 0.014] |

\*\*\* p < .001 \*\* p < .01 \* p < .05 *Note.* Logistic regression models utilized scores on the MFQ as the predictor variable and presence of the corresponding moral category in the artworks (on a binary where 0 = no moral items in this categorization selected and 1 = at least one moral categorization selected) as the outcome variable; such that, for example, scores on the Harm/Care section of the MFQ predicted the presence of Harm/Care categorizations in response to artworks.

**Table 6***Counts of Extreme Scores on Moral Foundations Questionnaire.*

| Foundation           | Low Scores (-2 SD) | High Scores (+2 SD) | Total Extreme Scores |
|----------------------|--------------------|---------------------|----------------------|
| Harm/Care            | 250                | 0                   | 250                  |
| Fairness/Reciprocity | 250                | 125                 | 375                  |
| In-group-Loyalty     | 150                | 175                 | 325                  |
| Authority/Respect    | 175                | 100                 | 275                  |
| Purity/Sanctity      | 75                 | 0                   | 75                   |
| Liberty/Oppression   | 225                | 150                 | 375                  |

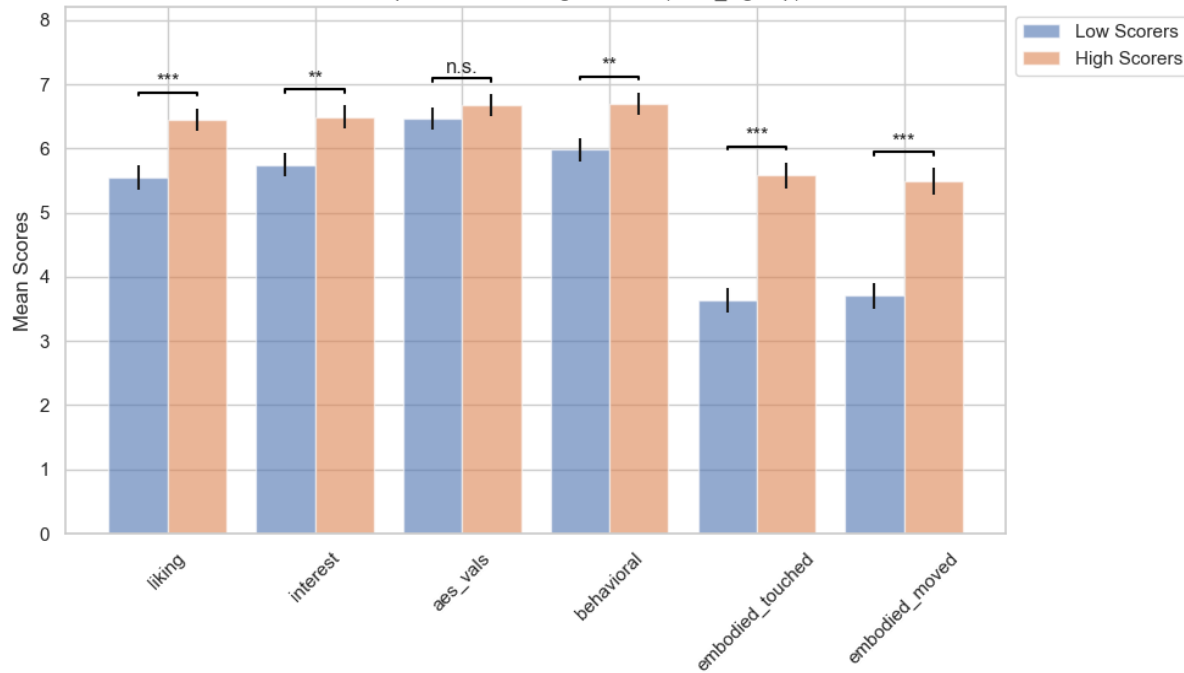
**Figure 3***Independent t-tests low vs high scorers on fairness/reciprocity.*

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$  Note. Low and high scorers were determined by taking the mean score for the fairness/reciprocity foundation and calculating scores which were plus or minus 2 standard deviations from the mean. Mean scores for the aesthetic responses of low scorers are depicted in blue and in orange for high scorers.

**Table 7***Independent t-tests low vs high scorers on fairness/reciprocity.*

| Aesthetic response   | $\Delta M$ | SE    | t-stat  | p-val  | 95% CI       |
|----------------------|------------|-------|---------|--------|--------------|
| Liking***            | 1.620      | 0.240 | -6.787  | < .001 | [1.15, 2.09] |
| Interest***          | 1.816      | 0.245 | -7.447  | < .001 | [1.34, 2.30] |
| Aesthetic value***   | 1.612      | 0.235 | -6.859  | < .001 | [1.15, 2.07] |
| Behavior***          | 2.776      | 0.277 | -9.523  | < .001 | [2.23, 3.32] |
| Embodied: touched*** | 2.628      | 0.263 | -11.774 | < .001 | [2.11, 3.14] |
| Embodied: moved***   | 2.580      | 0.278 | -11.403 | < .001 | [2.04, 3.12] |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

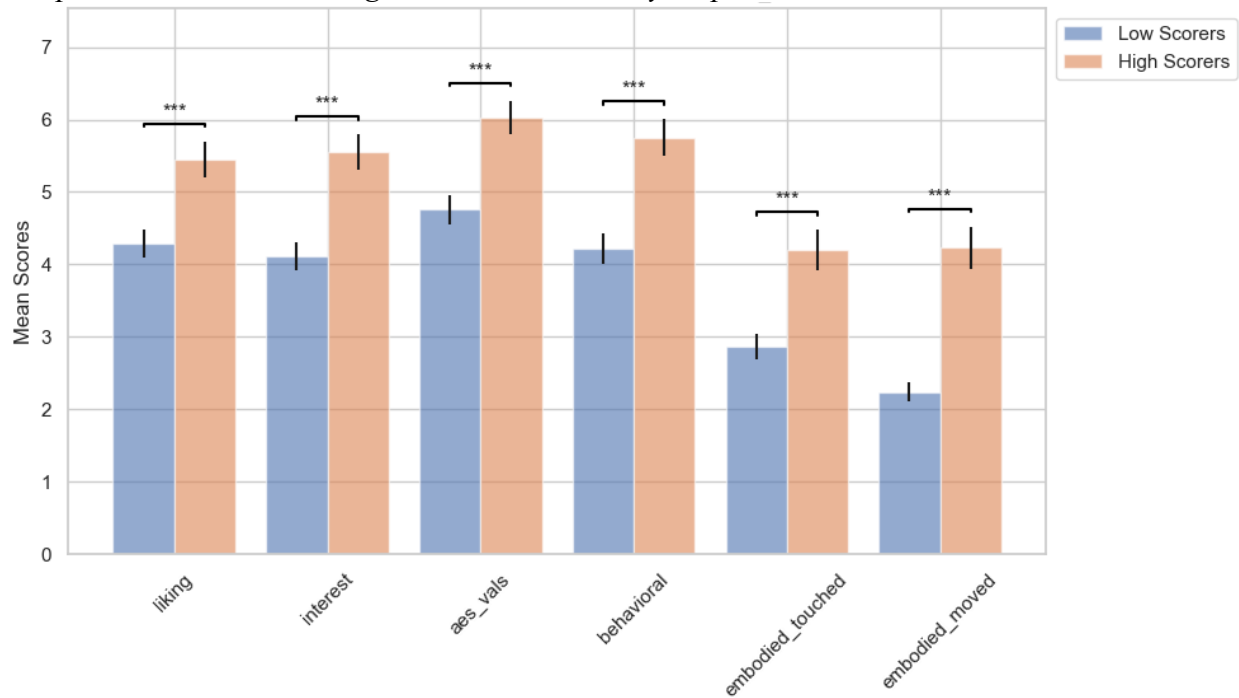
**Figure 4***Independent t-tests low vs high scorers on in-group-loyalty.*

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$  *Note.* Low and high scorers were determined by taking the mean score for the in-group-loyalty foundation and calculating scores which were plus or minus 2 standard deviations from the mean. Mean scores for the aesthetic responses of low scorers are depicted in blue and in orange for high scorers.

**Table 8***Independent t-tests low vs high scorers on in-group-loyalty.*

| Aesthetic response | $\Delta M$ | SE    | t-stat | $p$  | 95% CI        |
|--------------------|------------|-------|--------|------|---------------|
| Liking             | 0.892      | 0.258 | -3.465 | .001 | [0.39, 1.40]  |
| Interest           | 0.745      | 0.253 | -2.933 | .004 | [0.25, 1.24]  |
| Aesthetic value    | 0.202      | 0.245 | -0.823 | .411 | [-0.28, 0.68] |
| Behavior           | 0.717      | 0.257 | -2.785 | .006 | [0.21, 1.22]  |
| Embodied: touched  | 1.937      | 0.280 | -6.829 | .001 | [1.39, 2.49]  |
| Embodied: moved    | 1.779      | 0.286 | -6.162 | .001 | [1.22, 2.34]  |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

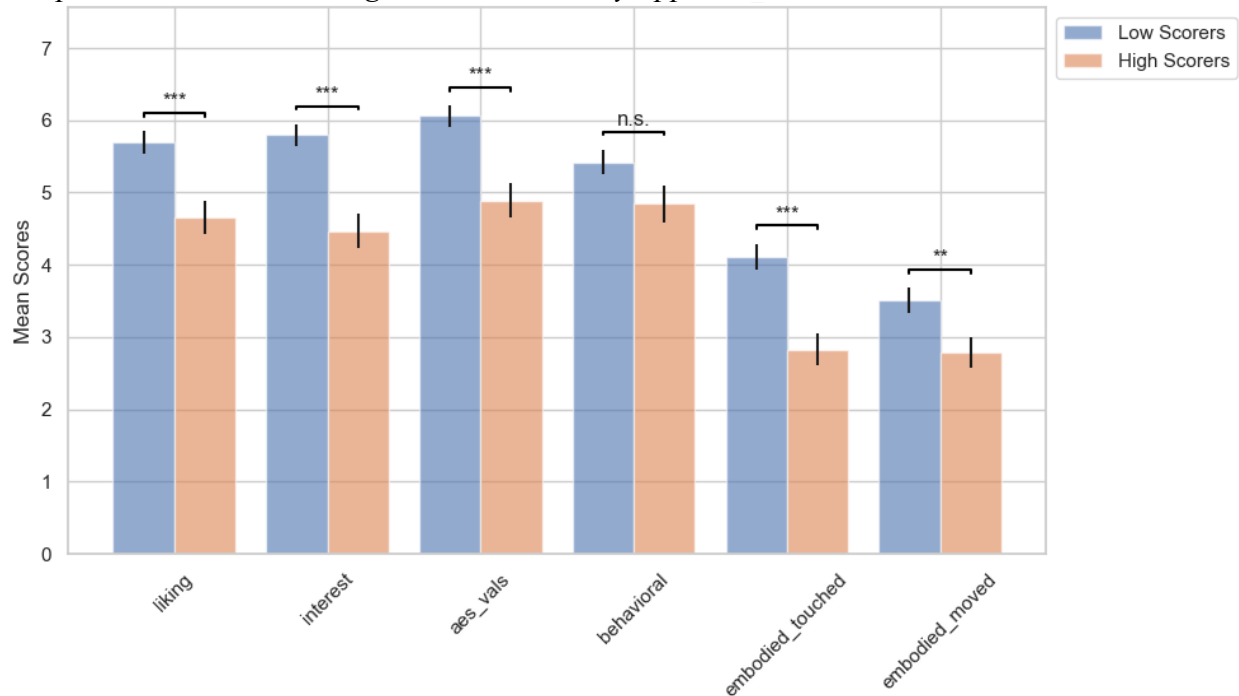
**Figure 5***Independent t-tests low vs high scorers on authority/respect.*

\*\*\* p < .001 \*\* p < .01 \* p < .05 *Note.* Low and high scorers were determined by taking the mean score for the authority/respect foundation and calculating scores which were plus or minus 2 standard deviations from the mean. Mean scores for the aesthetic responses of low scorers are depicted in blue and in orange for high scorers.

**Table 9***Independent t-tests low vs high scorers on authority/respect.*

| Aesthetic response | $\Delta M$ | SE    | t-stat | p-val  | 95% CI       |
|--------------------|------------|-------|--------|--------|--------------|
| Liking             | 1.159      | 0.312 | -3.673 | < .001 | [0.55, 1.77] |
| Interest           | 1.436      | 0.309 | -4.586 | < .001 | [0.83, 2.04] |
| Aesthetic value    | 1.276      | 0.308 | -3.957 | < .001 | [0.67, 1.88] |
| Behavior           | 1.533      | 0.336 | -4.438 | < .001 | [0.87, 2.19] |
| Embodied: touched  | 1.337      | 0.333 | -4.215 | < .001 | [0.68, 1.99] |
| Embodied: moved    | 1.996      | 0.316 | -7.188 | < .001 | [1.38, 2.62] |

\*\*\* p < .001 \*\* p < .01 \* p < .05

**Figure 6***Independent t-tests low vs high scorers on liberty/oppression.*

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$  *Note.* Low and high scorers were determined by taking the mean score for the liberty/oppression foundation and calculating scores which were plus or minus 2 standard deviations from the mean. Mean scores for the aesthetic responses of low scorers are depicted in blue and in orange for high scorers.

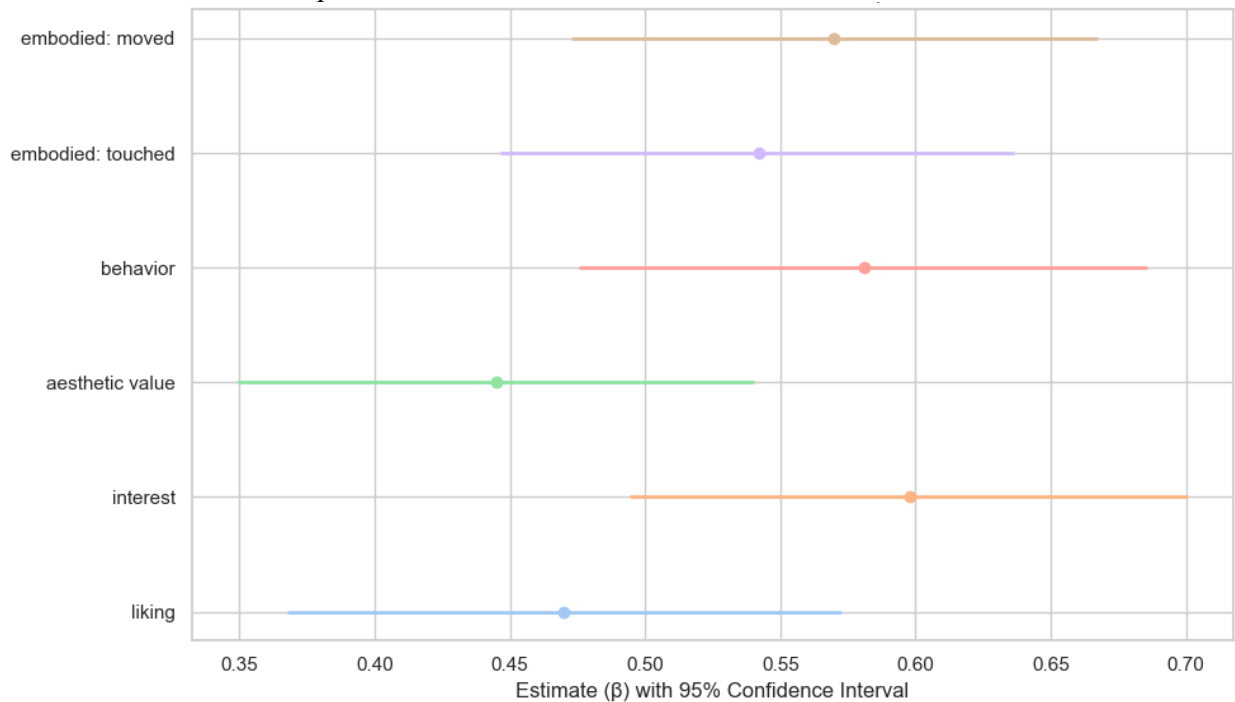
**Table 10***Independent t-tests low vs high scorers on in-group-loyalty.*

| Aesthetic response | $\Delta M$ | SE    | t-stat | p-val  | 95% CI         |
|--------------------|------------|-------|--------|--------|----------------|
| Liking             | -1.040     | 0.285 | 3.785  | < .001 | [-1.60, -0.48] |
| Interest           | -1.329     | 0.279 | 4.980  | < .001 | [-1.88, -0.78] |
| Aesthetic value    | -1.164     | 0.282 | 4.380  | < .001 | [-1.72, -0.61] |
| Behavior           | -0.576     | 0.307 | 1.941  | .053   | [-1.18, 0.03]  |
| Embodied: touched  | -1.289     | 0.281 | 4.608  | < .001 | [-1.84, -0.74] |
| Embodied: moved    | -0.724     | 0.274 | 2.651  | .008   | [-1.26, -0.19] |

\*\*\*  $p < .001$  \*\*  $p < .01$  \*  $p < .05$

**Table 11***Means for aesthetic responses of artworks with and without perceived moral presence.*

|                                                     | Liking | Interest | Aesthetic value | Behavior | Embodied: touched | Embodied: moved |
|-----------------------------------------------------|--------|----------|-----------------|----------|-------------------|-----------------|
| Means for Artworks with Perceived Moral Presence    | 5.70   | 5.88     | 6.22            | 5.85     | 4.22              | 4.21            |
| Means for Artworks without Perceived Moral Presence | 5.01   | 5.03     | 5.52            | 4.99     | 3.20              | 3.12            |

**Figure 7***Results of linear mixed effects models to examine the fixed effect of perceived moral presence in artworks on aesthetic responses.**Note.* All estimates are presented with 95% confidence intervals.

**Table 12**

*Linear mixed effects models to examine the fixed effect of perceived moral presence in artworks on aesthetic responses.*

|                      | Estimate ( $\beta$ ) | SE    | t-stat | p-val  | 95% CI         |
|----------------------|----------------------|-------|--------|--------|----------------|
| Liking***            | 0.470                | 0.052 | 9.025  | < .001 | [0.368, 0.572] |
| Interest***          | 0.598                | 0.052 | 11.458 | < .001 | [0.495, 0.700] |
| Aesthetic Value***   | 0.445                | 0.048 | 9.195  | < .001 | [0.350, 0.540] |
| Behavior***          | 0.581                | 0.053 | 10.897 | < .001 | [0.476, 0.685] |
| Embodied: Touched*** | 0.542                | 0.048 | 11.203 | < .001 | [0.447, 0.636] |
| Embodied: Moved***   | 0.57                 | 0.050 | 11.506 | < .001 | [0.473, 0.667] |

\*\*\* p < .001 \*\* p < .01 \* p < .05

## General Discussion

Aesthetic experiences are vital to our understanding of the human experience. Especially in the context of arts, aesthetic experiences are connected to key processes we engage in everyday such as meaning-making and communication (Dissanayake, 1992; 2008). To date, the study of aesthetics within psychology has mainly focused on the mediums of music and visual art. Early explorations lay the foundation for more diverse methodology, beyond cross-sectional survey methods, and deeper insights into the important outcomes associated with arts engagement and potential precursors such as identity. With my research program, my general aim was to elucidate the importance of aesthetic experiences of various kinds, those that are solitary like listening to music alone in your bedroom or participating in a “visual art viewing” study and those that we share with others out in the wild like a live music concert. Throughout my studies, I presented evidence of the complex interactions these experiences have with our emotions, identities, and well-being.

In the first study, I utilized a within-subject, daily diary method to explore the correlates between daily music listening activity and the emotional experiences associated with them. Moreover, I was interested in connecting these everyday emotional experiences of music with psychological well-being. I found mixed results. First, listening to music was associated with greater feelings of social connectedness, on average, but not greater life satisfaction. Next, I found positive relationships between social connectedness and life satisfaction, as well-being outcomes, and positive emotion evoked by music. The inverse was also true for social connectedness where I found a negative relationship with negative emotion evoked by music.

For my second study, I developed a well-being intervention centered around the emotion of awe, as evoked by a live music concert. The design of the study featured an initial survey, two weeks of follow-up surveys, and brief pre and post-concert surveys. There were also three conditions: (1) a control condition of non concert-attending participants, (2) an active condition in which participants received awe prompting before the concert, and (3) an active condition in which participants received awe prompting before the concert and awe “reminders” in the weekly follow-up surveys. My aim was to further my investigation of music and well-being by exploring the well-being benefits of awe elicited by live music performance and developing an intervention to potentially sustain these benefits. I found two key results. First, I found significant increases in positive emotions such as gratitude and compassion, and significant decreases in negative emotions such as stress and concern for self directly after the concert. Second, the awe reminder intervention demonstrated the desired effect across well-being metrics including stress, mental health symptoms, and social connectedness, especially during the first follow-up measurement.

In the third study (Stamkou et al., 2024), I worked closely with my co-authors and advisors to construct a dataset of approximately 1500 visual artworks spanning across various regions, art movements, and years, and collect data over people’s aesthetic and emotional responses to those artworks. The purpose of this study was to develop a taxonomy of emotions and qualities elicited by visual art. We achieved this goal utilizing machine learning methods within the framework of Semantic Space Theory (Cowen & Keltner, 2021). Importantly, this work revealed high-dimensional properties of emotional experiences elicited by visual art, contrasting with past theorizing which mainly measured these experiences using judgments of pleasantness and liking (Reber et al., 2004).

In the fourth study, I used a subset of works from the visual art dataset to examine the perception of moral themes within visual art. In this cross-sectional study I asked participants to

complete the Moral Foundations Questionnaire (MFQ; Graham et al., 2013) and report whether they detected moral categorizations in a set of visual artworks. Additionally, participants also reported on their aesthetic experiences of the artworks including liking, interest and aesthetic value. I found that participants on average were able to perceive any moral theme within the presented artworks over 50% of the time. Building off this finding, results further revealed that participants' own moral beliefs influenced how likely they were to perceive the corresponding moral theme within the presented artworks. Lastly, results revealed that participants' own moral beliefs not only interacted with their perceptions of moral thematic content but also with their aesthetic responses to the artworks.

My research program demonstrates how music and visual art elicit diverse aesthetic experiences that evoke powerful emotions, enhance well-being, and meaningfully interact with personal identity. First, I found modest correlations between music-evoked emotions and well-being, which led me to hypothesize that more powerful emotional experiences, such as those associated with live music concerts (Koefer et al., 2024), might yield stronger effects. This motivated me to develop a concert-based intervention study centered around the emotion of awe, where I discovered that personalized reminders of the concert experience could effectively sustain its immediate positive benefits.

In my exploration of visual art, I sought to understand aesthetic and emotional responses to visual art. I worked to develop a comprehensive taxonomy of emotional and aesthetic responses, revealing that these experiences exist along multidimensional gradients rather than discrete categories. Furthermore, I sought to understand whether there was a particular driver of these responses, particularly the role that identity and the thematic content of visual art had to play. This study revealed that interactions between personal moral beliefs and perceived moral content could indeed impact aesthetic responses to visual art.

### **Implications**

A burgeoning literature in psychology on aesthetic experiences challenges the past reliance on pleasure and liking as the key variables to assess aesthetic experiences. My research program contributes to this by deepening the understanding of diverse, everyday music engagement and more powerful experiences, and how they relate to well-being. Furthermore, my work advances understanding of aesthetic responses to visual art and unearths morality as a key antecedent to such responses. Building upon previous literature linking moral and aesthetic judgments in the brain (Tsukiura & Cabeza, 2011; Eres et al., 2018; Heinzelmann et al., 2020; Cheng et al., 2021), my work provides a logical progression to the connection between morality and art, two deeply human phenomena.

The implications of this work also extend to the arts sector, especially the public arts. In one of my studies, I partnered with Carnegie Hall, a cultural institute and renowned music venue, and my results will help inform future work in public-facing programs. I am excited to share evidence supporting a new paradigm that focuses on reminding people of their concert experiences. This paradigm effectively extends the immediate feelings of positive well-being associated with those experiences, especially since most individuals cannot attend live music concerts frequently. Such a paradigm could apply to countless other domains, both within and outside the arts. My research in visual art showcases the vast diversity of aesthetic experiences of art. Along with the expanse of observed aesthetic experiences, the potential for poignant interactions with our individual identities creates endless possibilities to make meaningful connections with art.

### **Limitations**

There are crucial limitations to the work presented in this dissertation. In the first study, more specific information about music listening activity, such as whether it was active or passive listening, the context of the listening (where, when, with whom), and perhaps the use of more granular measures of how much music was listened to, is needed. Future studies could take advantage of the rise of streaming apps to capture more nuanced data about everyday music listening activity. The design of the second study provides ecological validity. However, it is not as generalizable due to the uncontrolled nature of the live music environment, with many potential extraneous factors such as the makeup of the audience at each concert and the conditions of the venue. Moreover, due to the complexity of the study and considerable time commitment for participants, the sample sizes were small, which could potentially limit the observed effects. Across studies, there is potential for self-selection bias due to the transparency in how I advertised these studies. For the main survey studies, participants signed up for the study likely due to some combination of interest in the topics of music or art and the rate of compensation. Importantly, in the live music intervention study, participants were recruited from people who already had an opportunity to attend the live music concerts, either via mailing list or general awareness of events occurring at Carnegie Hall or music venues in New York City. In order to diversify the populations represented in this area of research, future work should recruit participants from underserved communities, who may not have as much access to formal arts engagement.

## **Conclusion**

There are myriad ways in which the arts are present in daily life. These experiences are colored by aesthetic properties such as beauty and intrigue regardless of the medium. Aesthetic experiences of music and visual art are an essential part of humanity as they inspire emotional introspection, interact with our identities, and move us profoundly.

Within my work, my aim is to demonstrate how multifaceted our experiences with arts and aesthetics are, and the important downstream consequences such as well-being and identity. Through the use of mixed-methods, cross-sectional, daily diary, and longitudinal work, I demonstrated the effects that music and visual art can have on well-being, and experiences of emotion, respectively, and am eager to continue investigating these topics with the additional lens of identity. Findings such as these are crucial to understanding the impact of arts engagement and in turn, how these experiences can be utilized to foster a greater quality of life and a better understanding of who we are. I am endlessly excited for the opportunities for intervention on a larger scale in partnership with arts institutions, policy makers, and the world, that this work may have.

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