國立政治大學心理學研究所

碩士學位論文

負向情緒藝術之美感欣賞歷程

Aesthetic Experience of Negative Arts Appreciation

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摘要

本研究旨在探討觀賞帶有負向情緒的藝術時，負向情緒與美感情緒二者的關係和產生的順序性，以及心理距離對於情緒反應可能造成的影響。人們在接觸帶有情緒表達的藝術作品的過程中，可能會有美感情緒以及一般情緒的產生，但這兩種情緒的關係過去討論甚少。針對此一議題，根據以往研究之結果，本研究提出二者的關係可能為具共存性，獨立性以及不同時產生的特性，並且觀看者在接觸刺激時的心理距離狀態也會影響情緒反應。為驗證以上假設，本研究以藝術作品及其修改版為材料，操弄其情緒向度與美感程度，在不同的心理距離下進行欣賞，而以 fEMG 作爲情緒反應的測量工具，藉以分析人們在觀看負向情緒藝術作品時，所引發情緒之間的關係，也嘗試提出全新的情境相減方法，試圖在生理數據上分解單純美感情緒反應與單純基本情緒反應兩成分。實驗結果驗證了美感情緒與一般情緒的關係存在共存性及不同時性，並只有在足夠遠的心理距離下才能有美感情緒的產生，然而兩種情緒之間的獨立性則未獲支持。另外，兩種情緒產生的時間順序上，除了符合 DEM 的理論外，也發現了早期（1-2s）的美感情緒產生，顯示美感情緒可能在早期美感經驗中即已參與。本研究為第一篇探討美感情緒與一般情緒在時間向度上關係，並試圖利用生理測量拆分情緒之研究，為神經美學領域做出全新的貢獻。

關鍵字：美感情緒、臉部肌電位、心理距離

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Abstract

The purpose of this study was to explore the relationship between negative emotions and aesthetic emotion and the order of their generation, as well as the effects of psychological distance on emotional response when viewing arts with negative emotions. There may be aesthetic emotion and basic emotion experienced when people are in touch with artworks of emotional expression, but the relationship between these two emotions was rarely discussed in the past. To address this issue, based on the results of previous research, the relationship between these two emotions is proposed to be co-existent and independent, to be produced at different time during experience. In addition, the state of psychological distance is expected to affect the emotional response of the viewer. To verify these hypotheses, using original and modified artworks as the materials, the emotional valence and aesthetic level of the materials were examined for their manipulation. The artworks were viewed either in far or close psychological distance. The fEMG was used as a tool to reflect the emotional responses. A tentative way for decomposing the reaction of aesthetic emotion and basic emotion in physiological data by subtraction method were proposed, also. The results supported the hypotheses of co-existence and asynchrony, but not independency of the relationship between two emotions. Furthermore, aesthetic emotion might only be generated in the far psychological distance. The generation sequence of the two

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emotions was consistent with the DEM. Furthermore, an early (1-2s) component of aesthetic emotion was also found, indicating that aesthetic emotion might be involved in early aesthetic experience. This study was the first to explore the relationship between aesthetic emotion and basic emotion in terms of time, and attempted to decompose emotions with physiological measures, contributing more information to the field of neuroaesthetics.

Keywords: Aesthetic Emotion, Facial electromyography (EMG), Psychological Distance

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Introduction

When admiring “Ophelia” by John Everett Millais, how does the art move you emotionally? Do you feel sad, appreciative of its beauty, or both? Despite the painting portrays the girl dead, the whole scenario yields a sense of beauty. On the cognitive level, viewers might find sorrow in this painting, but also feel peaceful and beautiful at the same time. This is also the moment of “emotional conflict” exhibited by the audience, and such phenomenon is yet unclear of its underlying mental process. Therefore, this study aimed to investigate the mental process of existing internal emotional conflict toward arts with negative emotion.

Aesthetic Experience.

In understanding the emergence of aesthetic experience, Chatterjee and Vartanian (2016) have suggested that there are three key elements in aesthetic experience, including sensory-motor, knowledge-meaning, and the most concerned factor of this study, emotion-valuation.

There is no doubt that good sensory experiences are crucial to feeling of beauty. In the case of visual art, the visual features of a painting, such as orientation, shape, color, grouping, categorization, and even motion, play key roles in determining whether we can have an aesthetic experience of the painting (Chatterjee, 2003; Chatterjee &

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Vartanian, 2016; Greenlee & Tse, 2008; Wandell, Dumoulin, & Brewer, 2009).

In addition to the visual features of the painting itself, the background knowledge of the art also has a significant influence on the aesthetic experience. When the audience has a better understanding of the work itself, whether it is the title of the work, the identity of the author, or the ability to analyze the work in more aspects like experts (Chatterjee & Vartanian, 2016), the top-down information can endow the viewer a better experience and appreciation of aesthetics. Gerger and Leder (2015) once found that participants tended to have higher aesthetic evaluations in the paintings with titles that matched their meaning in comparison to that having no title or even inconsistent title. The same result was found in facial electromyography (fEMG) data of the smiling muscle (M. zygomaticus), having more positive reaction with matched titles when compared to works without title or with inconsistent title. The other study of visual art also found that viewers with professional knowledge showed higher aesthetic evaluation of paintings with negative emotional themes than non-experts, and were more likely to have gained pleasure in negative art expressions (Leder, Gerger, Brieber, & Schwarz, 2014). The knowing of information significantly influences on the aesthetic experience, empowering people to process more smoothly, to have appropriate psychological distance, and a better transformation of such aesthetic experience to pleasure (Leder, Belke, Oeberst, & Augustin, 2004; Leder et al., 2014; Menninghaus et

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al., 2017).

Aesthetic emotion is an emotional reaction that the viewer will experience in the process of aesthetic appreciation. Many studies of positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) have shown that the increase of blood flow in orbitofrontal cortex (OFC) during aesthetic evaluation is the clear evidence of emotional involvement in aesthetic evaluation, as a suggestion of the capability of beautiful things to arouse emotional response and rewarding experience (Chatterjee & Vartanian, 2016; Kampe, Frith, Dolan, & Frith, 2001; Nakamura et al., 1998; O'Doherty et al., 2003; Winston, O'Doherty, Kilner, Perrett, & Dolan, 2007). While aesthetic experiences may elicit emotional responses, such outcome is further classified as recipient feeling and processed thought. Recipient feeling is the emotion the viewer believes and experiences upon seeing the artwork. Processed thought, as the name suggests, involves a post-processing and understanding of the meaning of the artwork. The two types of response may differ in valence (either be positive or negative experience) and source (either stem from basic or appreciated aesthetic emotion). To get a whole picture of the psychological process of positive and negative affect generated in appreciation of art, it is necessary to consider the two types of response are both involved and yet decomposed in the working of aesthetic experience.

Since aesthetic emotion is closely related to aesthetic experience, it is necessary to

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fully understand the aesthetic emotion, the interaction between different emotions in aesthetic experience and their respective contributions to our feelings toward arts.

Aesthetic Emotion

People usually experience the aesthetic feeling when observing beautiful pictures. While appreciating art, aesthetic feeling, usually a positive valence of emotion as the response, may arise and bring viewer a sense of comfort and happiness, especially when artwork is full of positive themes, such as bright flowers, happy children, or cheerful facial expressions in the painting. Viewer will naturally be attracted, affected and immersed themselves in the positive emotion conveyed in these works, even unconsciously.

Inconsistent Emotion in Art Appreciation

However, there are atypical conditions in which we appreciate beautiful yet negative-emotion arts. How people react in this conditional setting is one of the main interests in this study. The themes of many famous paintings depict negative events and emotions, such as sacrifice, death, sadness and suffering. “Ophelia”, as mentioned above, as well as “The Entombment” by Peter Paul Rubens and “Chart of Hell” by Sandro Botticelli, to name a few, are all artworks with negative themes. But

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paradoxically, even when it comes to “negative themes”, people might still gain positive affect from them. Such contradiction always continues to puzzle psychologists for explanation and attempt to understand its underlying psychological process.

Mixed Emotion

Mixed emotions are surprisingly common and fully discussed. Studies on mixed emotions showed the possibility that different emotions could be motivated by and co-exist in the same event (Carrera & Oceja, 2007; Ersner-Hershfield, Mikels, Sullivan, & Carstensen, 2008; J. T. Larsen & McGraw, 2011; Oceja & Carrera, 2009; Rafaeli, Rogers, & Revelle, 2007; Schimmack, 2001). But how these different emotions co-exist and interact with each other is another issue to be addressed.

Oceja and Carrera (2009) proposed four possible patterns that the relationships between these two types of emotion could exhibit. The first one is the prevalence pattern, where a dominant emotion co-exists with a weaker emotion simultaneously. The second one is the sequential pattern, where the two emotions are showing in order. The third one is the inverse pattern, where one emotion grows more intense when the other emotion grows weaker in the process. And, the last one is the simultaneously high pattern, where two emotions not only exist at the same time but also with equally strength in intensity.

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In their results, the prevalence pattern and the simultaneously high pattern were supported by their data, showing the possibility that the two emotions could exist at the same time. However, how the two emotions were generated and the question of any possible dependency between the two remained an unsolved issue to be investigated; thus, other relevant studies would be reviewed in the next section.

Other hypotheses on inconsistent aesthetic emotion and basic emotion

Sequentially Generated

There have been several critical studies on the relationship between the conflict emotion induced by negative artworks. A study about the experience of appreciating sad music showed that people would exhibit two types of emotion, particularly when inconsistent in valence of these emotions (Kawakami, Furukawa, Katahira, & Okanoya, 2013). Researchers would measure the listeners' mixed emotions while manipulating some characteristics of music. The tonality of music may affect the emotional response of a listener. Major tonality usually makes people feel more cheerful and hopeful with positive emotions, while the minor tends to be sad and painful with negative emotions. In the study of Kawakami and the colleagues (2013), they changed the major musical stimulus into minor. The participants were presented with two versions of music stimuli and asked to evaluate their mood when listening. It

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was found that listeners were able to distinguish emotional feeling as "received" and "processed". With music of major tonality, every listener reported experiencing positive emotions. But in case of music in minor, most listeners reported that their received a sense of sadness and depression, even though they produced the emotion of happiness and a sense of beauty. Furthermore, through the interviews of participants and based on the re-evaluation hypothesis, a sequential inter-emotional relationship was considered to be the process of ambivalence results. In sad music, negative musical scene initiated the experience of negative emotion first. Then the pleasant emotion was experienced subsequently due to the rewarding effect or a deeper understanding of the music which induced personal memory or interpretation (Kawakami et al., 2013; Koelsch, 2012). This study suggested the possibility that the engendering of aesthetic emotions might be sequentially generated. Additionally, these emotions could be inconsistent in valence.

Simultaneous but Independent

An aesthetic study of picturing rotten food with a professional shooting style showed that two inconsistent emotions were induced simultaneously (Wagner, Menninghaus, Hanich, & Jacobsen, 2014). In this study, researchers allowed some uncomfortable stimuli, such as rotten food or dirty garbage, be pictured professionally

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in the perspective of photography as very artistic pictures. The pictures were shown to the participants and they were asked to feedback on their feeling about these pictures. Surprisingly, the results showed that while the viewers experienced the negative emotions from the content of these images, they also produced aesthetic emotion at the same time to these pictures. This study showed a remarkably interesting phenomenon that contrasted from previous research. It seemed that two types of emotion produced by the viewers could be oppositive and yet independently co-existed at the same or different time course.

Distance Embrace Model

Another idea is that the feeling of beauty, pleasure, and enjoyment, can be transformed from and contributed by basic emotions, especially including negative emotions. This idea was proposed by Winfried Menninghaus and his colleagues in their Distance Embrace Model (DEM) (Menninghaus et al., 2017). They believed that to generate pleasure and aesthetic feeling from a negative stimulus, the final result must go through the process of "distancing" and “embracement”.

Distance factors

Distance can help to create pleasure. By distancing, the viewer is psychologically

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away from the negative stimulus but is in reality still in touch with it at a “safe” distance and space to "enjoy it", in which it is a room of opportunity for the viewer to experience pleasure. At a close proximity, the viewer may still feel threatened by disgust and if too far away, it will become difficult to interact with the stimulus. Therefore, to have better experience in viewing artworks, it is necessary to have a proper psychological distance with it (Bullough, 1912; Cupchik, 2002; Hanfling, 2000; A Peter McGraw, Williams, & Warren, 2013; Pandit, 1976; Price, 1977; Trope & Liberman, 2010). According to DEM, there are three factors that help inducing distancing, including the art schema, the representation schema, and the fiction schema. The art schema is the upmost important factor of all, and the prerequisite of distancing. The representation schema and the fiction schema are secondary factors that are not necessary but as bonuses to the effect of distancing.

Art schema provides an art-related environment that allows individuals to feel more secure and in control (Menninghaus et al., 2017). A study of anger had found that individuals in a anger-inducing exercise knowing that it was a performance for art exercise had a more neutral score of self-assessment about negative emotion and a more stable pulse and blood pressure measurement, in comparison to those performing the same exercise but in a self-developing group with acknowledgment of it as a test of their ability (Wagner et al., 2016). The emotions triggered by arts usually contain little

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direct personal goal relevance and goal orientation, nor did they need to challenge an individual's coping potential or stimulate strong action responses for it (Hunter & Schellenberg, 2010; K. Scherer, 2013; K. R. Scherer, 2005). Therefore, art schema may help the viewer process the stimulus at a better psychological distance (Menninghaus et al., 2017). Even in face of negative emotional stimulus, the viewer may still get a more “rational” and “smoother” emotional response.

In terms of presentation, physical factors, such as temporal, spatial, and cultural distancing, could also influence psychological distancing. When placed the self at an adequate distance, the viewer feels indirect exposure to the work and such will help to build a psychological distance (A. Peter Mcgraw & Warren, 2010; A Peter McGraw, Warren, Williams, & Leonard, 2012; A Peter McGraw et al., 2013); (Menninghaus et al., 2017; Trope & Liberman, 2010; Trope, Liberman, & Wakslak, 2007). The inclination of building a psychological distance through physical distancing allows individual to reduce the threat of negative stimulus and minimize any possible referencing to oneself; thus, people will become more willing to interact with the harmless threat, and even get a sense of humor and pleasure from it.

The other vital element that may affect psychological distancing is the knowing of fictitious theme of the artwork. When knowing something as fictional or even fake, such as in case of portrait of fictional murder, the threat of being harm by such authentic

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artwork diminishes. While creating a sense of fiction works in the form of arts, immersion in a story can have a similar effect cognitively or subconsciously (Busselle & Bilandzic, 2008; Goldstein, 2009; Green, Chatham, & Sestir, 2012; Green et al., 2008; Kuijpers, Hakemulder, Tan, & Doicaru, 2014; Tan, 2008; Zwaan, 1999). A study on the effect of sad movies (Goldstein, 2009) also indicated that the negative stimulus could still pose entertaining attribute because of the reduction of negative emotion inside, even though the emergence of positive emotion had not diminish or even resolve any negative emotions. It is simply that negative emotions lead to producing of positive emotions (Menninghaus et al., 2017).

The necessity of negative emotions in arts

There have been sufficient accounts of discussion on the necessity of negative emotions and their role in the experience of art appreciation. Just as in literatures, paintings, films, music and other artistic creations from ancient times to the present day, all seemed to agree that plot of simple joy could not resonate with the audience, but tragic stories could (Grodal, 2007; Hanich, Wagner, Shah, Jacobsen, & Menninghaus, 2014; Krämer & Witschel, 2010; Lausberg, 1998; Sugiyama, 2005). Negative emotions also seem to be more impressive and memorable than positive emotions, and there is some empirical evidence for this notion (Baumeister, Bratslavsky, Finkenauer, & Vohs,

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2001; Cacioppo & Gardner, 1999; Frijda, 1988; R. J. Larsen & Prizmic, 2008; Musch & Klauer, 2003; Rozin & Royzman, 2001; Vaish, Grossmann, & Woodward, 2008). Individuals even seem to be more motivated to explore, seek, and maintain negative emotions if they are accompanied by positive emotions or engaged with mixed emotions (Riediger, Schmiedek, Wagner, & Lindenberger, 2009). Therefore, researchers believe that in the process of art appreciation, sadness does not simply work as a negative emotion, but instead, sadness contributes in great proportion to the evolution of aesthetic experience (Berenbaum, 2002; Dubé & Le Bel, 2003; Menninghaus et al., 2017; Menninghaus et al., 2015). It is also argued that the art with sadness may ultimately be enjoyed due to other emotional responses that must be extended through negative emotions (Menninghaus et al., 2017).

In sum, DEM provides sufficient evidence of how psychological distancing provides the necessary atmosphere of proper reasons for the need of negative emotions in arts to produce enough positive enjoyment in aesthetic appreciation.

Issues of current findings

The current study focused on the relationship between basic emotions, especially negative emotion, and aesthetic emotion in the process of art appreciation. The interaction between the two emotions and the effect of psychological distancing were

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also investigated, which were not greatly discussed in the past. In the literatures, DEM has provided elegant solutions for these questions. However, it is not a component-process model but more a more resemblance of a theoretical framework. As a result, the influential factors proposed by this model may need to be further tested by empirical research (Menninghaus et al., 2017). Additionally, the relationship between the basic and aesthetic emotion in the course of time was also a topic rarely discussed. Previous research on aesthetic experience relied more on self-evaluation as the measurement tool. The current study would further incorporate objective physiological measure with high temporal resolution as a tool to understand the relationship between different emotions and how psychological distancing could yield different results in the art experience.

To understand the inconsistent valence of emotions experienced in aesthetic appreciation and its underlying mechanism, EMG would be an appropriate tool in the study. Aesthetic emotions are usually complicated and difficult to detect or distinguish, that they can be simply an indistinct feeling on the subconscious level or impossible to separate from other types of emotion. Therefore, an appropriate tool to clearly distinguish the valence of produced emotion is of course necessary. The current measurement tools, such as EEG and MRI, still have many limitations on measuring emotional valence and distinguishing different emotions. However, fEMG is specialized in distinguishing between positive and negative emotion, that it is certainly

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the choice of tool to distinguish such incongruent and inconspicuous emotion like aesthetic emotion.

Studies with fEMG showed that people would spontaneously imitate with proper facial muscles while observing other emotional facial expressions, as they were "contagious" (Lundqvist & Dimberg, 1995). Studies revealed that when people see emotions expressed, not only their emotional state was affected but also, they would change facial muscles to synchronize with smiling, frowning or any other behaviors in imitation. Also, how strong the participants would respond to the emotional faces depends on the arousal level of the stimuli. For a stronger emotion, the participant would act stronger, too, yielding bigger EMG signal waves (Achaibou, Pourtois, Schwartz, & Vuilleumier, 2008; Aguado et al., 2013; Fujimura, Sato, & Suzuki, 2010; Hess et al., 2017; Künecke, Hildebrandt, Recio, Sommer, & Wilhelm, 2014). To measure different emotions with EMG in facial muscles, the most common way to distinguish the positive and negative emotion is to measure the activation level of the M. zygomaticus (smiling muscle) and the M. corrugator (frowning muscle) as the indicators. The activation of the M. zygomaticus and the relaxing of the M. corrugator are usually identified as the indicator of positive emotion. On the contrary, the activation of the M. corrugator and the relaxing of the M. zygomaticus are usually identified as the indicator of negative emotion. In this way, researchers can use fEMG

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to detect whether participants receive stimulus images and generate emotions, as well as determining the valence of emotions.

Hypothesis

This study would attempt to investigate the reason for people to prefer negative emotion in the theme of arts, since many various studies were only offering glimpses of parts of the entire puzzle of understanding aesthetic experience. Kawakami et al. (2013) mentioned how people could separate and tell the difference between sad feeling that music brought and the pleasure they feel after listening to it. Moreover, there were two hypotheses about the relationship of those emotions: the "sweet anticipation" and "re-evaluation" when listening to sad music in the context of art, which were believed to be the reason of pleasure experience, and that pleasure, as a consequence of cognitive progress, was derived from sadness (Kawakami et al., 2013). These hypotheses were consistent with DEM prediction, in which art with a negative theme was believed to contribute more than a positive theme in the creation of the final aesthetic pleasure (Menninghaus et al., 2017). Moreover, the pleasure was thought to come from the result of transforming the negative emotion; hence, the need of producing negative as one of the basic emotions before aesthetic emotion.

In addition, there have been some examples that such "paradoxical emotions"

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could co-exist. In the study of mixed emotions, Oceja and Carrera (2009) have found some evidence that negative and positive emotion could be detected simultaneously. Wagner et al. (2014) also found that a sense of disgust and aesthetic appreciation could be felt by the audience at the same time. Those findings all revealed that regardless of the order of appearance, different emotions could co-exist along the course of time, even if they paradoxically contrasted in valence, as this is a very common phenomenon in our daily life.

In the case of DEM and the example of study by Wagner et al. (2014), the authors also pointed out that appropriate psychological distancing and art context were indispensable elements for deriving pleasure from arts of negative theme. If people in face of the stimuli were without adequate psychological distancing, they could completely react in a different way that might not even result in pleasure at the end.

In a fEMG study (Gerger, Leder, & Kremer, 2014), people's reaction in different psychological distancing was revealed by manipulating the connotaion of artworks. Specifically, the response toward a negative stimulus was found to be relatively positive under the context of art (at a relatively far psychological distance). In their study, half of the images were taken from the IAPS, and half of the images were taken from real artworks. For one group of participants, they were told that the picture they were looking at was "a work of art", while the other half were told that it was "a press photo".

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The fEMG results showed that the contextual effect was significant in smiling muscles, but not in frowning muscles. For the smiling muscles, when participants viewed the stimulus as in the context of artwork, the response to the positive stimulus was modulated and smoothed down. And more importantly, for the negative stimulus, only the real artwork stimulus was "positively attuned" in the negative response of the smiling muscle, which was also liked more in the ratings. This phenomenon may well be the supporting evidence that psychological distancing modulates the response to positive and negative stimuli, especially producing positive appreciation of negative stimuli in the works.

Based on the evidence described above, the current study also generalized that the basic emotion and aesthetic emotion could both exist simultaneously, in which there were at least two emotions produced from viewing arts, instead of shifting from one to another form of response. No antagonism was observed and only independence between the two was noted. Moreover, there might be an asynchrony in the production of the two emotions. According to DEM and other supporting evidence, it is possible that basic emotion comes first and then followed by aesthetic emotion. On the other hand, an appropriate distance is prone to produce aesthetic emotion. Therefore, psychological distancing was manipulated to enhance the level of aesthetic emotional response in the present study.

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In summary, the aim of the present study was to explore the relationship between basic emotion and aesthetic emotion when viewing artworks with negative theme. To verify multiple theoretical points, an all-sided experiment was designed to understand the time course of both aesthetic and basic emotion, the possibility of co-existence of these two emotions, and the effect of psychological distancing. The study adopted a three-factor design with the aesthetic level, the valence of emotion and the psychological distancing as independent variables. fEMG was used as the assessment tool, and the change relative to baseline with its temporal parameter was the dependent variable. Multiple hypotheses were proposed for testing in this study to reveal the process of appreciating negative arts as described in the following sections.

Parallelism Hypothesis

One of the main hypotheses was that ***aesthetic emotion and basic emotions are independent of each other and yet still co-exist***.

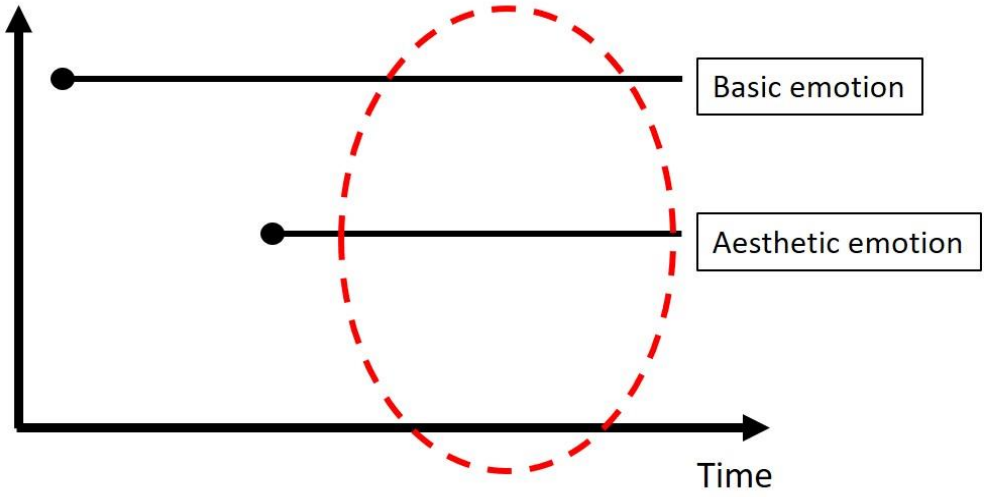

Figure 1. The Diagram of *Parallelism Hypothesis*.

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As shown in **Figure 1**, when viewing an artwork with aesthetic elements, the individual would feel the positive or negative emotion conveyed by the work and acquire an aesthetic feeling, to be cognitively perceived simultaneously. On the contrary, if the work has only few aesthetic elements, only the positive or negative emotion conveyed by the work could be observed by the audience.

In the studies by Wagner et al. (2014) and Carrera and Oceja (2007), it was found that basic emotion and aesthetic emotion could co-exist at the same time point, and even consciously perceived by the audience. In DEM, the phenomenon of co-existence has also been mentioned. Based on these findings, the Parallelism Hypothesis was postulated by us and verified in this study.

Asynchrony Hypothesis

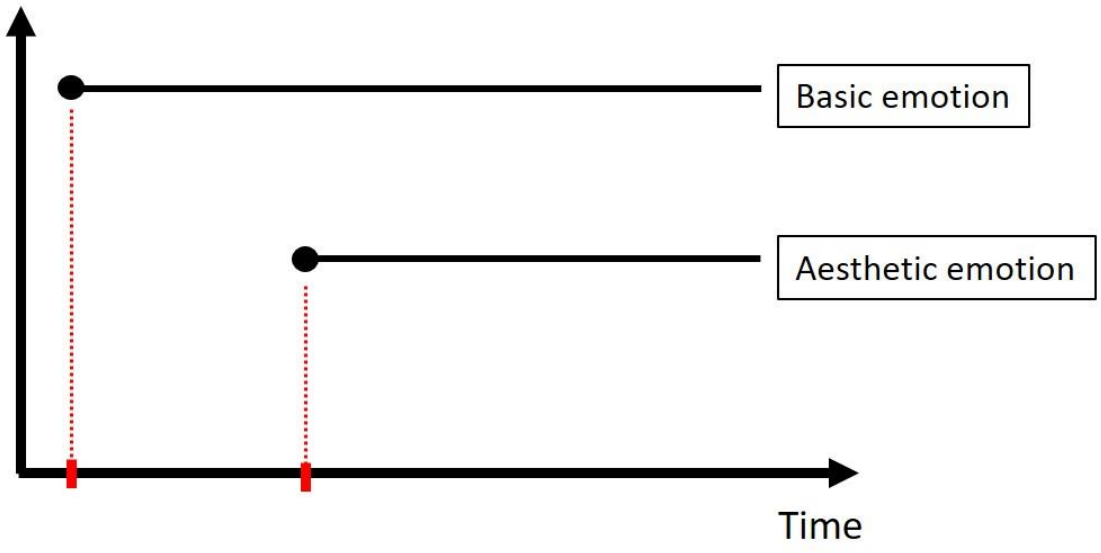

Figure 2. The Diagram of *Asynchrony Hypothesis*.

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The other main hypothesis assumed that ***the audience feels two opposing emotions (inconsistent) while appreciating negative arts, produced at different time points in the course.*** As shown in **Figure 2**, the hypothesis further suggested that the basic emotion is the initial product of observing the artwork content before the audience consciously produces an aesthetic appreciation later. This hypothesis could be referred to and derived from DEM and other findings from studies by Kawakami et al. (2013).

Psychological Distancing Hypothesis

Figure 3. The Diagram of *Psychological Distancing Hypothesis*.

The final hypothesis was that ***aesthetic emotion is moderated by psychological distancing when viewing artwork of emotional theme.*** As shown in **Figure 3**, at different psychological distancing, the audience experiences differently from the artwork. In close distance, both positive and negative stimulation would have a stronger effect on emotional reaction. But at a far distance, negative response is reduced, and the

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audience is moved toward gaining a sense of appreciation and beauty from the stimuli.

DEM and other relevant studies of psychological distancing all consistently pointed out the importance of psychological distancing in experiencing aesthetic emotions (Bullough, 1912; Cupchik, 2002; Goldstein, 2009; Hanfling, 2000; A. Peter Mcgraw & Warren, 2010; A Peter McGraw et al., 2012; A Peter McGraw et al., 2013; Menninghaus et al., 2017; Pandit, 1976; Price, 1977; Trope & Liberman, 2010; Wagner et al., 2016). Furthermore, a fEMG study with manipulation of the context of arts provided strong evidence for the modulation effect of psychological distancing. The results showed that people would adjust their perception and evaluation reactions under cognition of different contexts, especially when the response toward a negative stimulus was relatively positive in context (Gerger et al., 2014). In the current study, the instruction and the interior layout of the experimental environment would be manipulated to help people at psychological distancing, where any different reaction patterns in these two situations would validate the Psychological Distancing hypothesis.

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Method

Participants

A total of 44 participants were enrolled in this experiment, 12 males and 32 females. The average age of the participants was 21.18 (*SD* = 1.33) in years. Participants came from different departments of Chengchi University. All participants reported no symptoms of color blindness, normal or corrected normal vision. All of them were divided into two groups by random assignment - each group for one of the two conditions of psychological distancing manipulation, which was a between-participants factor in design.

Materials

Oil paintings of high and low aesthetic level for conveying different emotion (either negative or positive) were prepared as visual stimuli, while their familiarity, tonality and composition of the paintings controlled. Oil paintings of realism with medium public familiarity, fair color tonality, similar composition of human face in the middle and scenery background, which have been rated with high level of aesthetic level, were chosen as negative stimuli. For each painting of high aesthetic level, a software-modified version (with physical features altered with *Adobe Illustrator*) of the painting with the same content and structure but low level of aesthetic level was created

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as the comparison group. The preparation of the positive stimuli followed the same instruction, but with medium public familiarity, vivid color tonality and similar structures as above.

For all the images prepared, familiarity, emotional valence, emotional arousal, and level of aesthetics of the stimuli were rated in a pretest beforehand. A total of 15 participants rated 73 pairs of pictures of negative stimuli and 30 pairs of pictures of positive stimuli, respectively, on the level of aesthetics (1 as very unbeautiful to 10 as very beautiful), emotional valence (1 as very negative to 10 as very positive), and the level of emotional arousal (1 as very calm to 10 as very intense).

Finally, 20 paintings (10 pairs) of each group were selected as the stimuli. The average rating scores of the selected materials in the pretest were summarized in **Table 1**. Additional information such as the provenances and rating score of each picture were shown in **Appendix 1**. All pictures were reported as "never seen before" by participants to insure the unfamiliarity of the pictures. To avoid the contrast effect of viewing the original and modified versions of the same painting, only one version of each painting

Table 1. The average rating scores of the selected materials in pretest.

	Aesthetic Score	Emotional Valence	Emotional Arousal
NB	7.29	5.28	5.39
NU	5.27	4.36	6.16
PB	7.70	7.33	6.59
PU	6.77	7.33	6.59

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

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was presented to a single participant. For example, as a specific beautiful painting of negative connotation was presented to an individual, the person would not see its modified version. Consequently, there were 10 images in each of the four conditions to be presented to a participant. Half of the participants would see a set of 4 groups of 10 pictures each, and the other half of the participants saw another set of 4 groups of pictures. All images were presented in random order.

Experimental Design

To have a comprehensive validation, the current research used a 2 x 2 x 2 mixed design with *Distance* (Far, Close) as a between-participants variable, and *Emotion* (Negative, Positive) and *Aesthetics* (High, Low) as within-participants variables. 10 pictures of each condition, including the negative-beautiful, negative-unbeautiful, positive-beautiful, and positive-unbeautiful conditions, were randomly assigned into 4 blocks in a program made by MATLAB.

Two conditions of *Distance* (Far, Close) were manipulated by contexts and instructions between participants. An art context was created to build up a far distance, and a non-art context for the close distance. As mentioned above, immersing individuals in an art context would help them with a more appropriate psychological distancing to view the stimulus, while depriving them of this cognitive environment was prone to set

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the distance closer than the presumed safety.

Therefore, in order to create a more vivid context of art viewing environment in a laboratory, walls were covered with background of art gallery, museum ambient sound was set as environmental noise, and instructions as expected in a museum were all adopted to create a more realistic emulation. On the contrary, the participants of the control group would see and feel the original laboratory with office environmental sound, as well as instructions of observing images from a virtual person at a close distance. The contextual layout illustration of an art gallery with condition of setting the viewer at far distance was shown in **Figure 4**.

The fEMG data, including M. corrugator and M. zygomaticus, were the dependent variables, by comparing changes at different time intervals as the main target of measurement. The SCR data were also collected in complementary to fEMG results.

Figure 4. The illustration of gallery as background at far distance.

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fEMG and SCR Recordings

The fEMG and SCR signals were recorded while participants viewed the images of stimuli. Facial EMG electrodes (Ag/AgCl electrodes, 4 mm diameter) were placed according to Fridlund and Cacioppo (1986) guidelines, over the regions of M. corrugator supercilii and M. zygomaticus major in bipolar arrangement on the left side of the face. Another electrode was placed on the right mastoid for grounding. Before placing the electrodes, the face was cleansed with swab before conductive gel was applied to reduce resistance. Electrodes would be connected to the amplifier (*Brain Products GmbH*) with 2000 Hz sampling rate and a software (*Recorder*) was used to record the signals during the experimentation.

To record SCR data, bipolar electrodes were fixated on the middle phalanx of the ring and middle fingers of the participant's non-dominant hand, which was cleansed with water and alcohol beforehand.

Procedure

After preparation, participants would be seated at 60cm in front of the screen. To increase the credibility of the environment, situational instructions in match with the set distance of the testing group would be accordingly described to the participants. Then, both the presentation of instructions and stimuli and the recording of responses

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would be controlled by MATLAB. In the group of far distance, the participants were told that they were in a simulated exhibition environment and were invited to evaluate the artworks in front of them. To create a distanced environment, it would be emphasized that the artworks were from famous foreign artists from the 18th century to the 19th century (emphasizing the art, fiction, and temporal distance factors). In the group of close distance, they were kept in the original experimental environment, and participants would be told that these pictures were modified as oil painting from recently collected real images.

The steps of the procedure were shown in **Figure 5**. At each trial, the participant would view pictures without time limit and rate each picture on the spot. The pictures would be rated in aspects, including aesthetic level, emotional valence, and emotional arousal. The participants would not know the proposed hypotheses during the experimentation. After the instruction, during the practice trial of one picture for each stimulus group, participants would be presented with these practice images until they were confident of completing the task. In the experiment, the participants would be asked to view the images on screen those pictures shown on the screen and press the "emotion switch" button in any cases of internal change of their emotional state. After looking at the image, the participant would then rate the emotional valence as negative valence and positive valence separately, as well as emotional arousal and aesthetic level

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of their perception. Forty pictures were separated in 4 sessions of viewing with 3 break time in between for the participants. All stimuli and questions would be presented in a random order.

An experimental trial started with a fixed cross for 2000ms, after which one picture would be presented in the center, that there would be no limit on the viewing time until the participant finished and pressed the button. During rating on a 10-point Likert scale, the presented artwork would remain on the screen at slightly smaller size. The participants would rate all artworks in the categories of aesthetic level (1 very unbeautiful to 10 very beautiful), negative emotional valence (1 extremely not negative to 10 extremely negative), positive emotional valence (1 extremely not positive to 10 extremely positive), negative emotional arousal (1 extremely calm to 10 extremely intense), positive emotional arousal (1 extremely calm to 10 extremely intense), and preference (1 extremely dislike to 10 extremely like). The names of all ratings were as shown on the top with the score below the artwork. The order of rating categories was fixed but counterbalanced for all participants across all sessions. Participants would rate all artworks with keyboard number button. After completing the rating in each trial, blank screen was shown for 7000ms before the next trial of artwork evaluation. The presenting order of artworks would be fully randomized.

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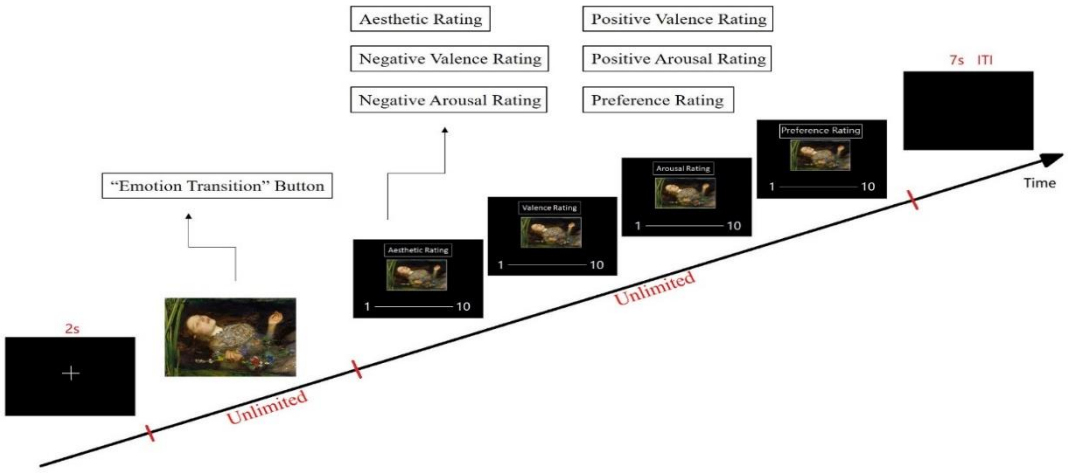

Figure 5. Steps during a trial of the experiment.

fEMG and SCR Analysis

The fEMG data would be statistically analyzed by MATLAB. For the steps of analyzing data, please refer to the study by Gerger, Pelowski, and Leder (2018). The signals recorded in the experiment would be stored as raw data. In subsequent processing, signals below 20 Hz and above 500 Hz would be removed by band-pass filter to remove the blink effect and drift, and a notch filter at 50 Hz would be set to filter the powerline artifacts. After that, the signal would be rectified and smoothed with a filter of 125-ms moving average window. The baseline of each person would be averaged in a 1000ms interval before the stimulus-onset of each trial. Due to the free viewing, there would be a different length between trials. The minimum viewing time of all participants would be used as the criterion to ensure that the viewing time of each trial could be aligned and compared. The averaged signal in a person would be pooled every 100ms and compared between conditions.

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SCR data would also be statistically analyzed by MATLAB according to guidelines (Benedek & Kaernbach, 2010a, 2010b). The raw data would be downsampled to 128 Hz and filtered with 1-Hz low pass filter. After that, continuous decomposition analyses (CDA) would be applied and integral of the phasic activity over the response window (ISCR) in a time window of 2-6 seconds after stimulus onset would be calculated. Finally, a log10-transformed ISCR would be compared between conditions.

Decomposition of Aesthetic Emotion and Basic Emotion

There was a tentative way to separate the reactions to basic emotion and aesthetic emotion in M. corrugator supercilii and M. zygomaticus major under different conditions. It has already been proven that a far distance receded basic emotion and created aesthetic emotion, while a close distance might enhance basic emotion but deprive one of aesthetic emotion (Gerger et al., 2014; Menninghaus et al., 2017). Based on this result, one could claim that the response to a highly aesthetic and yet with negative connotation at a far distance would show aesthetic component of emotion and a reduced level of basic emotion (i.e., negative emotion), while a unbeautiful and negatively connotated picture at a far distance would only show the same reduced level of basic emotion. Moreover, we would obtain a pure reaction of aesthetic emotion when

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subtracting the two. Also, the response to unbeautiful image of negative connotation at far distance was equivalent to the reaction of basic emotion at far distance. Thus, one could experience and distinguish two types of emotion at far distance, just as the positive emotion and aesthetic emotion when viewing at a far distance could also be separated. The subtraction of the two emotions is given below.

Aesthetic emotion = far-beautiful – far-unbeautiful

Basic emotion = far-unbeautiful

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Results

Behavioral Results

The scores of *Aesthetics*, *Negative Emotional Valence*, *Negative Emotional Arousal*, *Positive Emotional Valence*, *Positive Emotion Arousal* and *Preference* of each participant in each trial were recorded. The *Duration* of each trial and the number of pressed “emotion switch", and the *Transition Time*, were also recorded.

The Rating of Aesthetic Level

Table 2. Mean and Standard Deviation of *Aesthetic Level* in Each Experimental Condition.

Aesthetic Rating					
F			C		
	Mean	SD		Mean	SD
NB	7.11	1.04	NB	6.91	1.20
NU	5.15	1.22	NU	5.30	1.40
PB	7.51	0.95	PB	6.63	1.76
PU	6.89	1.14	PU	6.75	1.35

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

Mean and standard deviation of aesthetic rating scores in each experimental condition were shown in **Table 2**. A 2×2×2 mixed ANOVA with *Distance* (Far, Close) as a between-participants factor, and *Emotion* (Positive, Negative), *Aesthetics* (High, Low) as the within-participants factors was introduced. The results showed significantly major effects of *Emotion*, $F(1,7) = 23.25$, $p<0.1$, and *Aesthetics*, $F(1,7) = 26.15$, $p< 0.01$. The effect of *Emotion* profoundly showed that rating scores of aesthetic

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levels for positive stimuli (M = 6.95) were higher compared to those of negative stimuli (M = 6.12). The effect of *Aesthetics* showed that rating scores of paintings with higher aesthetic stimuli was indeed higher (M = 7.04) than those of low aesthetic stimuli (M = 6.02) as expected, serving as a check on manipulating the connotation.

The interaction of *Emotion* and *Aesthetics* was also statistically significant ($F(1,7) = 30.45$, $p < 0.01$). Post hoc comparison on negative stimuli showed that aesthetic rating for high aesthetic stimuli (M = 6.98) was significantly higher than that of low aesthetic stimuli (M = 5.24, $t(83) = 6.50$, $p < 0.0001$). But the difference of rating scores between high and low aesthetic stimuli in positive emotion was relatively small and did not reach a significant level. These results indicated that the effect of aesthetic level on aesthetic rating scores was stronger in negative stimuli than the positive ones.

The Rating of Viewer Preference

Table 3. Mean and Standard Deviation of *Viewer Preference* in Each Experimental Condition.

Preference					
F			C		
	Mean	SD		Mean	SD
NB	6.29	1.17	NB	6.02	1.15
NU	4.40	1.26	NU	4.52	1.34
PB	7.27	0.90	PB	6.45	1.49
PU	6.38	0.94	PU	6.25	1.16

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

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The mean and standard deviation of rating scores on viewer preference in each experimental condition were shown in **Table 3**. The same ANOVA test as before was applied to the data. The results showed that the effect of *Emotion* was significant ($F(1,7) = 72.63$, $p < 0.01$), indicating that the viewer's preference for positive stimuli ($M = 6.59$) was higher than for negative stimuli ($M = 5.31$). The effect of *Aesthetics* was also significant ($F(1,7) = 73.12$, $p < 0.01$), where they showed higher score in preference of pictures with higher aesthetic level ($M = 6.51$) than those of low aesthetic level ($M = 5.39$).

There were significant interactions in *Emotion* x *Aesthetics*, $F(1,7) = 31.16$, $p < 0.01$, and *Distance* x *Aesthetics*, $F(1,7) = 5.29$, $p < 0.05$. Post hoc comparison of *Emotion* x *Aesthetics* showed that the preference for high aesthetic pictures was higher in related with positive emotion ($M = 6.84$), compared to negative emotion ($M = 6.15$), $t(86) = -2.65$, $p < 0.01$. For low aesthetic pictures, the rating of preference was also significantly higher for positive emotion ($M = 6.31$) than negative emotion ($M = 4.46$), $t(85) = -7.36$, $p < 0.0001$. Although the effect of *Emotion* consistently influenced in high and low aesthetic condition, its effect was relatively stronger in the low aesthetic condition. From another perspective to interpret the interaction of *Emotion* x *Aesthetics*, the data suggested that the effect of *Aesthetics* (i.e., High vs. Low) was stronger during negative emotion than positive emotion. In terms of the interaction in *Distance* x

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Aesthetics, post hoc comparison revealed a significant difference between far and close distance during viewing of high aesthetic level, but not for low aesthetic condition, $t(86) = 2.05$, $p<0.05$, with more rating score toward viewer's preference at far distance. This result indicated that the effect of *Distance* on viewer's preference was stronger in the high aesthetic condition than in the low aesthetic condition.

The Rating of Negative Emotional Valence

Table 4. **Mean and Standard Deviation of *Negative Emotional Valence* in Each Experimental Condition**.

Negative Emotional Valence Rating					
F			C		
	Mean	SD		Mean	SD
NB	6.30	1.01	NB	6.46	0.89
NU	7.32	0.82	NU	6.52	1.62
PB	3.24	0.64	PB	3.81	1.27
PU	4.02	0.87	PU	4.56	1.02

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

The mean and standard deviation of the rating scores of negative emotional valence in each experimental condition were shown in **Table 4**. In ANOVA test, the effect was more significantly seen in *Emotion*, $F(1,7) = 219.19$, $p < 0.0001$, and *Aesthetics*, $F(1,7) = 33.46$, $p < 0.0001$. The effect of *Emotion* primarily showed that the rating scores of negative emotional valence toward negative stimuli ($M = 6.65$) were higher than facing positive stimuli ($M = 3.91$), as expected, which served as a check on manipulating the connotaion. The primary influence of *Aesthetics* showed that scores

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of negative emotional valence when viewing pictures of low aesthetic level (M = 5.61) were much higher than those with high aesthetic level (M = 4.95). There was a significant interaction of *Distance* x *Emotion*, $F(1,7) = 6.1$, $p < 0.05$. Post hoc comparison showed that the rating scores of negative emotional valence toward only positive stimuli at close distance (M = 4.19) were significantly higher than those at far distance (M = 3.63), $t(86) = -2.48$, $p < 0.05$, indicating that the effect of *Distance* on negative emotional valence was greater when exposed to positive stimuli than negative stimuli.

The Rating of Negative Emotional Arousal

Table 5. Mean and Standard Deviation of *Negative Emotional Arousal* in each experimental condition.

Negative Emotional Arousal Rating					
F			C		
	Mean	SD		Mean	SD
NB	5.19	1.07	NB	5.21	1.22
NU	6.41	1.19	NU	5.98	1.32
PB	2.69	0.60	PB	2.99	0.90
PU	3.40	0.57	PU	3.71	0.94

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

The mean and standard deviation of the rating scores of negative emotional arousal in each experimental condition were shown in **Table 5**. The ANOVA test showed significantly more effect by *Emotion*, $F(1,7) = 270.68$, $p < 0.01$, and *Aesthetics*, $F(1,7) = 60.69$, $p < 0.01$. *Emotion* was shown to have higher effect and thus score of negative emotional arousal to negative stimuli (M = 5.7) than to positive stimuli (M = 3.2), which

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could be a check on manipulating the connotaion. In terms of *Aesthetics*, it showed higher scores and more negative emotional arousal toward pictures of low aesthetic level ($M = 4.88$) than those of high aesthetic level ($M = 4.02$). There was a significant interaction of *Distance* x *Emotion*, $F(1,7) = 4.37$, $p < 0.05$. It showed a contrasting trend on the effect of *Distance* to arouse negative emotion when exposed to positive and negative stimuli.

The Rating of Positive Emotional Valence

Table 6. Mean and Standard Deviation of *Positive Emotional Valence* in each experimental condition.

Positive Emotional Valence Rating					
F			C		
	Mean	SD		Mean	SD
NB	4.46	0.86	NB	4.28	0.86
NU	3.27	0.58	NU	3.08	0.68
PB	6.85	0.87	PB	6.08	0.97
PU	5.81	1.16	PU	5.69	1.08

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

The mean and standard deviation of the rating scores of positive emotional valence in each experimental condition were shown in **Table 6**. The primary influence as tested by ANOVA was seen the most significant in *Emotion*, $F(1,7) = 308.97$ $p < 0.01$, and *Aesthetics*, $F(1,7) = 109.56$ $p < 0.01$. *Emotion* showed significantly more effect on the positive emotional valence toward positive emotional stimuli ($M = 6.11$) than toward negative stimuli ($M = 3.77$), which was a check on the manipulating of the connotaion.

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The main effect of *Aesthetics* was observed at high aesthetic pictures via higher scores of positive emotional valence (M = 5.42) than the scores of low aesthetic pictures (M = 4.46). There was a significant interaction of *Emotion* x *Aesthetics*, $F(1,7) = 7.4$, $p < 0.01$. Post hoc comparison showed that positive emotional valence of negative stimuli in high aesthetic pictures (M = 4.36) was higher than that of low aesthetic pictures (M = 3.17), $t(85) = 7.4$, $p < 0.001$. Furthermore, the positive emotional valence to positive stimuli in high aesthetic pictures (M = 6.45) showed higher scores than that of low aesthetic pictures (M = 5.74), $t(86) = 3.12$, $p < 0.01$. The effect of Aesthetics appeared to be consistent in condition of arousing negative and positive emotion, even though the data showed the effect of Aesthetics on positive emotional valence was greater toward negative stimuli than positive stimuli.

The Rating of Positive Emotional Arousal

Table 7. Mean and Standard Deviation of *Positive Emotional Valence* in each experimental condition.

Positive Emotional Arousal Rating					
F			C		
	Mean	SD		Mean	SD
NB	3.53	0.90	NB	3.41	1.09
NU	2.98	0.61	NU	2.73	0.72
PB	5.33	1.31	PB	4.68	1.40
PU	4.69	1.08	PU	4.41	1.34

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

The mean and standard deviation of the rating scores of positive emotional arousal

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in each experimental condition were shown in **Table 7**. The ANOVA test showed statistical significance in *Emotion*, $F(1,7) = 145.12$, $p < 0.01$, and *Aesthetics*, $F(1,7) = 23.69$, $p < 0.01$. The main effect of *Emotion* showed that the scores of positive emotional arousal to positive emotion stimuli ($M = 4.78$) were indeed higher than that of negative stimuli ($M = 3.16$), which could serve as a check on manipulating of the connotaion. The main effect of *Aesthetics* showed that scores of positive emotional valence from observing high aesthetic pictures ($M = 4.24$) were higher than observing low aesthetic pictures ($M = 3.70$).

The Duration

Table 8. Mean and Standard Deviation of *Duration* in each experimental condition.

Duration					
F			C		
	Mean	SD		Mean	SD
NB	19.25	9.14	NB	27.81	15.07
NU	19.35	8.45	NU	26.62	14.33
PB	18.56	8.65	PB	25.45	13.37
PU	17.86	7.91	PU	24.82	13.30

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

The mean and standard deviation of duration time in each experimental condition were shown in **Table 8**. The ANOVA test also showed significant difference in *Emotion*, $F(1,7) = 12.37$, $p < 0.01$, and *Distance*, $F(1,7) = 5.01$, $p < 0.05$. The main effect of *Emotion* showed that the duration of viewing of negative stimuli ($M = 23.26$) was

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significantly longer than positive stimuli (M = 21.67). The main effect of *Distance* showed that the duration of viewing at a close psychological distance (M = 26.18) were longer than at a far psychological distance (M = 18.75).

Time of Transition

Table 9. Mean and Standard Deviation of *Transition Time* in Each Experimental

Transition Times					
F			C		
	Mean	SD		Mean	SD
NB	2.55	1.56	NB	2.84	2.24
NU	2.78	1.58	NU	2.96	2.20
PB	2.19	1.50	PB	2.59	2.37
PU	2.38	1.45	PU	2.57	2.11

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

The mean and standard deviation of transition time in each experimental condition were shown in **Table 9**. The main effects were the most significant in *Emotion*, $F(1,7) = 52.51$, $p < 0.01$, and *Aesthetics*, $F(1,7) = 4.56$, $p < 0.05$ when analyzed by ANOVA test. The main effect of *Emotion* showed that the transition time of negative stimuli (M = 2.78) was more than the time under positive stimuli (M = 2.4). The main effect of *Aesthetics* showed that the transition time when exposed to low aesthetic stimuli (M = 2.67) were more than when exposed to high aesthetic stimuli (M = 2.54).

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SCR Results

Table 10. Mean and Standard Deviation of SCR in Each Experimental

ISCR					
F			C		
	Mean	SD		Mean	SD
NB	17.56	6.23	NB	20.51	9.14
NU	17.21	5.52	NU	20.10	9.75
PB	17.09	5.67	PB	20.61	10.10
PU	17.80	6.34	PU	20.19	9.78

F = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

The mean and standard deviation of SCR in each experimental condition were shown in **Table 10**. A 2×2×2 mixed ANOVA with *Distance* (Far, Close) as a between-participants factor, and *Emotion* (Positive, Negative), *Aesthetics* (High, Low) as the within-participants factors was conducted. The result showed a significant interaction of *Emotion* x *Aesthetics,* $F(1,7) = 6.18$, $p < 0.05$, and a trend that the effect of *Aesthetics* on SCR for the negative stimuli were greater than for the positive stimuli. The relative magnitude of SCR level of all conditions was also shown in **Figure 6**.

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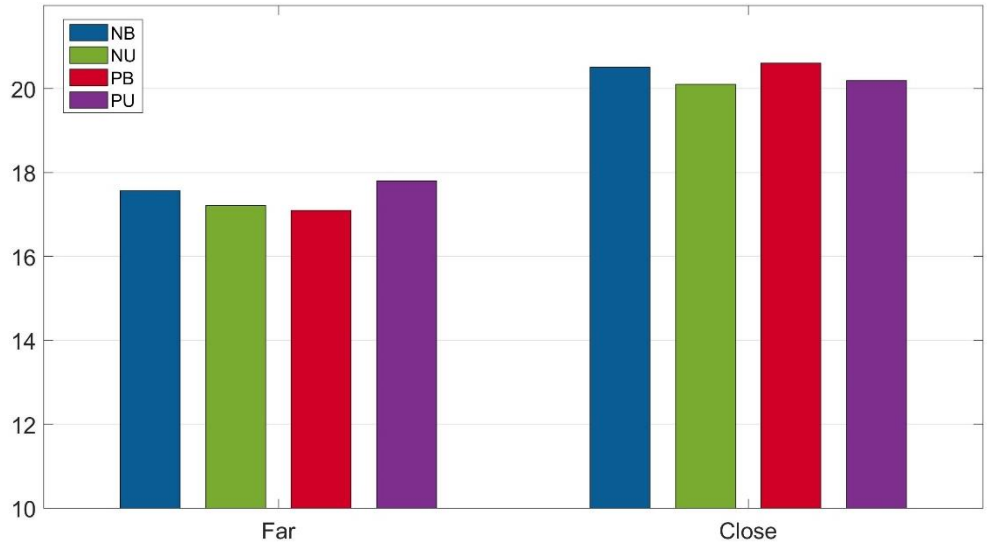

Figure 6. SCR level in each experimental condition. **F** = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures.

fEMG Results

General Analysis

The average reaction patterns of M. corrugator supercilii and M. zygomaticus major to positive and negative stimuli under influence of *Aesthetics* and *Distance* were respectively shown in **Figure 7** and **Figure 8**. The data of facial electromyography were respectively subjected to a 2×2×2×9 mixed ANOVA analysis and calculation with *Distance* (Far, Close) as a between-participants factor, and *Emotion* (Positive, Negative), *Aesthetics* (High, Low), and *Time* (T0-T8) as the within-participants factors.

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M. Corrugator Supercilii

The results of ANOVA test showed significant effect of *Aesthetics*, $F(1,0) = 10.79$, $p<0.01$, and *Time*, $F(8,0) = 5.39$, $p<0.01$. The effect of *Aesthetics* was primarily seen in M. Corrugator Supercilii, more strongly activated to low aesthetic stimuli ($M = 0.66$) than to high aesthetic stimuli ($M = 0.27$). In terms of *Time,* it was shown that M. Corrugator Supercilii activation changed at different time points (T4($M = 0.68$) > T8($M = 0.63$) > T7($M = 0.56$) > T6($M = 0.54$) > T3($M = 0.53$) > T5($M = 0.48$) > T2($M = 0.45$) > T1($M = 0.31$)). There were significant interactions of *Aesthetic* x *Time*, $F(8,0) = 2.34$, $p<0.05$, and *Distance* x *Emotion* x *Aesthetics* x *Time*, $F(8,0) = 1.98$, $p<0.05$. To understand these interaction effects, the activation of M. Corrugator Supercilii at each time point with 1-second-average during the total 8 seconds was compared with the baseline at the beginning (zero) under each condition by using one-sample *t*-test. The results of these post hoc comparisons were also shown in **Figure 7 and 8**.

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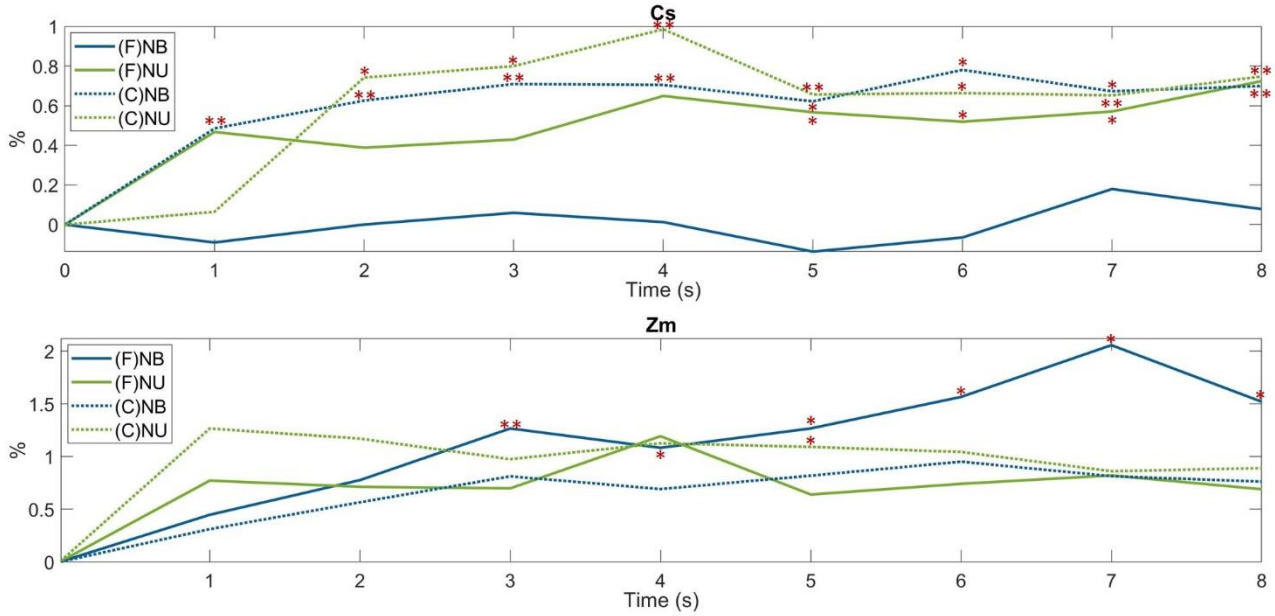

Figure 7. Activation patterns and Post Hoc Comparison of M. Corrugator Supercilii and M. Zygomaticus of Negative Pictures at Far and Close Distance. **F** = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **Cs** = M. Corrugator Supercilii. **Zm** = M. zygomaticus. * as the p-value of one-sample t-test for each data point. *as $p<0.05$. ** as $p<0.01$.

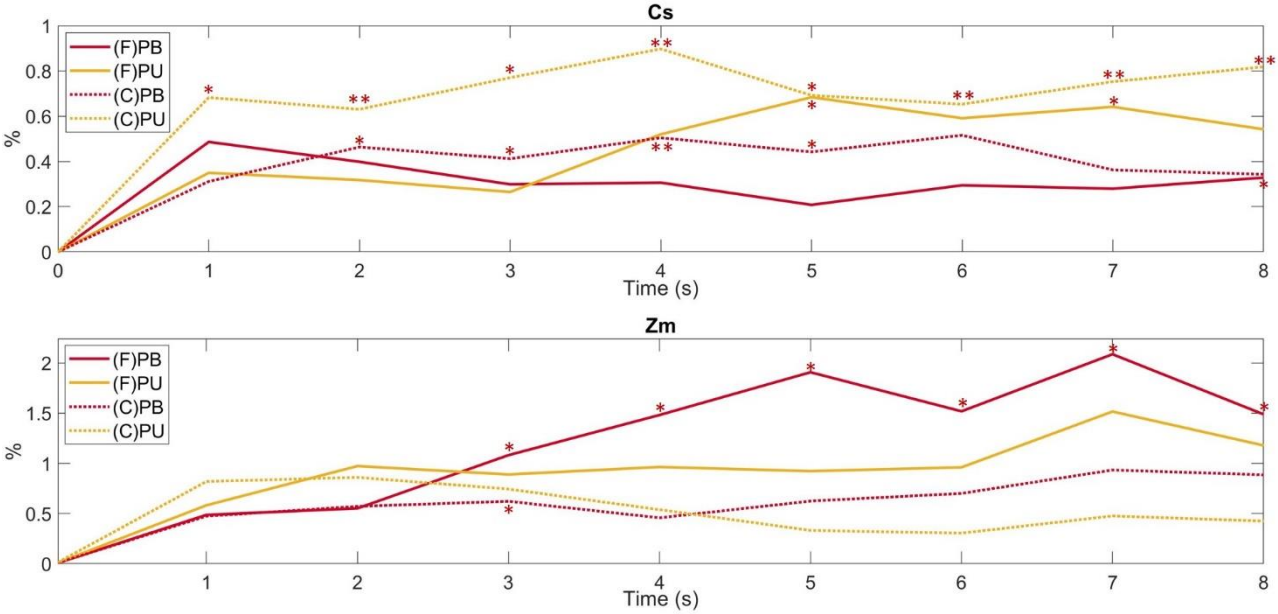

Figure 8. Activation patterns and Post Hoc Comparison of M. Corrugator Supercilii and M. Zygomaticus of Positive Pictures at Far and Close Distance. **F** = far distance. **C** = close distance. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures. **Cs** = M. Corrugator Supercilii. **Zm** = M. zygomaticus. * as the p-value of one-sample t-test for each data point. *as $p<0.05$. ** as $p<0.01$.

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The results of these comparisons indicated that the interaction of *Aesthetic* x *Time* might be due to the activation difference of time points (T1-T8) to low aesthetic stimuli, which were both significantly higher than zero during T5-T7 at far distance and T2-T8 at close distance. The interaction of *Distance* x *Emotion* x *Aesthetics* x *Time* might be due to the difference of activation pattern along time points of T0-T8 in four types of stimuli (*Emotion* x *Aesthetics*) at both far and close distance.

M. zygomaticus

The same ANOVA was performed for the data of M. zygomaticus. There were significant main effects of *Aesthetics*, $F(1,0) = 5.78$, $p<0.05$, and *Time*, $F(8,0) = 4.18$, $p<0.01$. The main effect of *Aesthetics* showed that the activation of M. zygomaticus to the high aesthetic stimuli ($M = 0.99$) was greater than that of the low aesthetic stimuli ($M = 0.57$). The main effect of *Time* showed that the activation of M. zygomaticus differed at every time point (T7($M = 1.20$) > T8($M = 0.99$) > T4($M = 0.97$) > T6($M = 0.94$) > T3($M = 0.93$) > T5($M = 0.86$) > T2($M = 0.72$) > T1($M = 0.40$)).

There were significant interactions of *Aesthetic* x *Time*, $F(8,0) = 5.81$, $p<0.05$ and *Distance* x *Aesthetics,* $F(8,0) = 2.79$ $p<0.01$. The same post hoc comparison of one sample *t* test as used in M. Corrugator Supercilii was performed to analyze the activation data of M. zygomaticus. The results of post hoc comparison were also shown

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in **Figure 7 and 8**. As indicated by the interaction of *Aesthetic* x *Time*, the activation by high and low aesthetic stimuli varied in time. And, the interaction of *Distance* x *Aesthetics*, as in terms of the difference in aesthetic effect at far or close distance, showed more aesthetic effect at far distance, but not at close distance.

The Verification of the Psychological Distancing Hypothesis

To verify the relationship between psychological distancing and aesthetic emotion, a comprehensive comparison was conducted separately for high and low aesthetic and yet negative stimuli at far and close distance. From the results of post hoc comparison of M. zygomaticus activation (**Figure 7, 8**) at far distance, there was significantly more activation to both negative and positive stimuli with pictures of high aesthetic level from t3 to t8, $p<0.05$. The activation pattern of the high aesthetic stimuli in 2(*Emotion*: positive, negative) x 2(*Distance*: far, close) conditions of the present study was similar to that of Gerger et al. (2014). To verify the similarity, the only significant effect of Gerger et al. (2014) relevant to this issue was tested with our data. An independent *t* test between the two *Distance* conditions was performed for the high aesthetic negative stimuli during later period (T4~T8) (**Figure 9**). There was a significant difference between the two, $t(42)= 9.77$, $p<0.001$, under a stricter alpha ($\alpha = 0.001$), that high aesthetic negative stimuli ($M = 1.62$) had a greater activation at far distance than at

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close distance (M = 0.68).

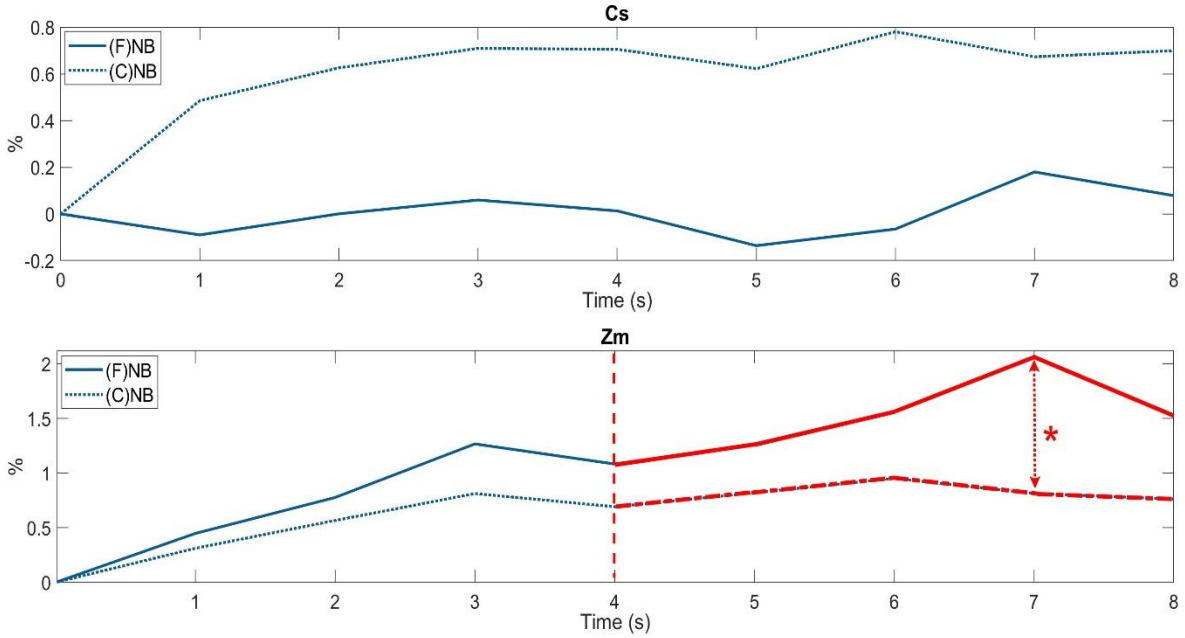

Figure 9. Verification of Psychological Distancing in the activation of M. zygomaticus. **F** = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **Cs** = M. Corrugator Supercilii. **Zm** = M. zygomaticus. * as the independent t-test p-value of each datapoint. *as p<0.001.

For the four Aesthetics-Distance conditions, beautiful pictures was assumed to produce aesthetic emotion when viewed at far distance. Therefore, to better understand the impact of distance on aesthetic emotion, the condition of high aesthetic but negative stimuli at far distance was compared to other conditions of negative emotion, including low aesthetic negative pictures at far distance and both high and low aesthetic but negative pictures at close distance. The same comparison was conducted for positive pictures. Please refer to **Figure 10** and **11**.

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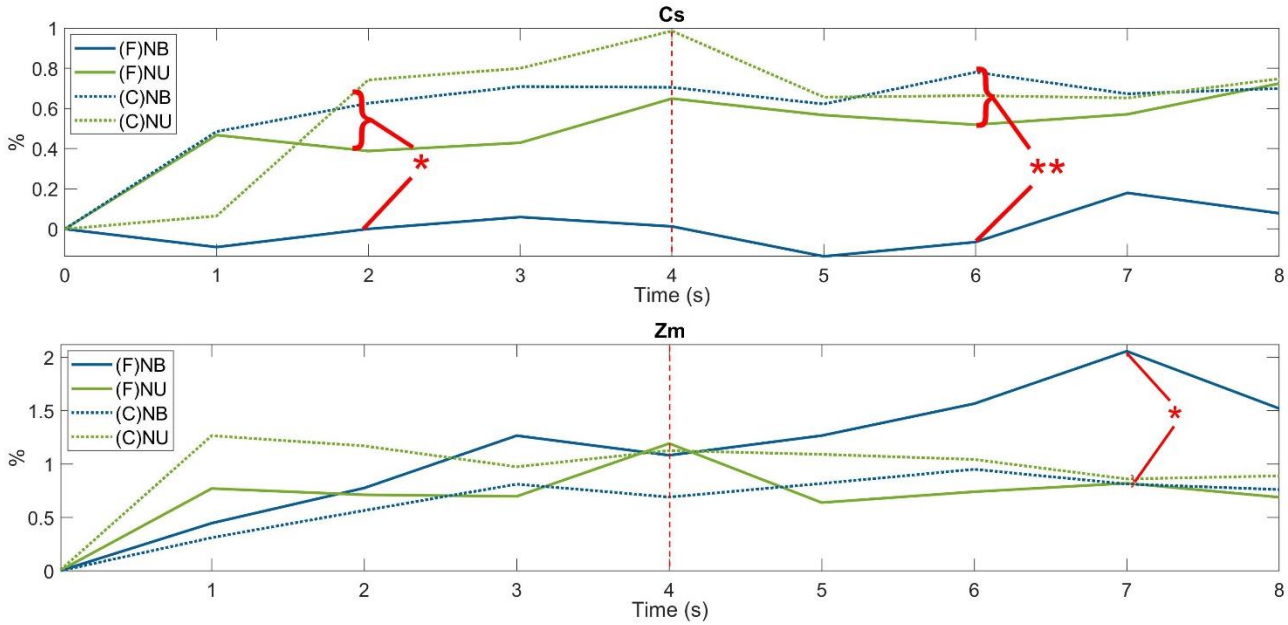

Figure 10. Comparison of the Effect of Distance in Negative Conditions. **F** = far distance. **C** = close distance. **NB** = high aesthetic but negative pictures. **NU** = low aesthetic but negative pictures. **Cs** = M. Corrugator Supercilii. **Zm** = M. zygomaticus. * as the independent t-test p-value at late period. *as $p<0.05$. ** as $p<0.01$.

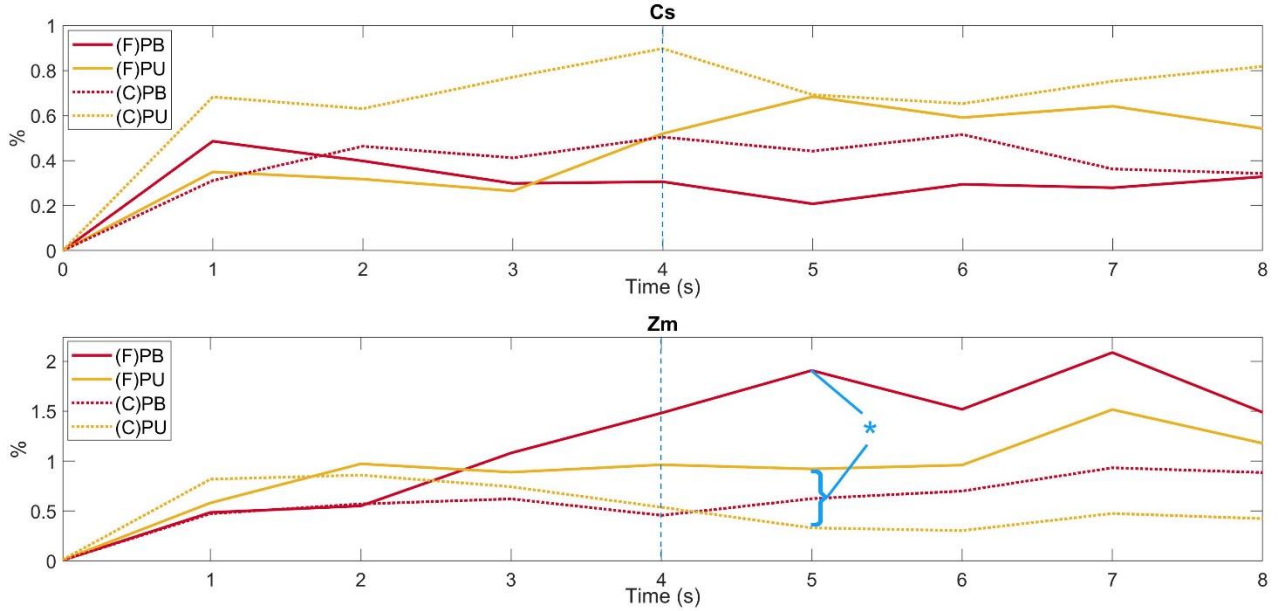

Figure 11. Comparison of the Effect of Distance in Positive Conditions. **F** = far distance. **C** = close distance. **PB** = high aesthetic but positive pictures. **PU** = low aesthetic but positive pictures. **Cs** = M. Corrugator Supercilii. **Zm** = M. zygomaticus. * as the independent t-test p-value at late period. *as $p<0.05$.

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This comparison was made separately for the early (T1-T4) and late (T5-T8) time periods with *t* test analysis. In M. Corrugator Supercilii, there were significant differences in the negative pictures in both the early and late time periods, T1-T4 ($t(82) = -2.57$, $p<0.05$), and T5-T8 ($t(82) = -2.96$, $p<0.01$). In M. zygomaticus, there were significant differences only at T7 of the negative pictures ($t(82) = -2.02$, $p<0.05$), and T5 of the positive pictures ($t(82) = -2.27$, $p<0.05$). The results indicated that with highly aesthetic but negative pictures at far distance, there was significantly lower activation of M. Corrugator Supercilii during the entire course of time, while observing higher activation of M. zygomaticus at only T7. For high aesthetic positive pictures at far distance, the only difference was the significantly higher activation of M. zygomaticus at T5. Considering that the activity of M. Corrugator Supercilii might be not the main characteristic of positive emotion in fEMG measurement, aesthetic emotion produced from high aesthetic pictures with positive and negative emotions at far distance was highly similar in pattern. This also implied that the emotional state of high aesthetic pictures at far distance was indeed different from other conditions, confirming the effect of distance on the production of aesthetic emotion. Therefore, these results could be indication that viewers would experience aesthetic emotion at a suitable to far psychological distance and were less likely to have it when viewing at a too-close distance.

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Decomposition of Aesthetic Emotion and Basic Emotion

The results were shown in **Figure 12**. First, a 2×2×2×9 mixed ANOVA test with *Distance* (Far, Close) as a between-participants factor, and *Kind* (Basic emotion, Aesthetic emotion), *Aesthetics* (High, Low), and *Time* (T0-T8) as the within-participants factors was separately conducted for analyses of M. corrugator supercilii and M. zygomaticus.

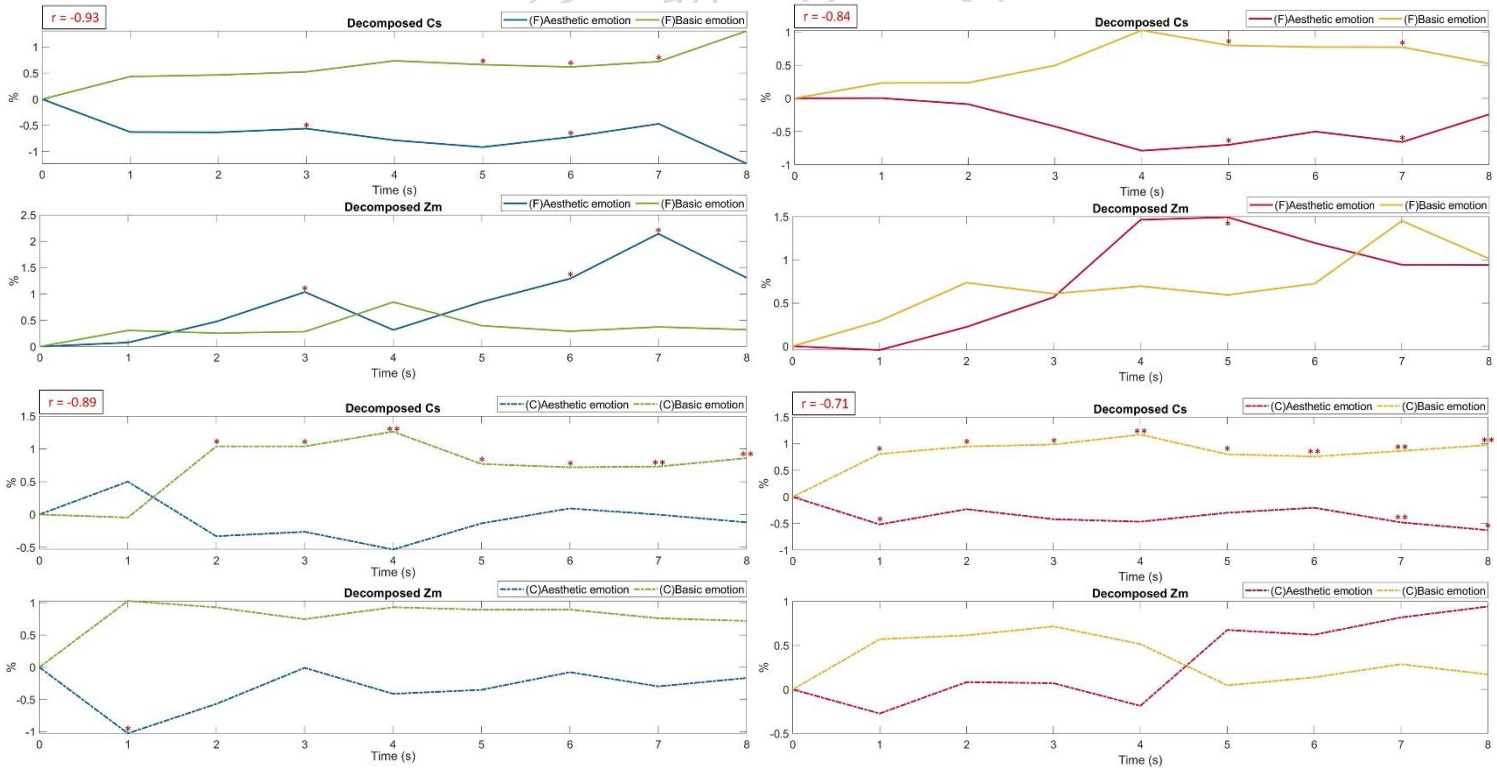

Figure 12. Activation Patterns, Host Poc Comparison and *Pearson's r* value of Decomposed Aesthetic Emotion and Basic emotion in M. Corrugator Supercilii and M. Zygomaticus. F = far distance. **C** = close distance. **Cs** = M. corrugator supercilii**. Zm** = M. zygomaticus.

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M. Corrugator Supercilii

The results of ANOVA test showed significant effects in terms of *Distance*, $F(1,0) = 4.65$, $p<0.05$, *Kind*, $F(1,0) = 17.57$, $p<0.01$, and *Time*, $F(8,0) = 2.28$, $p<0.05$. The main effect of *Distance* showed more activation of M. Corrugator Supercilii at far distance ($M = 0.65$) than at close distance ($M = 0.27$). The main effect of *Kind* showed that there was more activation of basic emotion ($M = 0.53$) than aesthetic emotion ($M = 0.41$). And, the main effect of *Time* showed that the activation did vary from time to time at different time points (T4($M = 0.19$) > T8($M = 0.18$) > T7($M = 0.18$) > T6($M = 0.18$) > T2($M = 0.17$) > T3($M = 0.16$) > T5($M = 0.11$) > T1($M = 0.09$)). There was an interaction between *kind* and *time* ($F(8,0) = 4.11$, $p<0.01$). The interaction between *Emotion* and *Time* indicated that the response levels of different emotions varied by time and in different patterns.

M. Zygomaticus

The ANOVA test results of M. zygomaticus only showed a significant effect in *Time* ($F(8,0) = 4.85$, $p<0.01$), when the activation did vary at different time points (T7($M = 0.83$) > T8($M = 0.67$) > T6($M = 0.65$) > T5($M = 0.59$) > T4($M = 0.54$) > T3($M = 0.51$) > T2($M = 0.35$) > T1($M = 0.12$)).

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The Verification of the Parallelism Hypothesis

The co-existence and independency between aesthetic emotion and basic emotion would be tested separately. It was assumed that there was no aesthetic emotion produced at close distance; thus, the following results were for far distance only. As for the verification of co-existence, one-sample *t*-test with stricter criteria (alpha = 0.01) was performed on average at every 100ms of the separated emotions for each condition. In order to rigorously determine the time period of activation changes, the criterion of statistical significance was set to be significantly differing from zero continuously for at least 200ms before it could be considered as a peak of authentic change in electromyography activation, instead of being the result of random pulsation.

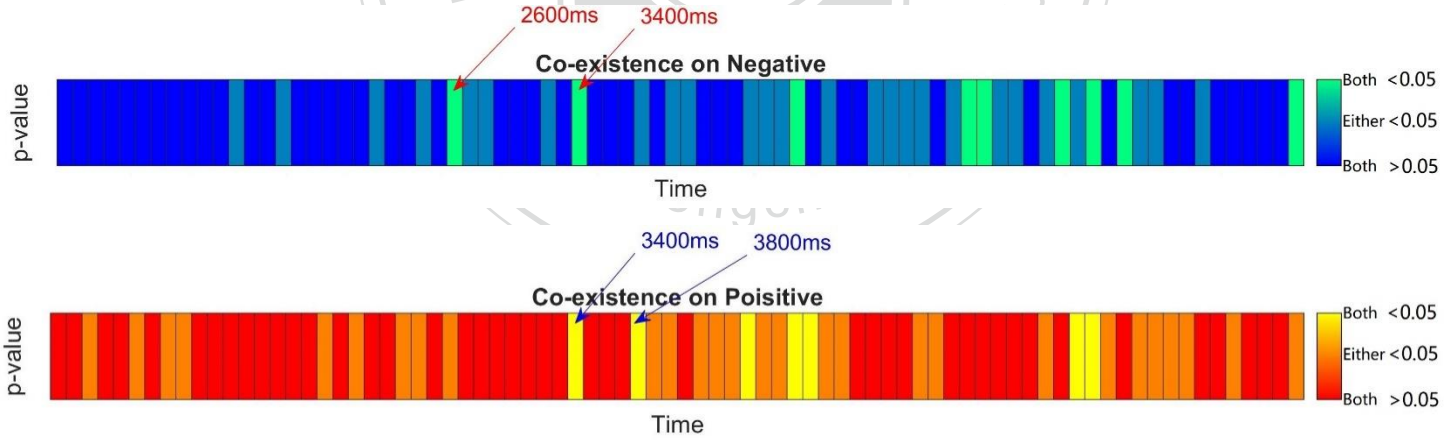

Figure 13. Comparison of Heat Map on Co-existence of Separated Aesthetic Emotion and Basic Emotion under Negative and Positive Conditions at far distance. The colors were based on the p-values of respective one-sample t-test of Aesthetic emotion and Basic emotion in either M. corrugator supercilia or M. zygomaticus at the same time point.

The time periods of significant changes were shown in **Figure 13**. For the verification of co-existence, significant negative emotion stimuli for both aesthetic and

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basic emotion were shown to initially appear at the earliest time point of 3600ms (basic emotion: $t(21) = 2.18$, $p<0.05$; aesthetic emotion : $t(21) = -2.15$, $p<0.05$) for M. corrugator supercilia. For positive emotion stimuli, the earliest time point of significance was at 3400ms (basic emotion: $t(21) = 3.99$ $p < 0.001$; aesthetic emotion : $t(21)=-3.3$ $p < 0.01$) for M. corrugator supercilia. This finding indicated that both aesthetic emotion and basic emotion expressed by M. corrugator supercilii were significantly different from the baseline of zero within the same period of time, which fully verified the concept of co-existence in the Parallelism Hypothesis.

As for the test of independency, the data were separately analyzed by the variable *r* in the Pearson's test for both the aesthetic and basic emotion under each condition. For negative stimuli at far distance, the Pearson's *r* between basic emotion and aesthetic emotion was respectively -0.93 ($p<0.001$) for M. corrugator supercilii and -0.51 ($p<0.01$) for M. zygomaticus. Please refer to **Figure 12** for the remaining correlation values. This finding suggested that at far distance, the aesthetic emotion and the basic emotion when observing high aesthetic but negative pictures might not be independent but co-existed, which partially supported the Parallelism Hypothesis.

The Verification of the Asynchrony Hypothesis

It was assumed that there was no aesthetic emotion at close distance and therefore,

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the following results would include data at far distance only.

To verify if aesthetic emotion and basic emotion were produced at different time points, one-sample *t*-test was performed on the average of every 100ms for both emotions under each condition. The earliest time period at which the two emotions met the significance criteria was checked. The criterion of statistical significance was the same as before (see p.52).

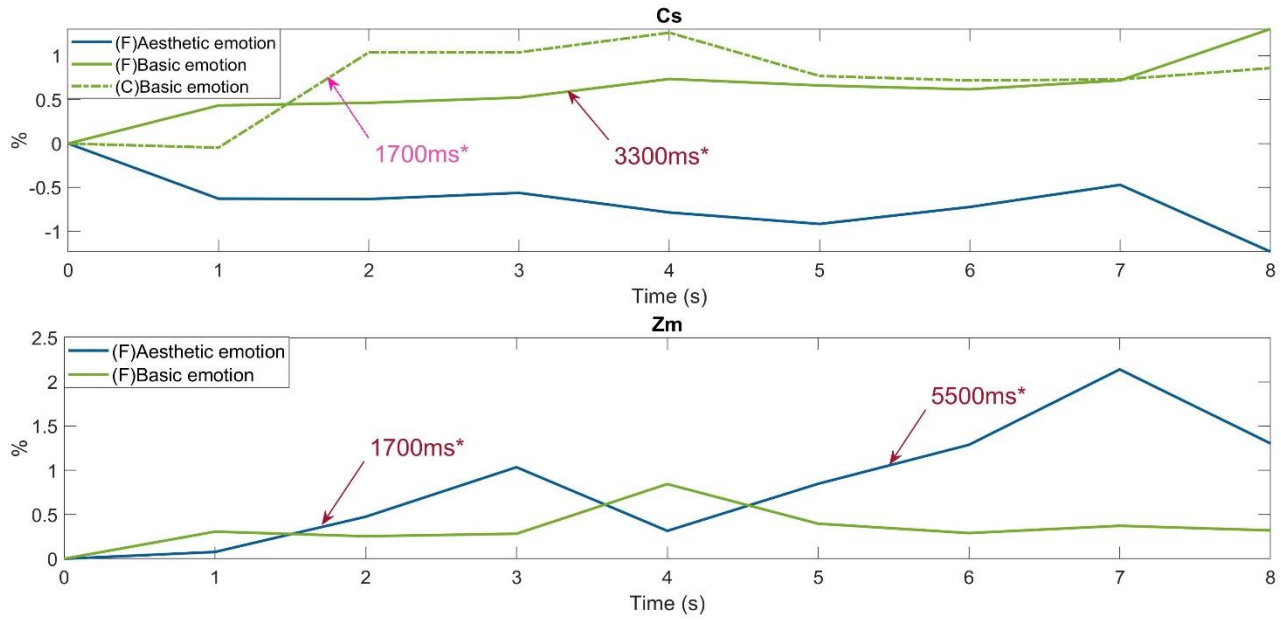

Figure 14. Verification of Asynchrony in Negative Conditions. **F** = far distance. **C** = close distance. **Cs** = M. Corrugator Supercilii. **Zm** = M. zygomaticus. * refers to the p-values of one-sample t-test. * as p<0.05.

As in **Figure 14**, the results showed that for the negative stimuli at far distance, the earliest peak of aesthetic emotion in M. zygomaticus appeared in the time period of 1700ms ($t(21) = 1.98$ $p < 0.05$) to 1900ms ($t(21) = 1.88$ $p < 0.05$). The first peak of basic emotion in M. corrugator supercilii appeared in the time period of 3300ms ($t(21) = 2.05$ $p < 0.05$) to 3500ms ($t(21) = 2.89$ $p < 0.05$). According to the above results, it

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was possible that aesthetic emotion and basic emotion were produced at different time periods, but aesthetic emotion might occur earlier than basic emotion in the order of occurrence.

Discussion

This study was to explore the relationship between basic emotion and aesthetic emotion over the course of time at different psychological distances. The stimuli were art pictures of negative and positive connotation with high and low aesthetic level, which were to be viewed at either far or close distance. The measurement included behavioral data, fEMG data, SCR data and the decomposing fEMG data.

The manipulation of emotional valence and aesthetic level in this study was confirmed by using behavioral data. In addition, beautiful (high aesthetic level) pictures were rated to convey higher emotional valence and were preferred over the unbeautiful pictures, especially more so at a far distance than at a close distance, even though viewers had shorter viewing time when standing far away from them.

The original purpose of measuring SCR data was to compare the difference in emotional arousal at different psychological distances. In contrast to the hypothesis, as demonstrated by SCR data, the effect of Distance was not significantly different, while

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the interaction of *Emotion* x *Aesthetics* was significantly different, which suggested that there was a larger arousal difference in the tendency of viewers on beautiful and unbeautiful pictures with negative stimuli. However, in terms of subjective evaluation, the interaction of *Distance* x *Emotion* on negative stimuli could reflect the effect of Distance. This might also indicate that the differences in emotional arousal at different psychological distances could be observed by the subjective evaluation but could not be clearly reflected in the physiological data.

The activation patterns of M. corrugator supercilia and M. zygomaticus in fEMG data were consistent with the prediction from the emotional valence of stimuli. In line with the behavioral results, beautiful pictures were found to have less activation in M. corrugator supercilia and more activation in M. zygomaticus than the unbeautiful ones. Psychological distance was found to interact with aesthetic level in which the beautiful pictures with negative stimuli viewed at far distance would activate M. corrugator supercilia less than activating more of M. zygomaticus when compared with the other three conditions (namely, beautiful but negative pictures viewed at close distance and unbeautiful pictures with negative stimuli viewed at both close and far distance). The further decomposition of fEMG data into aesthetic emotion and basic emotion showed that these two emotions could co-exist, but not independently, and were produced at different time. These results would be discussed below in relation to the hypotheses

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proposed in this study, DEM and other previous findings.

The Parallelism Hypothesis

According to the decomposition of data, the results did support the co-existence of aesthetic emotion and basic emotion, as both had been verified to be significantly activated simultaneously in many periods of time, with the earliest onset of M. corrugator supercilia at time point of 3400ms, further proving the co-existence of these two emotions. Such results were also consistent with previous literatures that if two emotions were produced, they could indeed co-exist with respective intensity for a period of time, rather than alternating between the two (Carrera & Oceja, 2007; Ersner-Hershfield et al., 2008; J. T. Larsen & McGraw, 2011; Oceja & Carrera, 2009).

However, to verify the independency of the two emotions, a strongly negative correlation was uniformly obtained by using the Pearson's *r* on the data analysis. The independency proposed in the Parallelism Hypothesis could not be supported by the result of decomposition on data, indicating that there might be no independent relationship between basic emotion and aesthetic emotion. The definitions of "co-existence" and "independency" are quite different from the description of the " simultaneous " emotional experience used in the series of studies by Wagner et al. (2014), Carrera and Oceja (2007); Oceja and Carrera (2009). In those studies, the

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emotions were specifically described as simultaneously experienced when both positive and negative emotions could be found in a period of emotional experience, which was a comprehensive result without considering the time course of their production. However, the "independency" of the present study focused on whether the emotions could change independently over the course of time without affecting each other. Therefore, the subjective rating would be the appropriate choice in reflecting the simultaneous experience as described by these previous studies on finding the co-existence of negative and positive emotional experience in the same picture. However, the independency of emotions as defined in the present study must be tested with continuous measurement over the time course, such as by using EMG data, which would make the temporal analysis of correlation possible, despite the difficulty of comparison with previous studies, since the temporal relationship between emotions had rarely been discussed before. From analyzing the decomposition of EMG data in the present study, it showed different results in the negative and positive pictures. In the negative pictures at far distance, where the basic emotion was shown with negative emotional valence and the aesthetic emotion with a positive valence, the negative correlation between M. corrugator and M. zygomaticus in activation to both emotions would, in a way, confirm an existing dependency in the intensity of two emotions. In other words, the intensity of negative basic emotion gradually increased with time as

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reflected by M. corrugator activation, just like the intensity of aesthetic emotion being reflected by M. zygomaticus activation. To further clarify, aesthetic emotion was produced simultaneously with basic emotion, or even dominated the overall emotional performance, similar to the *Highly Simultaneous* or *Prevalence* pattern observed by Oceja and Carrera (2009). However, for the positive pictures at far distance, the negative correlation and the patterns of the two emotions were much similar to the presentation of the four patterns found in the study by Oceja and Carrera (2009), where a decreasing positive basic emotion was reflected by the greater activation of M. corrugator and an increasing aesthetic emotion was reflected by the greater activation of M. zygomaticus. The inconsistency of results between positive and negative emotion could be explained in two ways. One possibility was that there were indeed different characteristics of aesthetic experience between negative and positive stimuli. The other possibility was the violation of either pre-assumptions of the decomposition method, which were the linear relationship between the emotions and the immutability of the basic emotions within the beautiful and the unbeautiful versions of stimuli. Therefore, the relationship between basic emotion and aesthetic emotion in the time domain might be co-existent, but it was not independent, and two emotions might influence each other over time.

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There were several differences between the EMG results and Wagner's findings (Wagner et al. (2014)). In this study, when viewing pictures with high aesthetic level and negative emotion at the far distance, aesthetic emotion was more dominant in leading to an extremely high positive emotion in fEMG, while negative emotion seemed to have disappeared. The differences between two studies might come from the following possibilities. First of all, this study was very different from Wagner et al.'s study in terms of the experimental materials. In this study, oil paintings with a distinctive high and low aesthetic level were used. The pictures with high aesthetic level should theoretically bring a higher level of aesthetic emotion. Second, the manipulation of context worked differently. In addition to the manipulation of instructions, this study simulated the background of an art gallery, which might increase the showing of aesthetic emotion in this context. Third, the selected types of negative emotion might also cause varying intensity. Compared with the theme of disgust, sadness would have lower degree of negative valence and arousal. These differences between types of negative emotions could also be found in previous studies (Wolf et al., 2005) . In addition, fEMG measurement at multiple time points contrasted from a general measurement of subjective rating to yield different outcomes. In summary, the inconsistency between two studies might be due to the different choices of experimental materials, context manipulation, the types of negative emotion and measurements.

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The Asynchrony Hypothesis

The asynchrony hypothesis was verified by one-sample t-test for basic emotion and aesthetic emotion. It was indeed different at time points when the level change was significantly greater than 0, and the emerging time of the aesthetic emotion (1700ms) was earlier than the time for basic emotion (3300ms). This order was opposite to what was initially predicted by DEM. However, a greater peak, which was found in a late period (5500ms), suggested that there might be different degrees and different stages of aesthetic emotion. Aesthetic emotion might be produced at the early time, even before basic emotion, but continued to affect the course of art experience.

On the other hand, if the processing fluency is associated with positive feeling and the experience of beauty, it was also possible that the effect of fluency might be reflected in the activation of M. zygomaticus, such as the emotional expression of aesthetic perception in a very early time (Forster, Leder, & Ansorge, 2013; Jakesch, Leder, & Forster, 2013; Pelowski, Markey, Forster, Gerger, & Leder, 2017; Reber, Schwarz, & Winkielman, 2004; Reber, Winkielman, & Schwarz, 1998; Silvia, 2009). However, the effect of fluency was not discussed in DEM.

In addition, for the negative stimulus at far distance, the first significant peak of basic emotion was located at 3300ms of the activation of M. corrugator, but the first significant peak of basic emotion to negative stimulus at close distance was observed

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at 1700ms ($t(19) = 2.51$, $p<0.05$). This finding might indicate that the appearing time of basic emotion at close distance occurred earlier, or the degree of emotion was relatively greater at close distance, which created the peak over the threshold at earlier time for M. corrugator. This phenomenon also suggested that the emergence of aesthetic emotion might delay or reduce the activation of negative basic emotion. In summary, not only was the Asynchrony Hypothesis supported, but there were some new and more detailed discoveries found.

The Psychological Distancing Hypothesis

The effect of psychological distance was supported by behavioral data and fEMG data. In the behavioral results, beautiful pictures were more preferred when viewed at far distance than at close distance. In the fEMG data, the activation of M. zygomaticus to the same negative but beautiful pictures at different distances in the late period of time was found to be significantly different, but generally, with more activation as viewers at far distance. Furthermore, the activation of M. corrugator to the negative but beautiful pictures at far distance in the late period was also significantly lower than the baseline of zero, which also implied a strong distance effect, requiring stepping away from the pictures to produce aesthetic emotion. Moreover, the comparison of viewing negative but beautiful pictures at far distance with the other three Aesthetic-Distance

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conditions also revealed a huge difference between the two. When viewing the negative but beautiful pictures at far distance, M. corrugator activation was significantly lower in all time periods, and M. zygomaticus activation was higher in the late period. This result showed that the highly aesthetic but negative pictures only produced aesthetic sensation particularity at far distance. Similar pattern also appeared in the comparison of high aesthetic positive pictures at far distance versus the other conditions. But since all emotions produced in response to the pictures were positive, only the activation of M. zygomaticus in the late period was greater than in other conditions.

The pattern of fEMG results was also consistent with the findings of Gerger et al. (2014). Both studies found that the activation of M. zygomaticus to high aesthetic but negative arts at far distance (or with the context of art) were significantly higher than that at close distance (or with the context of lab environment). Based on the above results, the Psychological Distancing Hypothesis was clearly supported by the evidence.

Furthermore, the subjective rating scores and physiological data were integrated to comprehensively discuss the differences in the effect of distance. Although the effect of distance was clearly shown in the EMG result, there was no significant difference in the rating scores of aesthetic levels, positive valence/arousal between far and close distance. There were several speculations about this phenomenon. First, it could not be ruled out that although art context was not provided at close distance, the participants

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might still adjust their psychological distancing during viewing, when they knew exactly that aesthetic level was one of the items to be rated. As a consequence, the results at either close or far distance could not show differences in the ratings. Second, the measurement of rating relied on conscious judgment, while EMG was more non-conscious reactions. These two kinds of reactions might contain different components. Finally, EMG specifically focused on the emotional changes in time, while the measurement of rating only showed as a single and comprehensive score at the end of the viewing process. This might also indicate that the difference in aesthetic emotion caused by different psychological distances was more likely to show the difference at various time points during the viewing process.

The Implications of DEM

The findings on the effect of distance in fEMG and the patterns of decomposed emotions of negative pictures at far distance were similar to the D-E-M stages of DEM hypothesis. Both the fEMG pattern and decomposed emotions showed the effect of distance on the experience of negative pictures. In the early period of time, the uplifted activation of M.corrugator corresponded to the low aesthetic negative emotion (i.e., basic emotion) while M. zygomaticus was relatively in low level of activation. In the late period, M. zygomaticus was significantly activated at far distance. This pattern

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indicated that basic emotion was the primary response in the early period, while aesthetic emotion became stronger in the late period of time, which was consist with the stages of DEM. In negative stimuli, the comparison of high aesthetic pictures at far distance with the other three Aesthetic-Distance conditions also showed higher activation of M. zygomaticus and lower activation of M. corrugator. This result indicated that only in this particular situation (viewing beautiful pictures at far distance) would we observe aesthetic emotion being produced, which was consistent with the results on the relationship between psychological distancing and aesthetic emotion in previous studies (Bullough, 1912; Cupchik, 2002; A. Peter Mcgraw & Warren, 2010; A Peter McGraw et al., 2012; A Peter McGraw et al., 2013; Menninghaus et al., 2017; Price, 1977). Moreover, at far distance, the low activation of the basic emotion in M. corrugator during all time periods also indicated that aesthetic emotion might mitigate the activation level of basic emotion.

Besides, the same pattern was seen in the positive pictures, as well. But considering that in this situation both basic emotion and positive emotion were in the same valence, there was no significant difference in M. corrugator in the early period of time, but still yielding a strong activation of M. zygomaticus by the high aesthetic pictures in the later period of time. It indicated that positive and negative emotion had similar pattern at far and close distance, which was an unexpected but interesting

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finding, suggesting that not only did negative stimuli required a suitable psychological distance to produce aesthetic emotion, but positive stimuli exposed at a context of distance also enhanced the production of aesthetic emotion. DEM should include this kind of applied technique which considering positive stimuli.

In another respect, there was a small peak in the early period of time for M. zygomaticus in response to the high aesthetic but negative pictures at far distance, which was considered to be related to perceptual fluency. The seperated peaks happened to be in line with the interpretation of why the distance was needed to produce aesthetic emotion from negative pictures, as described by the transition between the distance and the embrace stages by DEM. Yet there was no distancing stage in positive pictures that the activity in the M. zygomaticus continued to increase from the beginning, with no obvious differentiation between the two stages. All of these results were consistent with DEM.

Viewing Duration and Transition Times

The results of fEMG could also correlated with the subjective conscious experience of the participants. At both far and close distance, participants on average pressed the "emotion transition" button two to three times during the viewing. The time point of the first keystroke at far distance took about 5 to 6 seconds on average, which

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seemed to be in match with the rising of activating M. zygomaticus in the second peak of decomposed fEMG for the negative pictures. Unfortunately, at close distance, the first keystroke took 8 to 9 seconds that was beyond the time interval included in the analysis. Perhaps in the future study, attempts will be made to analyze long-term myopotential changes to provide a more comprehensive analysis of individual emotional changes.

Further Implications

There are still some unanswered questions worthy of future discussion. First of all, the decomposing method was built upon the assumption that aesthetic emotion and basic emotion were linearly additive in effect. But such assumption was violated, which led to imprecise decomposition of the two emotions. The subtraction procedure also caused the problem in mirror image symmetry in some cases. To decompose aesthetic and basic emotion better, more appropriate methods and experimental designs need to be developed.

Second, behavioral data might be difficult to clearly reflect the subtle changes in aesthetic emotion throughout the whole viewing process. Although the aesthetic effect on emotional valence was strong in behavioral data, it could not contribute much to the understanding of aesthetic emotion at different distances and the change of aesthetic emotion during every viewing time point.

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Finally, although there was a clear physiological distinction between positive and negative emotions and aesthetic emotion, these states of emotions were combined in subjective ratings. It was often difficult for participants to distinguish the difference between basic emotion and aesthetic emotion in positive emotional reaction, not to mention that it was also hard to distinguish the aesthetic emotion from negative emotional reaction. Perhaps for most people's subjective experience, emotional state is more like an integrated state of mixed experience rather than a clear individual experience of emotion, in which such concept remains consistent with previous studies that emotional heterogeneity may differ from individuals, be related to age and be affected by daily life stress (S. T. Charles, 2005; Susan T. Charles, Piazza, & Urban, 2017; Grühn, Lumley, Diehl, & Labouvie-Vief, 2013; Kashdan, Barrett, & McKnight, 2015; Kreibig, Samson, & Gross, 2015; Magai, Consedine, Krivoshekova, Kudadjie-Gyamfi, & McPherson, 2006; Rüger, Rode, & Döll-Hentschker, 2011; Ready, Carvalho, & Weinberger, 2008). This further increase the difficulty in discriminating emotions. These are the issues that need to be further addressed and discussed in the future.

Contributions of the present study

This study would be the first attempt to separate basic emotion and aesthetic emotion, and compare them in time. The results verified the relationship of co-existence

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and asynchrony between the two emotions over the course of time. These findings contributed much to the understanding of affective processing in aesthetic appreciation.

In this study, there was also a successful manipulation that changed the context in the laboratory to a gallery-like context full of art appreciation which provided an appropriate psychological distance to induce distancing of aesthetic experiment. Moreover, in contrast to Gerger et al. (2014), the stimuli of the present study were all art paintings with similar physical structures of beautiful and unbeautiful pictures. This design provided a good control and made the comparison between high and low aesthetic level possible. The results showed the effect of aesthetic level on valence rating, preference rating, the activation of M. corrugator supercilia and the activation of M. zygomaticus. Also, the interaction of Aesthetics and Distance revealed that beautiful pictures viewed at far distance would pose as the most appropriate condition to produce the necessary aesthetic emotion, especially the negative stimuli. These findings also contributed much to the understanding of aesthetic appreciation.

Limitations of the present study

There were some limitations in this study. First, when decomposing the emotions, the adopted method could not exclude the possibility of nonlinear relationship between the emotions. Future studies may explore other decomposing methods to have a better

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result. Furthermore, there might be a chance and new thinking of using multiple facial muscles to run ICA (Independent Component Analysis) and other multiple source-positioning methods to try to separate different kinds of emotions in the future. The methods of ICA can also be applied to the measures of the comprehensive behavioral performances of emotions such as voices, or psychophysiological measurement such as brain waves, which are all the analysis methods that can be included in the future.

Second, the difference between high and low aesthetic level of positive pictures was not sufficiently significant at close distance. This might be the key reason for the insignificance of those statistical test results. Future studies should try to set conditions to further apart the difference between various aesthetic conditions to obtain a statistical reliable effect.

Finally, the context of placing viewer at close distance might still allow the negative stimuli of the artwork to pose psychological threat that M. zygomaticus was activated as a way to neutralize such discomfort, or else, the viewer would try to further distance even more far away in mentality to set a “rational” space to view the painting and with no emotion engaged. Future studies may need stricter environmental control to avoid any potential confounding factors, or have a good experimental design to keep subjects at an appropriately far psychological distance.

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Conclusion

This study by fEMG found the effect of distancing on high aesthetic but negative arts, where aesthetic emotion was induced at far distance, instead at close distance. Moreover, the relationship of asynchrony and co-existence between aesthetic emotion and basic emotion was verified. The evidence of activation sequence of emotions also supported DEM and previous studies. In addition, the results suggested that the relationship between aesthetic emotion and basic emotion was likely to be non-linear addition. Aesthetic emotion during arts appreciation might also be multi-layered which influenced the experience at a very early time. In the future, it is hoped that more suitable decomposing methods can separate the two emotions more clearly. And it is also suggested that researchers may consider recording and analyzing the complex psychological aesthetic experience with multiple transitions through long-time-record analysis.

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Appendix

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Appendix 1. Provenances and Rating Score of each Stimuli.

Work Name	Author	Stimuli Number
Athena and Centaur, 1482	Sandro Botticelli	NB_A01
Hunting from SINPALABRAS	Rogger Olmos	NB_A02
寒霧, 2012	艾軒	NB_A03
The taking of Christ, 1602	Michellangelo Merisi da Caravaggio	NB_A04
no topic(Their story series)	Haenuli	NB_A05
8050	Adam Tan	NB_A06
Ophelia	John Everett Millais	NB_A07
TURNING VINCENT - KEYFRAME from << loving vincent >>	Anna Kluza	NB_A08
微風掠過髮梢, 1990	艾軒	NB_A09
冬日寂寥, 2005	艾軒	NB_A10
Penitent Magdalene, 1565	Tiziano Vecelli	NB_B01
Milk from SINPALABRAS	Rogger Olmos	NB_B02
Dreams of Atlantis	Josephine Wall	NB_B03
無語問蒼天 （局部）	梁建新	NB_B04
Science And Charity 1897	Pablo Picasso	NB_B05
SKULL PAINTINGS Series	Johnny Crap (Jonathan Bergeron)	NB_B06
Deposition	Raffaello Sanzio	NB_B07
Self-Portrait with Dark Felt Hat	Vincent Willem van Gogh	NB_B08
聖山, 2009	艾軒	NB_B09
遠方飄來陌生的歌, 2005	艾軒	NB_B10
Penitent Magdalene, 1565 *(modified)*	modified by Yu, Yun-An	NN_A01
Milk from SINPALABRAS *(modified)*	modified by Yu, Yun-An	NN_A02
Dreams of Atlantis *(modified)*	modified by Yu, Yun-An	NN_A03
無語問蒼天 （局部）*(modified)*	modified by Yu, Yun-An	NN_A04
Science And Charity 1897 *(modified)*	modified by Yu, Yun-An	NN_A05
SKULL PAINTINGS Series *(modified)*	modified by Yu, Yun-An	NN_A06
Deposition *(modified)*	modified by Yu, Yun-An	NN_A07
Self-Portrait with Dark Felt Hat *(modified)*	modified by Yu, Yun-An	NN_A08
聖山, 2009 *(modified)*	modified by Yu, Yun-An	NN_A09
遠方飄來陌生的歌, 2005 *(modified)*	modified by Yu, Yun-An	NN_A10
Athena and Centaur, 1482 *(modified)*	modified by Yu, Yun-An	NN_B01
Hunting from SINPALABRAS *(modified)*	modified by Yu, Yun-An	NN_B02
寒霧, 2012 *(modified)*	modified by Yu, Yun-An	NN_B03
The taking of Christ, 1602 *(modified)*	modified by Yu, Yun-An	NN_B04
no topic(Their story series) *(modified)*	modified by Yu, Yun-An	NN_B05
8050 *(modified)*	modified by Yu, Yun-An	NN_B06
Ophelia *(modified)*	modified by Yu, Yun-An	NN_B07
TURNING VINCENT - KEYFRAME from << loving vincent >> *(modified)*	modified by Yu, Yun-An	NN_B08
微風掠過髮梢, 1990 *(modified)*	modified by Yu, Yun-An	NN_B09
冬日寂寥, 2005 *(modified)*	modified by Yu, Yun-An	NN_B10
Romeo and Juliet	Frank Dicksee	PB_A01
GUITAR AND SOUL	leonid afremov	PB_A02
Feelings	Michael and Inessa Garmash	PB_A03
PASSIONATE FLAMENCO	leonid afremov	PB_A04
The Passion	leonid afremov	PB_A05
After School	leonid afremov	PB_A06
Beautiful painting of a full moon on the beach, sailboat, homes on stilts and pier	Chuy Carillo	PB_A07
ANTWERP - BELGIUM PORT	leonid afremov	PB_A08
RAIN'S RUSTLE IN THE PARK	leonid afremov	PB_A09
The Grace	Gurdish Pannu	PB_A10
Springtime (1873)	Pierre Auguste Cot	PB_B01
Metallica Cliff Burton	leonid afremov	PB_B02
COSTA BRAVA DREAM	Vladimir Volegov	PB_B03
Ballet girl in white	ɔm https://ar.pinterest.com/pin/696439	PB_B04
BEAUTIFUL TANGO	leonid afremov	PB_B05
BEHIND THE FOG	leonid afremov	PB_B06
FLORIDA-LAKE OKEECHOBEE	leonid afremov	PB_B07
VENICE IN COLOR	leonid afremov	PB_B08
THE MOST BEAUTIFUL BRIDGES OF AMSTERDAM	leonid afremov	PB_B09
My playground	Teodora Chinde	PB_B10
Springtime (1873) *(modified)*	modified by Yu, Yun-An	PN_A01
Metallica Cliff Burton *(modified)*	modified by Yu, Yun-An	PN_A02
COSTA BRAVA DREAM *(modified)*	modified by Yu, Yun-An	PN_A03
Ballet girl in white *(modified)*	modified by Yu, Yun-An	PN_A04
BEAUTIFUL TANGO *(modified)*	modified by Yu, Yun-An	PN_A05
BEHIND THE FOG *(modified)*	modified by Yu, Yun-An	PN_A06
FLORIDA-LAKE OKEECHOBEE *(modified)*	modified by Yu, Yun-An	PN_A07
VENICE IN COLOR *(modified)*	modified by Yu, Yun-An	PN_A08
THE MOST BEAUTIFUL BRIDGES OF AMSTERDAM *(modified)*	modified by Yu, Yun-An	PN_A09
My playground *(modified)*	modified by Yu, Yun-An	PN_A10
Romeo and Juliet *(modified)*	modified by Yu, Yun-An	PN_B01
GUITAR AND SOUL *(modified)*	modified by Yu, Yun-An	PN_B02
Feelings *(modified)*	modified by Yu, Yun-An	PN_B03
PASSIONATE FLAMENCO *(modified)*	modified by Yu, Yun-An	PN_B04
The Passion *(modified)*	modified by Yu, Yun-An	PN_B05
After School *(modified)*	modified by Yu, Yun-An	PN_B06
autiful painting of a full moon on the beach, sailboat, homes on stilts and pier *(modifie*	modified by Yu, Yun-An	PN_B07
ANTWERP - BELGIUM PORT *(modified)*	modified by Yu, Yun-An	PN_B08
RAIN'S RUSTLE IN THE PARK *(modified)*	modified by Yu, Yun-An	PN_B09
The Grace *(modified)*	modified by Yu, Yun-An	PN_B10

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Stimuli Number	Aesthetic level	Negative emotional valence	Negative emotional Arousal	Positive emotional valence	Positive emotional Arousal
NB_A01	6.61	6.00	5.61	4.13	3.26
NB_A02	6.24	7.19	7.86	3.14	2.81
NB_A03	7.68	5.64	4.86	5.32	3.82
NB_A04	7.19	6.33	6.48	4.24	3.57
NB_A05	7.90	7.57	6.52	3.90	3.43
NB_A06	7.55	5.73	4.68	5.05	4.41
NB_A07	7.59	7.36	5.68	4.05	3.59
NB_A08	7.50	5.50	3.80	4.25	3.45
NB_A09	7.09	5.64	3.82	4.86	3.50
NB_A10	7.24	6.33	4.48	4.57	3.14
NB_B01	7.00	5.91	5.05	4.82	3.59
NB_B02	6.27	5.86	5.00	3.95	3.36
NB_B03	5.86	3.86	2.82	6.23	4.36
NB_B04	6.95	7.77	5.36	3.59	3.23
NB_B05	6.59	6.95	5.50	2.64	2.36
NB_B06	7.27	6.95	6.09	4.95	4.00
NB_B07	7.09	7.68	6.41	3.18	2.55
NB_B08	5.59	6.00	3.91	3.14	2.50
NB_B09	7.00	5.00	3.68	5.77	4.45
NB_B10	7.27	6.68	4.45	4.55	3.50
NN_A01	4.64	7.00	5.77	3.50	3.00
NN_A02	5.14	6.91	5.91	3.41	2.86
NN_A03	3.50	6.20	6.30	2.75	2.45
NN_A04	4.90	7.48	7.33	2.95	2.52
NN_A05	5.19	5.57	6.57	2.76	2.33
NN_A06	4.68	7.77	7.27	3.27	2.91
NN_A07	4.90	6.50	6.80	2.90	2.65
NN_A08	4.60	6.25	6.35	2.75	2.40
NN_A09	5.00	5.95	6.09	3.41	3.27
NN_A10	5.23	6.73	5.86	3.18	2.77
NN_B01	5.05	7.59	6.09	2.59	2.41
NN_B02	5.82	5.86	5.27	2.77	2.77
NN_B03	6.14	6.95	5.45	3.91	2.68
NN_B04	6.18	8.18	7.55	3.82	3.86
NN_B05	6.68	7.09	6.82	2.86	3.05
NN_B06	4.36	7.00	5.32	3.27	3.14
NN_B07	4.23	6.77	6.14	2.59	2.91
NN_B08	5.73	6.95	4.91	2.86	2.68
NN_B09	6.50	8.14	5.45	3.36	2.95
NN_B10	6.23	6.14	5.59	3.77	3.00
PB_A01	7.32	2.91	2.23	7.14	5.32
PB_A02	7.86	3.52	3.14	6.76	5.67
PB_A03	7.95	4.64	2.95	5.23	4.05
PB_A04	7.38	3.57	3.24	6.76	6.05
PB_A05	7.86	3.05	2.68	6.41	5.91
PB_A06	7.18	4.82	3.86	5.59	4.73
PB_A07	6.50	2.86	2.36	6.05	5.14
PB_A08	8.05	2.60	2.60	6.60	4.15
PB_A09	6.10	3.10	2.50	6.90	5.75
PB_A10	6.62	4.86	4.05	5.19	4.52
PB_B01	5.68	2.32	2.14	6.86	6.32
PB_B02	6.82	2.91	3.00	6.95	5.32
PB_B03	6.82	3.36	2.59	6.41	4.00
PB_B04	5.73	3.91	3.09	6.77	5.73
PB_B05	7.41	3.18	2.41	7.86	6.55
PB_B06	7.95	5.32	3.32	4.82	3.09
PB_B07	6.14	3.45	2.68	6.05	4.59
PB_B08	8.32	2.55	2.27	7.27	4.73
PB_B09	8.05	2.68	2.23	6.41	4.95
PB_B10	4.32	2.82	2.18	6.73	3.91
PN_A01	6.75	4.00	3.00	6.85	5.40
PN_A02	6.00	4.43	4.74	5.74	5.04
PN_A03	7.32	3.50	2.36	7.27	4.91
PN_A04	7.00	3.95	3.86	6.38	5.90
PN_A05	5.27	4.73	4.45	6.23	5.64
PN_A06	6.67	4.29	3.05	4.43	3.57
PN_A07	7.43	4.19	3.29	5.81	4.14
PN_A08	5.85	4.75	4.65	4.95	4.05
PN_A09	6.73	3.77	2.86	5.50	4.73
PN_A10	6.75	4.70	4.40	5.40	4.10
PN_B01	6.77	5.82	4.05	6.36	5.50
PN_B02	7.27	3.86	3.64	5.82	5.05
PN_B03	6.64	6.27	4.86	3.64	2.77
PN_B04	6.23	4.00	3.18	5.50	4.45
PN_B05	6.77	3.18	2.95	6.68	5.23
PN_B06	8.23	3.45	2.68	6.18	4.41
PN_B07	7.27	3.50	2.55	6.45	4.45
PN_B08	7.41	4.41	3.77	4.59	3.32
PN_B09	7.86	3.41	2.68	6.36	4.32
PN_B10	6.50	5.64	4.27	4.36	2.91

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Stimuli Number	Duration time	Preference	Emotion transition times
NB_A01	23.04	5.26	1.65
NB_A02	24.37	6.43	2.33
NB_A03	20.04	6.59	2.05
NB_A04	21.21	5.71	2.19
NB_A05	23.32	6.90	2.43
NB_A06	23.39	6.41	2.45
NB_A07	22.33	5.95	2.18
NB_A08	18.45	7.00	1.90
NB_A09	19.73	6.91	2.05
NB_A10	20.61	6.71	1.86
NB_B01	29.41	6.45	2.86
NB_B02	27.76	5.64	3.23
NB_B03	30.16	6.23	3.68
NB_B04	22.95	5.68	3.36
NB_B05	28.39	4.86	3.64
NB_B06	28.63	6.23	3.82
NB_B07	35.30	5.23	3.27
NB_B08	18.82	4.95	2.00
NB_B09	25.08	7.14	2.95
NB_B10	22.76	6.32	3.36
NN_A01	22.55	4.14	2.09
NN_A02	27.45	5.41	2.55
NN_A03	19.86	3.35	2.70
NN_A04	22.20	4.24	2.33
NN_A05	22.71	4.14	2.14
NN_A06	26.14	4.05	2.55
NN_A07	23.11	4.10	3.00
NN_A08	18.34	3.60	2.05
NN_A09	20.97	4.18	2.00
NN_A10	22.20	4.45	2.18
NN_B01	27.03	4.41	4.00
NN_B02	29.87	5.36	4.09
NN_B03	23.84	5.09	3.18
NN_B04	31.30	4.95	3.59
NN_B05	26.83	6.00	3.23
NN_B06	27.16	3.82	2.73
NN_B07	22.51	3.55	2.77
NN_B08	20.22	4.41	3.18
NN_B09	21.52	4.41	3.14
NN_B10	28.69	5.23	3.23
PB_A01	19.77	7.36	1.86
PB_A02	19.15	7.10	1.62
PB_A03	20.99	7.18	1.73
PB_A04	18.99	6.95	1.95
PB_A05	20.26	7.05	1.86
PB_A06	20.71	6.23	1.91
PB_A07	20.94	6.77	1.95
PB_A08	20.21	7.35	1.55
PB_A09	22.91	6.10	2.20
PB_A10	21.49	6.29	1.90
PB_B01	26.36	7.45	3.23
PB_B02	23.64	6.18	3.00
PB_B03	24.50	7.05	3.41
PB_B04	23.94	6.50	3.32
PB_B05	22.67	6.82	2.50
PB_B06	24.78	6.73	2.86
PB_B07	27.17	7.45	2.82
PB_B08	27.45	7.77	2.32
PB_B09	23.90	7.23	2.23
PB_B10	30.55	4.86	3.36
PN_A01	16.67	6.30	1.70
PN_A02	19.26	5.22	2.13
PN_A03	18.67	7.41	2.05
PN_A04	18.45	7.00	2.38
PN_A05	21.20	5.50	2.00
PN_A06	23.80	5.95	1.62
PN_A07	19.10	6.62	1.81
PN_A08	21.69	5.55	2.00
PN_A09	21.33	6.91	1.95
PN_A10	19.53	5.90	2.05
PN_B01	24.47	5.64	3.27
PN_B02	28.91	6.45	2.55
PN_B03	21.95	5.45	3.00
PN_B04	24.27	6.23	2.73
PN_B05	26.55	7.64	3.18
PN_B06	21.58	6.91	2.41
PN_B07	26.01	6.50	3.27
PN_B08	24.34	6.41	2.59
PN_B09	26.57	7.00	3.59
PN_B10	26.61	5.77	2.86

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