Summary and Initial Exploration of Barbara Gail Montero's Article "The Artist as Critic: Dance Training, Neuroscience, and Aesthetic Evaluation"

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Abstract: In a sentence in the article "The Artist as Critic", Wilde reveals that critics are also artists and that critics should have their aesthetic appraisal, and the purpose of criticism is to be more innovative. Meanwhile, the writer reads Barbara Gail Montero's article (The Artist as Critic: Dance Training, Neuroscience, and Aesthetic Evaluation) and attempts to find a breakthrough in dance training and neuroscience to achieve the ability to establish one's aesthetic evaluation. This paper tries to understand the Multi-expression forms of art from the relationship between dance training, neuroscience, and aesthetic evaluation. This interdisciplinary study can evolve into an integral part of the field of dance. In order to further promote the development stages and value of applications in the research work, a series of integration and related analyses has been investigated by the author.
***Keywords*:** The Artist as Critic, Barbara, dance training, neuroscience, aesthetic evaluation

1. Introduction

Since the mid-to-late 18th century, with the rise of aesthetic evolution and neuro-basic science research, Gibson explained how people perceived specific actions in 1979. In 1890, humans discovered the inseparable relationship between Hemodynamics and Neurons. Until 1990, the functional magnetic resonance imaging technique was rediscovered and used in the field of neuroscience by Japanese physicist and neurologist Seiji Ogawa. In 1980, neurophysiologist Giacomo Rizzolatti discovered the evolutionary process by which mirror neurons function to facilitate human action. (The human mirror system, known as mirror neurons, is a much-studied topic in neuroscience. The nerve cells in mirror neurons function to reflect others' behaviours so that one can imitate them. Imitation becomes increasingly complicated, which includes acquiring language, art, music, and tool-using skills.) It was not until 1999 that neuroaesthetics appeared in the sights of scientific and artistic communities. People seem to have found many answers to explain the causal relationship between science and aesthetics, but those answers have different views for different people, and they still fail to explain many phenomena of spontaneous aesthetic perception from art practitioners. For the aesthetic research of dance majors, it is also one of the important research subjects in neuroscience and neuroaesthetics in European countries in recent years. In order to explore further the aesthetic experience mechanism of dance, which has triggered a series of thoughts by the author: How does dance affect the neural activity of the human brain? How does an artist's aesthetic evaluation arise from the dance? How does neuroscience affect the aesthetic perceptual function of dance training? Since the aesthetic perception of art exists in the world of human perceptual thinking (Nadal & Pearce, 2022), and the perceptual thinking based on subjectivity is far from being able to make an objective definition of aesthetic perception, it is necessary to evaluate the criteria for its evaluation with the help of scientific instruments to reflect the internal structure of the human brain. For a practitioner who has received professional dance training, they will subtly establish the aesthetic perception function of the action in the process of training. For instance, dancers exude exclamation of admiration when they look at the instep of a ballerina's feet, which cannot be fully appreciated in the eyes of the layman (George, 2020). Dance training, therefore, helps people see aesthetic aspects that others may not see. In contrast, those who have not been trained in dance perceive this unfamiliar aspect. This article is divided into five aspects as an overview; The first three parts summarise the issues involved in Barbara's article, while the fourth and fifth parts explore the value of extensibility.

2. The relationship between dance training and neuroscience

As far as neuroscience, dance is a combination of body and mind as one of the overall movement, music (hearing), space (vision), body movement (kinesthesis), muscle work (proprioception), and other sensory stimulation at the same time, which more requires a nervous system to regulate and integrate them (Montero, 2013). Meanwhile, neural network connections will also be enhanced to adapt to this rich and complex stimulus. Some scientific research in recent years that used dance as a tool

to understand links between action perception and action execution because long-term dance training will make the structure and function of the cerebral cortex have corresponding adaptive changes (Wu, 2017). The effect of dance on adaptive changes in the brain comes from "Physical Movement". Western scholar Hulnggi et al. first used magnetic resonance imaging (MRI) to test professional and non-professional dancers, and the results showed that the professional dancers were significantly more active in the premotor cortex, supplementary motor area, nuclei, internal capsules, and corpus callosum are reduced in grey and white matter volume in some brain regions, and it will alter how the brain accepts and habitually behaves for things (Kolcio, 2010). Calvo Merino, a researcher from the University of London in the United Kingdom, tested the same study using the functional magnetic resonance technique (FMRI) to confirm the validity of the original study. [Functional Magnetic Resonance Imaging FMRI refers to neuroimaging that measures the changes in hemodynamics caused by neuron activities. It is now mainly used to study the human and animal brains or spinal cords. As the changes in blood flow and blood oxygen (collectively referred to as hemodynamic response) are closely related to the excitation of neurons, there will be yellow or orange images in the exciting areas of the brain when one receives external stimuli. Data obtained during this time allow cognitive neuroscientists to gain information regarding the role of particular brain regions in cognitive function]. In the test, non-expert groups and the Royal Ballet's expert groups compared data by watching videos of the Capoeira (Brazilian martial art dance form) dances. The results showed that trained dancers exhibit relatively heightened movement observation network activity when they watch the form of dance they have learned (Montero, 2013). Calvo Merino argues that differences in movement can only explain any change in neural activity associated with aesthetic evaluation. In addition, these neural activities that are active in the premotor region of the cerebral cortex cause "motor synchronization", also known as human mirror systems, action observation networks, and action resonance circuits. When these systems are more active in the subject's brain, we can understand that the subject's action perception is enhanced (Ruprecht, 2007). In one study, researchers also found that when male and female ballet dancers watched movements that matched their gender, the motor areas of their brains were more active than when watching movements of the opposite gender. The researchers claim that the brain's response to seeing an action depends not only on the vision and experience of this action seen before but also on the experience of the movement that has previously acted. Various research behaviours suggest that dance training affects the brain's mirror system and has a higher-level perception effect. The action perception and human aesthetic perception is the oneness concept: the mirror neuron system contains cells that represent actions activated when we detect the movements and emotions of other people. For instance, in this system, when the actors' curtain calls, the emotions conveyed by the audience's vigorous applause are the most intuitive sense of aesthetic identity. Thus, it could be further argued whether dance training can affect a person's aesthetic perception ability.

In order to deeply explore the characteristics of neural activity in dancers' brains during dancing, some scholars from European countries have done a variety of studies on the integration mechanism of dance and rhythm and the work of the neuronal mechanism of the dancer's brain during the dance, and the specialization of the dancer's brain nerve mechanism when dancing. (Karpati et al., 2015). Multi-movement basis involves the rhythm, control of space, appropriate responses to external stimuli, coordination of the whole body with external responses, etc. However, dance is a form of advanced movement, whether it follows a standard action mechanism or another new brain mechanism response system different from the ordinary action mechanism? Berger (2003) Scholar Steven Brown et al. conducted comparative research systematically through Positron Emission Computed Tomography. They found many similarities in the nerve basis of movement between dance and normal motion, while the brain regions activated in dance were also activated in some primary motions (Zardi, A. et al., 2021)[Positron emission tomography (PET) is an imaging technique currently used extensively in the activities of neurotransmitters on living bodies. This is also the technique employed by FRMI.] Therefore, it shows that dance and primary motion follow the same brain activity program. The brain has a similar motion perception process for complex dance and single local movements. In particular, the motion under regular notes and irregular notes showed the automatic control function of the right nucleus: during dance training, some regions such as the brain, the cerebellum, are activated at the overall level, which indicates that multiple brain regions function as a standard connection during a dance (Basso et al., 2021).

Moreover, Hüfner et al. found that the tephrylometer of dancers in the anterior hippocampus was relatively small (Lapshina, 2020). However, the posterior hippocampus and the two sides of the tongue fusiform gyrus were relatively large, indicating that dance training impacted the hippocampal structure while improving the balance ability. Similar to the research approach used in Calvo-Merino,

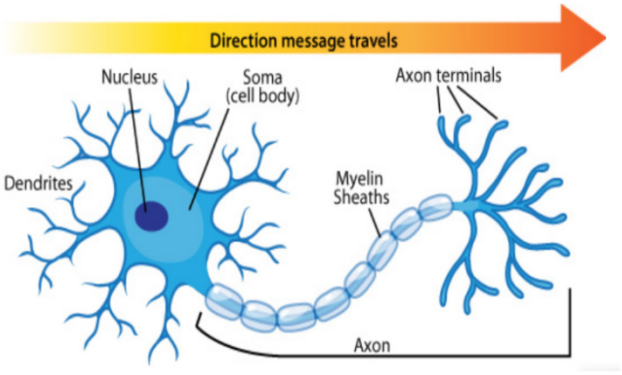
Nigmatullina used the magnetic resonance imaging technique (MRI) to measure differences in brain structure between dancers and kayakers and found selective reductions in grey mass in the cerebellum associated with dance training but related to vestibular task performance and time of dance training (Nannicelli, 2020). In other words, the increase in brain grey matter

density is positively correlated with perceptual capacity and negatively correlated with reflex adaptability (Ruprecht, 2007). Therefore, the symbolic influence of dance training on brain structure is related to the stimulation and experience of various complex factors such as space (vision), body movement (kinesthesis), and muscle work (proprioception) (Wu, 2017). The significance of dance to the adaptive changes of the human brain is reflected in the structure of the brain and its functional aspect.

3. Multiple applications of neuroscience

Electroencephalography was utilized in another study in the article to monitor cerebral activity by detecting electrical activity and measuring event-related desynchronization in alpha and lower beta frequency areas. [Researchers discovered that electroencephalography (EEG), a technique for capturing an electrogram of electrical activity on the scalp, provides a good predictor of the macroscopic activity of the brain underneath the surface. EEG can accept signals from deeper in the brain and more easily determine which signals come from the surface and deeper in the brain.] The test gave nearly the same conclusion as FRMI: professional dancers who watched dance videos were significantly more active than non-professional dancers' movement observation networks. Since the human observation-execution matching system in functional magnetic resonance imaging research is comparable to the single motion library (Kirsch & Cross, 2018), we can understand that the aesthetic perception of trained dancers does not come from their innately keen perception of movements but from the relatively high level of movement observation network activity they exhibit during motion observation. The conclusion of this study was to confirm that the trained dancers received the motor reaction irrelevant to their natural motor reaction in the dancers' brains (Karpati et al., 2015). According to these study values, trained dancers showed a relatively high action observation network when watching the dance videos they had learned.

On the other hand, non-dancers observed the smallest increase in event-related desynchronization when observing dance manoeuvres. These studies may suggest that the trained dancers are not receiving their naturally keen motor perception but rather the relatively high level of action observation network activity they exhibit during movement observation. Kirsch & Cross (2022) study further shows that trained dancers have a more extensive action observation network than untrained dancers. Lots of research has also shown that dancing plays a significant role in increasing dopamine levels in the brain. (Dopamine, a neural region, can enhance spatial perception, memory, and attention, thus contributing to physical coordination while producing pleasure at the same time). Dr Marllyn Albert is a Harvard University neurologist who has long studied the relationship between physical activity and neuroscience. He believes that exercise also contributes to the transporting of oxygen, allowing the brain to get more oxygen. However, from the development level of the brain's transformation, this kind of physical activity ought to be a novel form, needs to think about and communicate between multiple senses. This indicates that dance (a form of physical movement) is irreplaceable in promoting brain thinking activity. He also points out that dance promotes the growth of neural dendrites (Kirsch & Cross, 2018), which are responsible for receiving information. A motor neuron regulates muscle contraction and relaxation, as motor neurons are responsible for the dancer's movement. The three essential components are the dendrite, the cell body or soma, and the axon. When an electrical impulse is transmitted from one neuron to another, the dendrite is the first to receive it and transmit it to the cell body (Chatterjee & Vartanian, 2016). As is shown in Figure 1.



https://askabiologist.asu.edu/neuron-anatomy

Figure 1. Neural dendrite

Through the movement and usage of the human body, it is also feasible to observe the physical kinesthetic parts

of Gardner's multiple intelligences theory. The theory of multiple intelligence promotes the development of previously neglected intelligence in the brain by expanding the content field of learning to fully explore the enormous potential hidden in each person and optimize the human brain. At the same time, dance is undoubtedly a multi-nerve movement pattern worth discussion (Essex, 2021). Therefore, these neurological and behavioural studies demonstrate that dance training can improve one's action perception. Meanwhile, Barbara confirmed in her article that various behavioural studies about dance have shown that training affects the mirror system of the human brain and has a higher-level perceptual effect (George, 2020).

On the one hand, research into brain science can reveal the features and rules of dance activity from microscopic factors and biological domains and provide a theoretical basis for the value and function of dance. Therefore, reasonable use of the influence of neuroscience on dance training can provide a new perspective and method for the practical exploration of the dance field and lay a solid scientific research foundation for it, making it more scientificity, experimental, and manipuility (Montero, 2013). On the other hand, as a unique art form presented by the coordination of human movements, dance can bring adaptive brain changes to a certain extent. The advances in research on the adaptability of body movement and the brain have confirmed that exercise has near-omnipotent adaptability to the brain throughout life because exercise can positively improve the brain's adaptability and promote physical and mental health (Kolcio, 2010). Furthermore, exercise can change the activation level of relevant brain regions and the ability of functional brain networks. Neuroscience research can accurately calculate the movement of brain nerves during the dance and provide a new starting point for dance research, and new interdisciplinary may be derived from it (Nadal & Pearce, 2022). Since neuroscience and dance have academic connections in many aspects and cross-penetration and complementarity between disciplines, it can form emerging interdisciplinary disciplines such as dance neurology, dance aesthetics, dance education science, dance physical anthropology, dance medicine, health, etc. From the current perspective of the development trend of cognitive neuroscience and aesthetics in the world, the study of neuroaesthetics of dance is bound to become an essential subject of aesthetic research in the field of dance (Mintarsih & Azizah, 2020).

4. Exploration and application of aesthetic evaluation in dance training

Author Montero raised whether these phenomena of kinesthetic responses are aesthetically relevant? Edwin Denby is a dance critic who emphasizes aesthetic perception through motion perception. He believes that people trained in dance can make better expressions of the quality of dance movements and indirectly control the ability to express the quality of music. That is to say, all awareness of aesthetics comes from the human experience of motion perception. He also pointed out that, to a large extent, the movement of aesthetic attributes such as beauty, precision, fluency and elegance in the value of watching dance is related to the aesthetic experience. Next, the author combines four critics with different standards of aesthetic cognition of dance, representing the dancer's limpness (Martin), emotional tension (Denby), power (Macaulay) and lyric beauty (Horst). They generally accept the aesthetic relevance of "kinesthetic sympathy"(Montero, 2013). For instance, John Martin argues that to appreciate dance fully, one must take advantage of the Kinesthetic sympathy. In his words, "Not only do dancers need to express their ideas with movements, but the audience must also respond to the dancers' intentions with movements and try to understand what he is conveying, although this may seem strange and unreasonable." Another dance critic, Edwin Denby, who often emphasizes kinesthetic perception in his work, emphasizes in the review of the performance *Afternoon of a Faun* that the sensation of the body comes from the tension when imitating objects, such as the dancers' imitations of Greek vases and reliefs. Alastair Macaulay believes that when watching Fredrick Ashton's choreography, the perception of movements evoked by vision is often difficult to make people sit in a seat, and a force is also generated inside the audience's body.

Louis Horst describes the "lyric beauty" of a dance choreographed by Anna Sokolow as having a direct appeal to the kinetic response (Calvo-Merino,2010). However, how do these critics prove they have experiences associated with kinesthetic sympathy and aesthetic perception? According to Elizabeth Anscombe, one is that unconscious experiences influence proprioception. Proprioception is controlled by sensory receptors in our neurological system and body (Kolcio, 2010). These receptors are found in our muscles, joints, and tendons. Our brains acquire exact information about our movements from our bodies' sensors. The visual, neurological, and vestibular systems process these impulses in our brains. For example, you are not required to know where your foot is going; so proprioception is critical if you wish to move without thinking about your next step. (Elizabeth Anscombe was born in London, England. Intention, her magnum opus, is a monograph (1957). From Parmenides to Wittgenstein, 1981 saw the publication of Metaphysics and the Philosophy of Mind and Ethics, Religion, and Politics. Human Life, Action, and Ethics was released posthumously in 2005).

In my view, appreciation of dance is an advanced form of artists' expression in dance art and dance appreciation activities, which should make people have an aesthetic identity of dance. When conducting appreciation activities, it requires

aesthetic subjects to look at dance works with an aesthetic vision. It is a thinking activity composed of aesthetic subjects through the beautiful images, real movements, and superb skills of dance work. As the author says in the epilogue to the article: "Perhaps the best critics are those who have received a mass of dance training in Aristotle's thought (Koh et al., 2018). In addition, aesthetic as a kind of medium is the midst link between aesthetic subject and aesthetic object, and it is a psychological state of aesthetic perception and sensory association when the aesthetic subject faces the aesthetic object. It combines the connoisseur's psychological consciousness and perceptual and rational thinking. As Lapshina (2020), the mesomeric concept is the most common in the Hegelianism system, the bridge between the whole idea and the opposing side. The generation and development of the aesthetic process are based on the aesthetic subject's grasp of the aesthetic information of the objective world and are constrained by the essence of the aesthetic object (Nannicelli, 2020).

Given that the aesthetic subject has a subjective agency (Philosophy), the same aesthetic experience process will produce different outcomes (Iqbal & Sidhu, 2022). Because the lifespan of a dance career in practice is relatively short, much time can be set aside after retirement to pursue critical art. Thus, training a large amount of dance can promote the continuous improvement of the aesthetic perception capacity of the dancers.

5. Other factors in dance training associated with aesthetic evaluation studies

Instrumental accompaniment plays a significant role in dance training. However, because each accompanist has self-subjective emotion and personal performance style, their music creation and performance will inevitably involve the universal instinct of human beings, such as the intrinsic physiological factors, the influence of the cultural atmosphere, and the acquired socialization factors. Therefore, in the aspects of dance, musical accompaniment lacks objective and scientific theoretical guidance (Collard-Stokes & Irons, 2022). At present, Asia-related theoretical studies mainly focus on the basic theoretical knowledge of accompaniment, the improvement of the subject's ability, and the training of talents' thinking experience. In contrast, researchers in European and American countries tend to research dancers' behaviours and movements or subjective feelings. For instance, Dahl, a Swedish scholar, indicates in his article, "Rhythm - the movement and rhythm of the human body in the processing of musical creation and perception," observing dancers' performance movements through audio and video, their mental activities as well as felt emotion ability of accompaniment music can be analyzed (Rosenthal et al., 2021). In American scholar Geringer and Sasanfar's essay "The dancer's perception of the pianist's different expressive force in collaborative performance, " adjusting the way the accompanist plays to change the various degrees of musical rhythm and have the dancers evaluate the accompaniment music. This method can verify the feelings of different accompaniment music to the expressive musical strength of the dancer (George, 2020). The author emphasizes dance appreciation as a creative activity because, in the process of dance appreciation, connoisseurs transform dance works into dance images in their thinking through "re-creation." Therefore, through dance appreciation and aesthetic, psychological processes, it is also possible to stimulate one's creativity.

Theoretical foundations based on cognitive neurosciences can also promote the effect of musical function on dance training. For example, the fast, slow tempo of the music will affect the bodily movement of people and produce a more obvious emotional response with the change in the subcortical structure. Speed is an important element that affects individual music for emotional processing; it decides the emotional atmosphere for dancers (Shen et al., 2020). While the fast, slow tempo of the music is closely related to the rhythm and the creation of music. For instance, take Tchaikovsky's famous ballet "Swan Lake" — among them, the dance of the Four Cygnets is fast and light, and the dancers mainly make small jumps with fast speed and strong explosive power, expressing the joyful mood of the characters in the play. By comparison, in the phrases of Death of the Swan, the music is low-pitched and long, and most of the dancers' movements are mainly slow and have a sense of extension.

Moreover, the sad expression shows the inner entanglement of the protagonist and the painful emotion to express the feeling of sadness. Emotional stimulation and expressive power are based on the music's mode structure characteristics-- the major scale produces more positive emotions, while the minor scale generates more negative and sad emotions. We found that in the dance rehearsal, the emotional performance of the subjects was significantly different under the stimulation of signals from different modes, which could be reflected specifically in the body language and movements of the performers. In conclusion, for artists as critics, the influence of dance training on aesthetic judgment is the combination of multiple factors in dancers' training and the combination of interacting factors such as human perception, kinesthetic sympathy, and recognition of aesthetic attributes (Montero, 2007).

6. Concept of cognitive neuroaesthetics

Based on what the author discovered while exploring, the field of neuroscience focuses mainly on the areas of the brain

involved in the human aesthetic process and their connections. From the perspective of neuroscience, human brains can directly connect others' experiences with personal feelings. For example, we can be affected by and experience others' emotions directly with mirror neurons. However, in addition to neuroscience and aesthetics, the birth of the emerging discipline of neuroaesthetics is undoubtedly a subject that scholars in Western countries have been keen on exploring in recent years. The purpose is to study the relationship between the aesthetic subject and the aesthetic object. According to the books on neuroaesthetics, the writer found a view of a triangular structure that interacts with each other and generates aesthetic experiences, which consists of three elements: (1) Sensory-motor, (2) Emotion-valuation (3) Knowledge-meaning. In other words, aesthetic experience comes from the coordination among different human brain parts. As is shown in Figure 2.

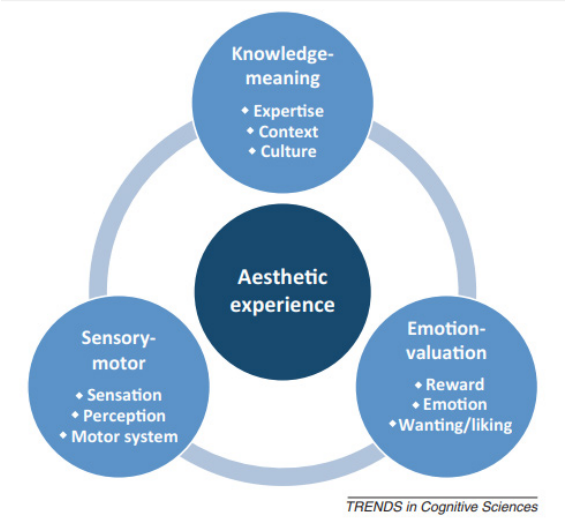


Figure 2. The triangular structure of Neurasthenics

On the other hand, despite the close relationship between aesthetics and Neuroaesthetics, they play different roles in research. Regarding the evolution of aesthetics, the author can explain that philosophy had an original relationship with aesthetics in the early days. The aesthetics process is a discipline that has evolved independently of the philosophical system in recent times and belongs to a branch of the philosophical system. In contrast, philosophy is a metaphysical concept that studies intangible objects (this is because the production of beauty is at the imagery level). Moreover, therefore, to some extent, it needs to be philosophically demonstrated; aesthetics, as a product of an aesthetic process, is based on physical concepts. Because the object of study in the field of aesthetics is all tangible objects, such as tangible movement - dynamic aesthetics (dance, sports), tangible objects - static aesthetics (sculpture, painting, architecture) and all other visually related works of art have undergone aesthetic evaluation and research. Since people are accustomed to defining what is pleasant as beauty, beauty is a subject that thinkers have constantly been exploring since the origin of philosophy.

In this sense, dances, sculptures, paintings, buildings, and other forms of visual art have all been evaluated aesthetically. There are key concepts and terms like aesthetic experience, evaluation, perception, judgment, and appeal in the aesthetic demonstration. As an emerging discipline in the western social and scientific field, (Chatterjee & Vartanian, 2016) was founded by the visual Neuroscientist Semir Zeki in 1999. It studies the chemical reactions between the brain and art. Neuroaesthetics focuses on the neural mechanisms related to art appreciation and studies the aesthetic behaviours of humans and the psychological principles behind them with empirical methods (Nadal & Pearce, 2022). In this way, the aesthetic rules will eliminate the metaphysical thinking pattern of philosophical aesthetics.

According to the theoretical basis of cognitive neuroaesthetics, some studies are similar to neuroscience: observational test groups from different professional backgrounds have conducted an appreciation of famous Renaissance paintings. When the painting is presented to the observer, the laboratory uses a hyperspectral imaging system to analyze the painting's light source and colour space. It combines a series of precise algorithms for the observer's reflection of the colour gamut, colour patch and image, resulting in different activity patterns in the induced observer's brain, meaning that the paintings are considered beautiful or unattractive. (Ishizu and Zeki, 2011, Kawabata and Zeki, 2004). Empirical research on neuroaesthetics is more comprehensively summarized in a *PsyCh Journal* titled "Factor Structure of Audiences' Physical Experience While Watching Dance". The paper analyzes dance and its associated kinesthetic sympathy (bodily experience) through exploratory factors(EFA) and breaks down the neuroaesthetic research process into three modules: (1) Participants,

(2) Stimuli, (3) Procedure. Next, in the two groups of selected professional and non-professional dancers, let them write down as much as possible about their physical experiences and feelings when watching different videos of dance forms. The experiment reflected that the viewer's physical experience of the observed dance was the entire result of their participation in the dance video, from which they derived an element of pleasure and the function of evoking kinesthetic empathy in themselves. This discipline combines experience aesthetics with the neural mechanisms of human cognition and emotions. Aesthetic perception well reflects human emotions. Healthy aesthetic activities arouse the learning ability and creativity in individuals. Many scholars have organized a series of activities to promote dance amongst the public and community in Western countries and China. Meanwhile, it also requires aesthetic subjects to look at dance works with an aesthetic vision when carrying out appreciation activities. For instance, Dai Ailian, a famous dancer in China, once promoted the Dance for Everyone event among the public, engaging the participants in the aesthetic appreciation of dancing and making public dancing widely acceptable (Mintarsih & Azizah, 2020).

7. Conclusion

In conclusion, despite the complexity and challenges of interdisciplinarity, the aesthetic perception generated through dance training can better reflect the higher level of human emotion. Dance appreciation activities can give people a sense of aesthetic identity with dance and help potential dance art groups enter the theatre to watch dancers or directly participate in dance activities. The author believes that aesthetic research, neuroscience, or neuroaesthetic research is conducive to dance training and neurobiology, dance neurology, cognition and emotion studies. So perhaps, it will also make excellent contributions to more scientific research, disease treatment, pedagogy, AI, human engineering, etc. These findings have significant application value and exploration space for art appreciation.

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