CHAPTER

Moving through silence in dance: A neural perspective

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Abstract

The word "silence" typically refers to the auditory modality, signifying an absence of sound or noise, being quiet. One may then ask: could we attribute the notion of silence to the domain of dance, e.g., when a movement is absent and the dancer stops moving? Is it at all useful to think in terms of silence when referring to dance? In this chapter, my exploration of these questions is based on recent studies in brain research, which demonstrate the remarkable facility of specific regions in the human brain to perceive visually referred biological and, in particular, human motion, leading to prediction of future movements of the human body. I will argue that merely ceasing motion is an insufficient condition for creating a perception of silence in the mind of a spectator of dance. Rather, the experience of silence in dance is a special situation where the static position of the dancer does not imply motion, and is unlikely to evoke interpretation of the intentions or the emotional expression of the dancer. For this to happen, the position of the dancer, while being still, should be held effortlessly, aimlessly, and with a minimal expression of emotion and intention. Furthermore, I suggest that dynamics, repetitive movement (such as that of Sufi whirling dervishes), can also be perceived as silence in dance because of the high level of predictability and evenness of the movement. These moments of silence in dance, which are so rare in our daily lives, invite us to experience the human body from a new, "out of the box" perspective that is the essence of all the arts.

Keywords

Human body, Human movement perception, Neuro-aesthetics, Action observation, Stillness, Implied motion

1 Introduction

The term *silence* conveys a complexity of ideas—varying from the absence of an entity or process (lack of sound, lack of thoughts) to a state of extremely active concentration and presence (such as in meditation) (Schwartz, 1999). Therefore, when using the term silence in the context of dance, we need to clarify to which of the

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qualities of silence we are referring to. In other words, we need to characterize which aspects of silence are relevant to the experience of dance. Active concentration means the process of attempting to block out incoming thoughts and concentrate only on one aspect, either physiological—such as one's own breathing (inhale and exhale) or the mental repetition of some words. The term presence means the concentration of the mind on present sensations (pain, alignment of the body, etc.). This is to distinguish from the state of remembering something from the past or simulating a future situation. Presence also implies awareness, self-awareness, consciousness and alertness (Giannachi and Kaye, 2011; Pini, 2019).

Dance, the artistic expression via movement of the human body, can be related to the notion of silence. Dance, as an implicit non-verbal endeavor, operates at times in the realm of silence in the acoustic sense, where no sound is involved as part of the performance (no music, no spoken words, no vocal expression and minimal body sounds). Yet, even under such circumstances, dance is often experienced by spectators as a non-silent event (Orgs et al., 2016; Schwartz, 1999). When dance conveys a certain message, communicates a narrative of an episode, when it presents a series of actions taken by the dancers (such as lifting, jumping, walking) or when transmitting a clear emotional expression by the performers—then dance is unlikely to be perceived as silent (Jaworski, 1992; Schwartz, 1999; Sontag, 1969). Although performed in an acoustic silence, the situations described above correlate with verbal, explicit experiences and are therefore considered non-silent in their nature (Schwartz, 1999). This invokes the questions: In which situations or under what circumstances does the notion of silence relate to dance? In addition, if such a notion does exist in dance, what might it signify to the spectator and to the dancer, and how similar or different might their experiences be?

This chapter begins by adapting the term "silence" to the domain of dance, describing the various aspects related to the notion of silence that are relevant to dance, and continues by examining their manifestation in dance. In particular, how silence in dance is related to particular cases where motion has ceased. Next, the brain response to movement and non-moving situations of the human body is briefly discussed. Specifically, the brain's response to distinct situations such as: stillness; implied motion within a frozen position; retaining a position in the middle of a movement; and to a repetitive movement. I will then discuss what these specific situations of silence in dance might offer to the mind of a spectator, and speculate on the benefits from such moments of silence in dance.

2 What is silence? What could silence in dance represent/be?

Many scholars who investigate the phenomenon of silence, avoid defining it, because of its complexity and multi-faceted expressions (see for example, Bindeman, 2017; Catterall, 2005; Jaworski, 1992; Schwartz, 1999; Voegelin, 2010). Yet, they do

characterize some properties of silence, explore its nature, and categorize it. Silence can be categorized as absolute or *pure*—a genuine emptiness. But such pure silence or "emptiness" is an abstract idea as it is not realistic in the physiological world (Schwartz, 1999; Sontag, 1969). What we actually sense and perceive in our daily lives is an *impure* silence that, in terms of acoustics, is a lack of excessive noise (Schwartz, 1999). In terms of our own experience, it is the silence as we perceive and interpret the sensory (silent) input—such as an experience of the arrest of time, stillness of motion or complete darkness (Alvarez, 2020; Sontag, 1969). Silence can also be categorized as either *a passive* or *an active* experience. *Passive* silence is grasped as empty, quiet or peaceful, and contains no meaning. It might lead to self-reflection. Whereas *active* silence is experienced as "full" because it contains and conveys a meaning (an extra-linguistic meaning) or a purpose (as in meditation). Active silence directs the participants towards interpretation of the situation (Sontag, 1969). Silence also contributes to the *dramatic* aspect of the scene, by emphasizing a critical moment (Lissa, 1964; Schwartz, 1999), for instance, the 4′33″ silent piece of music by John Cage (Pritchett, 2009). Silence may also serve as a *rest* or a preparation for a future stimulus, for example, before the performance begins (Lissa, 1964).

Researchers do not necessarily avoid defining a *silent art* (Lissa, 1964; Withers, 1997). Withers (1997) defines art as silent when it is experienced rather than comprehended (addressed to the spirit vs the mind, as she refers to it). The mind is referred to our thought life and our reasoning powers whereas the spirit is referred to our experiences. According to Withers another prerequisite of silent art is that the time element is removed or when "time is frozen" (see also Sontag, 1969). This is in contrast to non-silent art, which expresses a sequence of thoughts that evolve within time, therefore, according to Withers (1997), time is a prerequisite component for non-silent art. Non-silent art is addressed to our cognition, to our mind (Withers, 1997). Withers adds that the essence of silence in art is centered around the intensity of its concentration on the now (the present), the absence of narrative, the economy of the symbol and harmonious use of the medium materials (such as colors and lines in the case of painting). Other elements, such as ambiguity of the artistic message or scene, might be also related to silent art (Withers, 1997). Art works might be silent in a subtle way: they might make noise, but the meaning of the noise may not be clear or obvious. Or their meaning may not even be present, such as in abstract visual art. Therefore, it is possible for sound in an art work to be silent, in the sense that it has no meaning or that its meaning is obscure, removed from any conventional interpretation; e.g., white noise (Aviv, 2014; Schwartz, 1999; Withers, 1997). Jaworski (1997) introduced the idea of silence as a metaphor for communication, so a frozen gesture of an artist on the stage can be considered as an instance of silence.

In light of the above, it seems clear that silence in general, and silent art in particular, can be expressed in many ways. Although the experienced silence can never be *pure*, we can experience silence in different varieties, ranging from an *impure*, *passive (empty)* silence to an *impure active communicative* and *dramatic* silence. Forms of silence have different expressions in different media (acoustics, plastic arts, etc.) and they might serve diverse purposes.

With respect to dance, silence is mentioned in several essays (Hamera, 1990; Main, 2010; Schwartz, 1999; Withers, 1997). Silence in dance is mostly referred to in relation to the acoustic aspect—either the absence of music during the dance piece or the minimal presences of noise made by the dancers, such as during breathing or foot tapping (Schwartz, 1999). But even if no acoustic sound is present during dance, still there has been a claim that the repertoire of steps in ballet are referred to as a vocabulary partly because they contain symbols of meaning. And if they do have a meaning they cannot be considered as being silent. Gestures are considered as a lower level of silence in dance, because they induce the audience to initiate the process of constructing interpretations (Hamera, 1990; Jaworski, 1997; Schwartz, 1999). In summary, the more abstract the dance piece, i.e., the more remote from direct and clear interpretation, then the more silent it can be considered (Aviv, 2017; Schwartz, 1999).

However, none of these studies explored the notion of silence in dance in the context of movement. Movement is the medium by which dance is expressed, analogous to sound which is the medium by which music is expressed. Absence of sound is silence in the music domain while absence of movement can be considered as silence in dance domain. One should note that there is always some movement within the body's muscular and skeletal systems. In order to keep a position muscles contracts in such a way that the limbs/body sway around a base. These postural movements are usually small and executed by reflexes (Adrian and Cooper, 1995). Therefore, I do not use the term cessation of motion but rather I refer to absence of visible motion, which could also be thought as absence of intentional motion. This is similar to music in the sense that silence in music do not necessarily means absolute acoustic silence, but rather a cessation of intentional acoustic signals in music.

In this chapter, I examine which situations, in terms of movement, could be considered as silence in dance. Three possible forms of silence in dance will be discussed: *stillness*—the ceasing of movement at the end of a motion or between two movement phrases (such as standing still after completing a jump); *holding a position*—the stopping of motion in the midst of a movement, (for instance, the arrest of movement in the middle of stepping, freezing a movement); and the special case of *a repetitive ongoing motion* (such as the Sufi whirling dervishes; see Cakmak et al., 2017), which might also be considered as a version of silence in dance. These different cases are discussed below with respect to movement perception.

3 The neural basis of the perception of human movement

In order to further discuss silence in dance, let's first look at the perception of human motion. The section below presents the major tools by which we analyze human motion and interpret it. First, I will indicate which brain areas respond to biological motion and which areas respond to human motion specifically. Then, I will present the phenomenon of implied motion perception and the brain areas involved processing this phenomenon. Because time is a major component of movement

perception, I will highlight difference in the perception of time when looking at real motion versus implied motion. In the final part of this section, I will discuss how people infer emotional states when observing the moving body.

There is a consensus among many researchers that a key goal of the brain, and specifically that of the human brain, is to understand motion (see Johansson, 1973; Llinás, 2002; Sommer and Wurtz, 2008; Zeki, 1993). Indeed, many brain researchers agree that the nervous system evolved primarily to enable animals (including humans) to move through the environment safely. Animals must be able to predict, on the basis of incoming sensory information (visual, auditory, etc.), the outcome of each movement, both their own as well as that of other animals or objects (Blakemore and Decety, 2001; Llinás, 2002).

A few brain areas have been found to be involved in responding to visually referred biological motion (Fig. 1). Based on brain imaging studies, brain connectivity and neural activity during movement, these areas have been identified to include: the STS (ventral and posterior parts of the superior temporal sulcus and the fusiform gyrus); the middle temporal cortex; parietal regions; inferior frontal gyrus; bilateral insula; left lateral cerebellum; and left intraparietal cortex (Blakemore and Decety, 2001; Grezes et al., 2001; Grosbras et al., 2012; Grossman and Blake, 2001; Peelen and Downing, 2007; Saxe et al., 2004; Sokolov et al., 2018). All these brain regions are activated in response to biological motion, and some (e.g., the occipitotemporal brain system) respond specifically to movement of the human body, as was shown in several studies (for reviews, see Blakemore and Decety, 2001 and Peelen and Downing, 2007). These areas do not respond to non-biological motion or to biologically impossible motions (Blakemore and Decety, 2001).

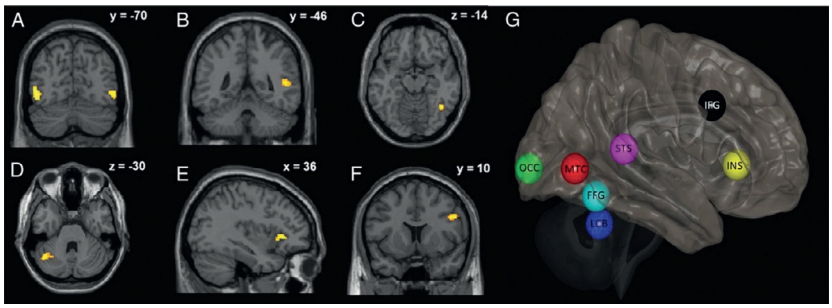

FIG. 1

Brain activity during perception of biological motion. (A–F) Regions showing higher responses for walker-present compared with walker-absent displays are located in the bilateral MTC (A), right STS (B), right FFG (C), left lateral cerebellar lobule Crus I (LCB) (D), right anterior insula (INS) (E), and right IFG (F). (G) Location of the seven network nodes of the cerebro-cerebellar network active during biological motion processing.

Adapted from Sokolov, A.A., Zeidman, P., Erb, M., Ryvlin, P., Friston, K. J., Pavlova, M.A., 2018. Structural and effective brain connectivity underlying biological motion detection. Proc. Natl. Acad. Sci. U S A 115 (51), E12034–E12042, with permission.

The human body (in both moving and stationary conditions), as well as its specific parts, induce a selective response in the EBA (extrastriate body area), in the right lateral occipitotemporal cortex and in the fusiform body area (FBE) (Downing et al., 2001; Grosbras et al., 2012; Peelen and Downing, 2005, 2007; Pitcher et al., 2019). Human drawings, in the form of stick figures and silhouettes of humans, also triggered a significant response in the EBA; this led to the conclusion that this area responds not to the surface properties of the body but rather to its representational outline (Peelen and Downing, 2007).

Some regions of the human brain are wired to respond to biological motion to such an extent that even a stationary stimulus that *implies motion*, such as when watching a photograph of a man throwing a ball, induces a response in the visual motion detection areas (the medial temporal visual area, MT/V5 and the medial superior temporal area, MST) and, consequently, leads to a perception of motion (Blakemore and Decety, 2001; Kourtzi and Kanwisher, 2000; Peelen and Downing, 2007). Not every stationary photograph of a person induces a perception of motion; for instance, a man sitting on an armchair is unlikely to elicit a perception of motion. It is important to note that biological motion that is biomechanically possible to implement, is processed in a different path in the brain than a non-biological motion (either of an object or biologically impossible motion) (Blakemore and Decety, 2001). Some lateral brain areas (EBA) respond more strongly to moving vs static bodies, while other ventral brain areas (FBA) do not demonstrate differences in response to moving vs static figure (Pitcher et al., 2019). Although sharing a similar brain path, the time perception of a real motion seems different (overestimated) than time perception of implied motion of human (not overestimated). This was demonstrated by studying dance movements when viewed as real motion as compared with the same dance movements shown as implied motion (Sgouramani et al., 2019). This could be due to the fact that real motion conveys a greater amount of contextual change as compared to implied motion and therefore, is judged as lasting longer. This argues for distinct processing mechanisms or differential involvement of the same brain areas for real versus implied motion (Sgouramani et al., 2019; see also Nather et al., 2013).

It is worth noting that implied motion perception is based on action prediction and the understanding of the consequence and the meaning of the upcoming action. In addition, it has been shown that observation of human motion may elicit an automatic attribution of intention to that person's action, a process which involves the medial prefrontal cortex and the STS (Blake and Shiffrar, 2007; Cole and Millett, 2019; Gallagher et al., 2000; Wellman, 2018). The attribution of intention may also lead to evaluation of that person's inner state, based on the interpretation of their movement (Cole and Millett, 2019; Schaafsma et al., 2015 and see Fig. 2) In this process, looking at a person's action may evoke the sensory motor representation of the action, which will lead (automatically and unconsciously) to the estimation of the intention of the person's action, based on the understanding of self-intention while having similar sensory motor input (Brass and Heyes, 2005; Heyes, 2011).

It is worth noting that specific movement characteristics convey certain emotions and influence dance expressions and their interpretations. For example, it was shown

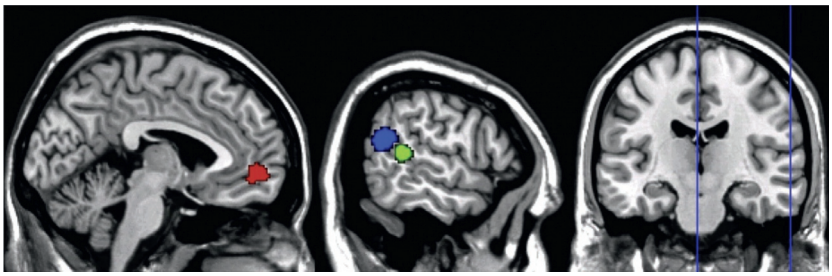

FIG. 2

Three examples of neural responses to actions at three conceptual levels. Responses to biological motion and goal-directed action in the superior temporal sulcus (STS, green), thinking about people's beliefs and desires in the temporo-parietal junction (TPJ, blue), and to people's stable personality traits and preferences in the medial prefrontal cortex (MPFC, red).

Adapted from Koster-Hale, J., Saxe, R., 2013. Theory of mind: a neural prediction problem. Neuron, 79 (5), 836–848, with permission.

that patterns of body movement that portrayed a set of 12 emotions (e.g., joy, amusement, interest, ager, panic, anxiety) could be differentiated by the spectators (Dael et al., 2012). In research focusing on dancers' expression of emotions (Sawada et al., 2003), the dancers were asked to express certain emotions using characteristics of only a particular body part and specific action, such as adduction of the right extended arm. Their expressed emotions were accurately perceived by naïve spectators. Other studies show that spectators accurately perceived the emotional meanings expressed by the dancers, based on the type and various dynamical parameters of the movements such as velocity and frequency (Shikanai et al., 2013; Van Dyck et al., 2017). The neural underpinnings of the perception of emotional states were explored by Bachmann et al. (2018).

To summarize. The section above was aimed to emphasize that a significant part of the human brain is specialized (and becomes expert) in analyzing human motion (both actual and implied). Being expert, the spectator automatically tends to interpret the intentions and emotions conveyed by the moving body of the other. The question than arises: are there conditions whereby, albeit such an automatic (and strong) reaction to movement of the human body, the spectator might interpret the movement or stillness as being "silent"?

4 Conditions for silence in dance

Based on the above, I maintain that *stillness* in dance (ceasing movement between two movement phrases), or *holding a position* (in the midst of a movement) are insufficient conditions for claiming that it corresponds to silence in dance. This is because ceasing movement may invoke an implied movement perception in the

spectator's brain. Under this condition, although static, the spectator's brain may (perhaps very actively) attempt to predict the next movement and/or feel a set of emotions corresponding to the predicted movement. It is therefore hardly justified to relate the term "silence" to such instances of stillness during dance that evoke emotional/predictive responses (see Fig. 3).

This means that, in order to create a perception of silence in dance, the choreographer needs to design instances of a unique type of motion/dance that do not invoke a prediction in the spectator's mind of the next steps that the dancer might take. This means a state of stillness that is not part of a clear action (such as lifting a partner). This requires an *abstracted* type of movement, which is unlikely to invoke an implied-motion response or to produce referred emotions or intentions to the dancer (for discussion on abstracted art, see Aviv, 2017). This, I claim, are very uniquely moments indeed, that should be carefully designed.

An interesting, perhaps somewhat unexpected, possibility of silence in dance are cases of repetitive long-lasting *ongoing motion* (like the Sufi whirling dervishes). From the spectator's point of view, watching whirling for a long time offers a situation of a very predictable movement, with little or no accelerations, which might be perceived as an effortless condition, not leading to a specific action other than itself. This is a meditative situation for the Sufi dervishes (Cakmak et al., 2017). Such whirling might also induce a silence-like perception in the spectator's brain because the

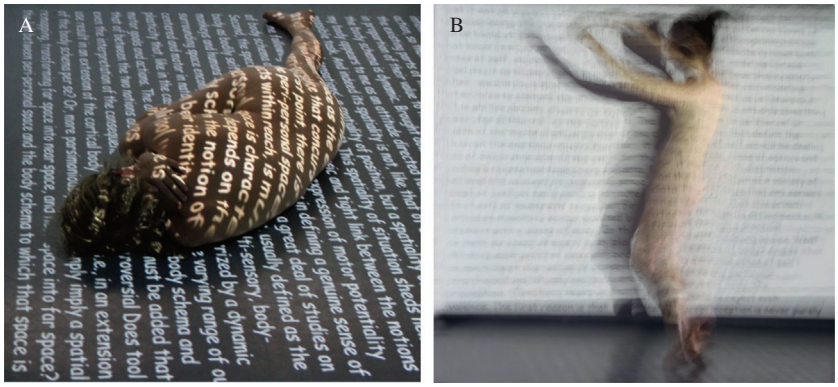

FIG. 3

A non-implied motion photograph of a dancer (A) vs an implied-motion photograph of a dancer (B). The dancer in panel (A) is situated in a stable position which she could hold for a long time—a situation that does not necessarily lead to prediction of motion (stillness). The dancer could also start moving out of this position in several ways and it is hard to predict the upcoming movement away from this position. The dancer in panel (B) is holding a position in the midst of a movement and her next step is rather easily predicted by the spectator. She also has more than one option to continue moving but the spectator can predict which path is more likely to be taken.

Photographed by Vered Aviv, 2013 ©.

brain is free to respond to the movement as such, it is a movement not leading to a specific related meaning or intention. A movement that induces a minimal need for interpretation by the spectator's mind might therefore be associated with silence in dance.

In addition to the above considerations, we should also consider another component that relates to the notion of silence in dance, namely, the *bodily effort* invested in keeping a position (during stillness or in repetitive motion). Humans are very good in visually evaluating the degree of effort applied by others when we watch them move. The quality of movement (or dance) is detected by the spectator who distinguishes whether the movement is performed effortlessly or by using a high degree of muscle power/effort (for details on the brain network involved in force perception, force estimation and the role of the cerebellum in these tasks, see Casiraghi et al., 2019). Note that goals and intentions can only be deduced from the visually kinematic data available to the spectator (Orgs et al., 2016). Indeed, when we watch a person executing a movement or dance, our own motor system is activated in a similar way (via the "mirror system" including the premotor, parietal and cerebellar cortices) and we therefore make a good estimation regarding the amount of force applied by the other when performing such movement (Calvo-Merino et al., 2006; Casiraghi et al., 2019; Orgs et al., 2016; Rizzolatti and Craighero, 2004). Therefore, the circumstances when the dancer applies high significant bodily-effort, either in stillness or in motion, is unlikely to invoke a perception of silence in dance. Muscle power/effort is involved in force perception and force estimation. Force estimation is necessary for understanding the actions of others, predicting appropriate reactions and subsequent interactions. In this context, perceiving the force applied to objects by others is crucial for understanding their intentions, for predicting the success of self-generated actions, and for dynamic movement control in interactions (Casiraghi et al., 2019).

5 Further elaboration of silence in dance with regards to communication

The complexity of attributing the notion of silence to dance emerges from the fact that dance is mediated by a human body—a body that, intrinsically, transmits intentions, emotions and ideas which are perceived as such by the spectator (Brass and Heyes, 2005; Calvo-Merino et al., 2006; Casiraghi et al., 2019; Heyes, 2011; Leach, 2013; Orgs et al., 2016; Rizzolatti and Craighero, 2004). Some researchers emphasize that dance is a human socio-cultural activity that involves both the moving dancer and a spectator. They point out that movement in dance serves communicative purpose, that it is expressive by its nature and it acts toward exchanging emotions, intentions and ideas between people, namely, the choreographer, dancer, and audience (Leach, 2013; Orgs et al., 2016). It has been shown that emotional expression is referred to static as well as dynamic human figures, activating the STS, FBA and premotor cortex areas of the spectator (De Gelder et al., 2010). Hence, as such, silence in dance should be bare of movements which (for the spectator) convey

intentions and emotions. Silence in dance is aiming to minimalize the communication of messages that might lead to association of narrative or high emotional subject matter which, by definition, are typical to many traditional (non-silent) dances.

6 Why pursue silence in dance?

Although hard to achieve, going against the "natural" way by which the brain interprets movement and the respective emotions it conveys, I suggest that it is worthwhile to pursue silence in dance. First, it provides the spectator's brain with a special condition (rarely, if at all, attained in our daily lives), enabling the brain to explore new (unfamiliar) experiences. Furthermore, it shifts the spectator's mind from their highly habitual way of interpreting the moving human body (with its survival function) to a realm whereby the human body is uninterpretable as a moving entity. There on the stage, although well identified and familiar, the dancer does not provide specific interpretations, predictions or cues for interpretation of expressed emotions. There is silence. Such episode will be based on the highly developed skills of the dancer to optimally transmit the message of the dance as well as precise expression of emotion relevant to silence (Orgs et al., 2016). This unique moment will invite the spectator to wonder and perhaps to generate internal, maybe new, brain states. It may lead to a different perception of time at that moment. Under such uncommon situation(s), the perception of time itself can change, as was shown to be the case by Sgouramani et al. (2019). It is also possible that such situations might lead to meditative-like brain states (e.g., when viewing Sufi whirling).

Clearly, non-silent dance may evoke feelings/experiences/patterns of thinking that go beyond the habitual way of interpreting a moving human body. However, it reasonable to assume that such new pattern of thinking/feeling is more likely to be evoked, because the viewers are exposed to the unique situation of silence in dance, whereby no predictions, no emotions and no effort are expressed by the dancer. Such situation is rare indeed (and probably new) for the spectator's experience and therefore is likely to induce new experiences and perceptions.

7 Conclusions

Silence in dance, as in other time-dependent art forms, is a powerful tool for emphasizing and creating critical and dramatic moments during the art performance (Lissa, 1964). In addition, by applying (the rare condition of) silence in dance one can achieve a spectacular and/or expressive performance (Main, 2010).

In this paper, I have shown that silence in dance is expressed by minimal or no movement—such as in stillness, or holding of motion or otherwise via an invariable repetitive movement. A ceasing of motion is not a sufficient condition to create a perception of silence in dance. The absence of implied motion in a static position,

an effortless movement (or effortlessly kept position), and a minimal expression of emotions and intentions are all necessary conditions for the experience of silence in dance.

Such a situation is far from our daily experience of looking at human bodies, understanding their actions, and interpreting their intentions. This situation can be created in the artificial, artistic, controlled realm of dance and might invite us to experience the silence of the human body (and brain) as a sublime emptiness or as a dramatic moment in the artistic domain of dance.

This situation, which induces the perception and experience of silence in the spectator brain, is indeed very demanding for the dancer motion-wise and expressively. Yet, in some rare situations, such as the Sufi whirling, the dancer and spectator might share a similar synchronized transcendental experience of silence.

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