

Symbiosis: a biological taxonomy for modes of interaction in dance-music collaborations

Manoli Moriaty
School of Arts & Media
University of Salford
Manchester, United Kingdom
manolimoriaty@gmail.com
e.moraitis1@salford.ac.uk

ABSTRACT

Focusing on interactive performance works borne out of dancer-musician collaborations, this paper investigates the relationship between the mediums of sound and movement through a conceptual interpretation of the biological phenomenon of symbiosis. Describing the close and persistent interactions between organisms of different species, symbioses manifest across a spectrum of relationship types, each identified according to the health effect experienced by the engaged organisms. This biological taxonomy is appropriated within a framework which identifies specific modes of interaction between sound and movement according to the collaborating practitioners' intended outcome, and required provisions, cognition of affect, and system operation. Using the symbiotic framework as an analytical tool, six dancer-musician collaborations from the field of NIME are examined in respect to the employed modes of interaction within each of the four examined areas. The findings reveal the emergence of multiple modes in each work, as well as examples of mutation between different modes over the course of a performance. Furthermore, the symbiotic concept provides a novel understanding of the ways gesture recognition technologies (GRTs) have redefined the relationship dynamics between dancers and musicians, and suggests a more efficient and inclusive approach in communicating the potential and limitations presented by Human-Computer Interaction tools.

Author Keywords

Interaction modes, dance, improvisation, collaboration, taxonomy, symbiosis

CCS Concepts

• **Human-centered computing** → **Interaction design**; Interaction design theory, concepts and paradigms; • **Human-centered computing** → Human computer interaction (HCI); Interaction paradigms; Collaborative interaction;

1. INTRODUCTION

Technologically mediated interaction between the artistic mediums of sound and movement is a topic that in recent years has received rigorous attention. Over the course of more than half a century, specialised research communities have gone to develop a wealth of novel outcomes in areas such as Digital Musical Instruments, sensor technologies, interaction design, mapping strategies, data sonification and compositional processes. Certainly within NIME, the principle motivation behind these research outcome is to exploit scientific knowledge towards expanding the possibilities of musical practice.



Licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0). Copyright remains with the author(s).

NIME'20, July 21-25, 2020, Royal Birmingham Conservatoire, Birmingham City University, Birmingham, United Kingdom.

Such creative outcomes have given rise to the specific practice of interactive performances, most often developed in collaboration with disciplines expressing through physical movement such as performance art and dance. This type of interdisciplinary collaboration can be traced from ancient times, and understood to have developed a 'complementary relationship... steeped in metaphor as we are invited to perceive one in terms of or in the light of the other' [4]. The emergence of interactive technologies has exaggerated this notion, with sensing devices allowing the imprinting of choreographic features within digital media.

Considering Goebel's definition of interaction as the 'interplay between two equal parties' [1], it could be concluded that an interactive performance is one where 'the dancer influences musical processes while the music in turn affects the performer' [21]. However, the vast majority of the related literature focuses its contributions in the aforementioned areas pertinent to technology and music, while revealing little about the role of the choreography beyond being a source of data for the sonification system. Furthermore, equally often the musician is presented as the source of technological innovation, who provides the knowledge in the specialised tools necessary to implement technologically mediated interaction. Taking this generalisation at face value, the reached conclusion is that dancers are simply not enthusiastic about technology [3], with the experts 'spending more time introducing people to working with computers... [than] doing creative work' [2]. Of course, this is simply not the case, as evident from the rich field of dance technology [4] [5] [6] [7], which employs and explores scientific knowledge to a degree at least as high as that observed in the field of music. From this conclusion, the emergent questions concern the role of the dancer in our own field's literature; do dancers need to become proficient in the language of the technologies driving our musical expression in order to exploit their potential? does music affect movement the same way as movement affects music? is there truly equality in the interaction between our mediums? and if not, is that something we should strive for?

Having collaborated with more than twenty dancers and performance artists over the past ten years, while our practice focused on performances featuring real-time interactions between sound and movement, my research has been investigating those questions through Practice Research and autoethnographic methodologies. Acknowledging both the vast differences and undisputed connections between music and dance [4], I placed my experiences as an electronic musician and dance collaborator against a 'conceptual debate' [8] with a biological mechanism which enables strong bonds between disparate individuals; that is the phenomenon of symbiosis. While my previous publications employed the biological concept towards investigating the social aspects and relationship dynamics that emerge during dancer-musician collaborations [10] [11], more recent work utilised the same findings, however focusing on the interaction between the collaborating practitioners' respective mediums. Complementing the latter chapter [12], this paper examines outcomes developed within

and around the NIME community. A discussion on the seminal collaboration between John Cage and Merce Cunningham is used to establish a relationship between sound and movement, and serves as the initial building blocks towards constructing a framework that identifies specific modes of interactions according to the taxonomy observed in symbiotic relationships. Finally, the framework is utilised as an analytical tool in examining six performance works borne out of dancer-musician collaborations, and concludes with an evaluation of the paper's original aims.

2. DEPENDENCIES AND PROPULSION

Practice-based and autoethnographic inquiries are certainly not new within NIME [13] [14] [15], with my application of Practice Research facilitated by using commercially available tools such as Ableton Live/MaxforLive combined with the venerable Nintendo Wii Remote as means of capturing and communicating movement data within the sound-generating systems constructed for each performance. Working predominantly with contemporary dancer Shona Roberts, who already was a close personal friend, we were admittedly inexperienced in each other's discipline, and as such felt more comfortable with restricting our labour within our respective practices, thus maintaining independence and full freedom of expression in developing our material. From my perspective, this was an opportunity to explore aleatoric and rule-based compositional processes that exploited the movement data as sources of randomised modulation, akin to the Low Frequency Oscillators, Envelope Generators, and sequencers familiar to electronic musicians. On reflection (one which we did not realise for considerable time), independence between mediums and indeterminate sound arrangement echoed the collaborative relationship between composer John Cage and choreographer Merce Cunningham, who in developing their joint works would 'intentionally segregate the creation of the sound from the creation of the movement until the performance' [16].

Dubbing this relationship 'autonomous complementarity', Andrew Uroskie notes that the two artists endeavoured to break away from the previously established 'propulsive' relationship between music and dance, where 'music was understood to govern, implicitly or explicitly, the movement of the dancers. Choreography, within this propulsive conception, was a kind of musical interpretation, judged on its ability to form a singular synaesthetic coherence in the experience of the audience' [17]. As a result of this relationship between the designs of sound and movement, a traditional dancer-musician collaboration also followed a similar dynamic, with the composition of music preceding that of dance, and serving as a platform on which the choreography can be then developed. This tradition was all but eliminated by Cage and Cunningham in the 1965 *Variations V*, arguably the first performance work to feature technologically mediated interaction between sound and movement. Utilising an array of analogue input devices [18], dancers were able to initiate prerecorded material through their movements, a methodology that facilitated a new type of relationship between the two mediums, one which allowed a greater level of interaction rather than governance. However, as Uroskie points out, the dancers were not in conscious control of the sonic palette, which would imply that 'one model of subordination would have merely been exchanged for another'; instead, movement was utilised to 'set a certain train of sonic events in motion' [17].

Reflecting with the benefit of more than fifty years of technological developments, this lack of precise control in *Variation V* can be attributed to the to the limitations of the relatively crude analogue system in interpreting movement into actuating commands. Nowadays, with technology allowing a

much more precise control of sound through movement, the propulsive relationship between sound and movement is once again evident, albeit reversed, with movement being the base on which sound can be developed. Setting aside techniques such as auditory scene analysis and other non real-time technologies commonly used in dance practice, recent outcomes in the field of NIME demonstrate a tendency towards using movement data extracted from the choreography as sources of modulation for the sound generating devices. In comparison with the original observation of 'choreography, [as] a kind of musical interpretation' [17] before the rise of interactive technologies, sound in these recent works can be described as a kind of *gestural interpretation*. Considering Uroskie's conceptualisation of 'subordinate' artistic mediums exploited towards 'propelling' that of their counterpart discipline, a useful investigation is not to make a case in favour of one type of subordination, but rather look at the causes of this relationship; interaction entails the creation of emergent elements in one domain resulting from the actions conducted in another, and as a result, requires that one of the interacting parties will affect its counterpart. In the context of the aforementioned interactive performances, the only means of interpreting sonic elements into choreographic expression are the dancers' and physical performers' own cognitive mechanisms. On the other hand, composers are able to exploit a range of gesture recognition technologies (GRTs) by which they can extract detailed movement data, and use these towards modulating real-time composition systems. As a result, an inherent dependency emerges, with sound being technologically propelled by movement. However, dependency neither implies subordination in a particular direction, nor does it describe a permanent and static status in the relationship between two elements, as evident by the conceptual topic of this paper.

3. BIOLOGICAL METAPHOR

The lexicological definition of symbiosis (i.e. Oxford English Dictionary) suggests two elements existing in a sustained harmonious relationship. However, in the context of biological associations, harmonious coexistence is merely one of the many manifestations of symbiotic relationships. Biologists define symbiosis as the close and persistent relationships between organisms of different species [12]. Organisms engaged in symbiosis are identified as the host and its symbiont, with the engagement most often initiated by the symbiont becoming attached to the typically larger host, motivated by the former's desire to extract benefit from the relationship. As a result of this extraction of benefit, or fitness outcome [19], symbiosis manifests in a variety of types. The three core types are mutualism, commensalism, and parasitism, with each type identified according to the effects it has on the engaged organisms. And since the symbiont is always benefited, it is the effect on the host which defines the type. Furthermore, it is important to note that the three types of relationship describe dynamics as these are observed currently, and follow an established evolutionary trajectory [30]. Relationships that are mutually beneficial to both host and symbiont are seldom the result of a fortuitous meeting between organisms with complementary traits. Instead, today's observed mutualisms have emerged from parasitic relationships; starting with a symbiont motivated to seek a host for exploitation, prolonged interaction causes a parallel adaptation of both organisms' biological traits as to allow both to extract benefit from each other [12].

Having explained the core taxonomy of symbiotic relationships, the first step towards drawing parallels between biological and creative associations is to firstly identify the elements making up each partnership, and secondly establish a relationship between these elements. The first shared aspect among the two forms of

association concerns the partners' motivation towards establishing a relationship; that is to combine their individual traits as means of jointly overcoming limitations, respectively borne of environmental [19] and disciplinary [20] factors. From this starting point, the remaining elements are placed through a process of conceptual debate, and finally become organised opposite each other, as summarised in table 1.

This (highly) subjective interpretation assumes the symbiotic relationship as the collaborative engagement, with the organisms as the collaborating practitioners. The interspecificity of the engaged organisms is reflected through the different disciplines employed by each practitioner, with each discipline's specific expressive media related to the biological traits carried by each species. In interpreting the roles of host and symbiont, these are allocated respectively on the practitioner instigating the collaboration and the one who is guided according to the former's direction. As will become clearer later on, the used nomenclature applies to engagements which feature a higher level of dependency, be that a parasitic relationship in symbiosis or a directive collaboration [31] in artistic practice, with the prescriptive meaning of these roles diffused during commensalistic/interactive engagements, and almost entirely absent in mutualistic relationships and collaborative/collective modes.

Table 1. related elements of symbiotic relationships and interdisciplinary collaborations

Symbiotic relationships		Interdisciplinary collaborations	
organisms	symbiont	instigator	practitioners
	host	directee	
interspecificity	biological traits	expressive media	interdisciplinarity
fitness outcome		expressive range	

The final interpretation concerns the element of fitness outcome into expressive range. As mentioned, the types of symbiotic relationships are identified according to the host's fitness outcome, or the level of benefit that organism experiences as a result of its engagement with the symbiont. In the context of my interpretation, expressive range refers to the level of creative input allocated to each practitioner during their collaboration. In the context of interdisciplinary collaborations, this approach presents an efficient way of understanding and allocating each practitioner's liberty in developing their respective disciplinary material during the process of collaborative engagements, with the same principle available towards organising the relationship between musician and dancer while operating an interactive system.

4. INTERACTIVE TAXONOMY

As mentioned in the introduction, the typical approach of using GRTs in music-dance interaction concerns the change of sound through movement. This effect is achieved by mapping movement data to various parameters of DSP devices, with the sound consequently affected as a result of the movement data performing alternations on the parameter's values. Considering this relationship between the two media, sound can be understood as the symbiont medium, with movement being the host governing the development of sound. With this principle in place, and taking into account a host's different fitness outcomes during each type of symbiosis, an equal number of interaction modes can be derived, where the 'host' movement can be 'benefited', 'harmed', or 'unaffected' by its 'symbiont' medium

of sound. In line with the previous subjective interpretation between the elements making up each association, the biological notions describing changes in fitness outcome are related to the restrictions, or lack of, placed on the expressive range of the associated media and their respective practitioners during a performance. The most efficient way to establish these relationship is by first observing the resulting sonic *outcomes*, followed by the restrictions placed on the dancer and the *provision* in which she or he develops movement, and finally the dancer's manner of *operating* the system, and the level of *awareness* of how movement affects sound, with this latter element related to the notion of 'legibility' or 'transparency' of mappings in the field of NIME [21], albeit from the perspective of the dancer rather than the audience.

5. SYMBIOTIC INTERACTION MODES

Looking at the first association, when the collaborative performance requires a determined sonic outcome (akin to a fixed music score), the dancer must perform a specific set of movements in order to alter the values of the DSP parameters in a predefined manner. As a result, this interaction mode imposes restrictions on the movement's range of expression in order to accommodate the desired sonic outcomes, in quite the same manners as traditional choreography does. Furthermore, with the the mappings between movement data and DSP parameters having been created by the musician, she or he needs to communicate to the dancer the required movements needed to achieve the determined development of sound over the duration of the performance. Consequently, the dancer is relieved from having to fully understand the ways her or his movements may affect sound beyond the predefined movements. As such, this interaction mode assumes movement as a predefined modulator for the sound. In other words, through the previously discussed subjective interpretation of the biological notions describing fitness outcome, the 'host' movement is 'harmed' in order to 'benefit' its 'symbiont' sound, thus establishing a parasitic symbiosis between the two expressive media.

On the opposite spectrum of sonic outcome, an indeterminate score entirely alleviates any requirement for the dancer to become familiar with the mappings between movement data and DSP parameters, with movement remaining independent to sound. However, from the musician's perspective, the mapping must be designed as to accommodate the dancer's full range of movements which she or he may deploy at will throughout the duration of the performance. In a way, the randomised alteration of DSP parameters during this interaction mode can be related to a generative music system, or to provide a further simplified reflection, to the modulations derived by an LFO set to random or noise waveform. In the context of the symbiotic interpretation, the 'host' movement is 'unaffected' due to enjoying a full range of expression, while the 'symbiont' sound extracts 'benefit' in the form of randomised modulations that can be used to develop and expand its outcome. As such, this interaction mode forms a commensalistic symbiosis between sound and movement, which on reflection can be associated with the interaction employed in *Variations V*, when dancers had an effect on sound despite being unaware of the ways their movements specifically controlled Cage's tape players. However, while Cage reveled in employed indeterminacy as a compositional approach [22], Cunningham directed his dancers through an explicit choreography. Nevertheless, this is but one manifestation of a commensalistic interaction mode, and free improvisation presents itself as fruitful provision for dancers, with the musician tasked with designing a system able to generate meaningful sonic outcome through random modulation inputs.

With mutualism being the remaining type of symbiotic relationship, such an interpretation into the context of

collaborative performance requires for both sound and movement to mutually extract ‘benefit’ from their interaction, which considering the earlier connection between fitness outcome and expressive range, suggest simultaneous full range of expression for both mediums. While the provision of free improvisation may at first appear salient to this mode, developing this mode through practice showcased that an intermediate provision is more appropriate, that of structured improvisation. Examining this provision in the context of music performance, structured improvisation differs from its free counterpart by the approach of creating real-time compositions by connecting pre-established material over an arrangement which is not predefined [23]. As such, while the resulting sonic outcome is not determined, its characteristics can be anticipated. Structured improvisation shares a slightly different meaning in the context of choreography, with dancers adhering to a predefined temporal arrangement in relation to stage placement and clustering, while retaining freedom towards their performed movements during each section of the arrangement [24]. Considering this provisions for music and dance respectively, in the context of HCI-mediated interaction, the dancer is allocated freedom towards her or his movements, with the caveat that these movements need to result to anticipated sonic outcomes. As such, the dancer must be well-familiarised with the system’s mapping, and be aware of the ways each movement may affect sound. In other words, the mutualistic interaction mode presents a mutual compromise between the expressive ranges allocated to sound and movement, with both mediums mutually extracting ‘benefit’ up to the level at which one of them can be said to experience ‘harm’, thus resembling the mechanisms by which mutualistic symbioses are developed over evolutionary scale in the natural world.

Table 2. taxonomy of symbiotic interaction modes with associated elements

	Interaction modes		
	<i>Mutualism</i>	<i>Commensalism</i>	<i>Parasitism</i>
Affect awareness	high	low	moderate
Provision	structured improvisation	free improvisation	score/choreography
Operation	exploration	detachment	instruction
Outcome	anticipation	indeterminacy	determinacy

The three symbiotic modes of interaction are summarised in table 02, with each mode identified according to their specific affect awareness, provision, operation, and outcome borne of the interaction between the two mediums. Furthermore, multiple modes can also manifest during a performance, either consecutively during different sections, or simultaneously while operating different layers of sound, each controlled via with a different mode, as demonstrated in *Symbiont Zero*, a work I developed in collaboration with Roberts. With this work detailed elsewhere [11] as means of activating the framework through practice, the framework is employed as analytical tool towards examining six collaborative works featuring HCI-mediated interaction between sound and movement.

6. PRECEDENT ANALYSIS

Table 3 presents a summary of works developed and presented in NIME and associated communities of researchers. The list is by no means exhaustive, and instead uses a sample of publications that provided sufficient information in regards to the experience of the performers. As previously stated, with the framework being the result of subjective interpretation, so follows that this analysis in conducted in the context of the established conceptual frame.

Digital Dance Project [27]

This early work describes the allocation of control to parameters that are perceptible yet do not require “excessive concentration on instrumental performance”. While the composers describe each section’s sonic characteristics in detail, they also point out a degree of freedom on the arrangement borne out of the dancers’ interaction, thus suggesting an outcome of anticipated textures and structure. The authors also describe the dancers’ positive feedback in feeling “freedom in the direct relationship between movement and music” with “fairly transparent or direct relationships between the dancer’s movements and their musical consequences”, pointing towards the high level of affect awareness. Besides this degree of freedom, the final work requires the dancers to follow a set of choreographic instructions.

Arroyo/Aura/Trio de Cuatro [24]

Traversing a labyrinth through motion-activated sonic clues suggests exploratory operation, with the previous knowledge of specific sound cues, albeit triggered over an indeterminate arrangement, relating to the notion of anticipated outcomes. At the same time however, the authors mention that “it is important for dancers to learn the musical consequences of their movements”, thus pointing towards a high affect awareness. And although the utilised system SICIB is designed towards ‘improvisation’, in the context of the three described works, a pattern of structured improvisation emerges, following a predefined rule-based exploration of the dancers’ environment.

Raja [25]

In *Raja*, a choreographer designed the dancers’ movements following a briefing of the composers’ intentions and possibilities presented by the system. Following the initial rehearsals with the interactive system, the dancers commented that “the sounds were somewhat irresponsive, predictability was weak”, suggesting a high level of affect awareness. However, although described as largely choreographed, the work also features a section with improvisation accompanied by “familiar piano sounds” as opposed to the “electronic sound set in the beginning and end parts”, something which allowed the now improvising dancers to better process the slow-paced soundscape towards developing their movements. As such, a mutation of modes is evident, with the first and third parts requiring the dancers to follow a determined choreography, while the middle part’s provision that of improvisation, consequently affecting the operation to that of exploration and the outcome to anticipation.

Emovere [26]

The ‘dynamic and unpredictable soundscape’ resulting from the sonified electrocardiography (ECG) data points towards an indeterminate outcome. Considering the opaque connection between the dancers’ movements and the sonic output, in combination with the largely involuntary bodily data measured by the ECG sensors, it can be concluded that the dancers possessed a low level of affect awareness, with their movements informed purely by the sonic output rather than a conscious engagement with the mapped parameters.

OtoKin [28]

In describing the performative aspects of *OtoKin*, the authors explain that they ‘did not use explicit choreographed movements, but... allow for exploration of various movement patterns within the sound space’. As such, any predefined structure followed by the performers relate to the conceptual narrative of the choreography, rather than any adherence to a determined sonic arrangement, thus suggesting an improvised provision and indeterminate outcome. The utilised system allows for a degree of improvisation within each section, and ‘lends itself well for both improvisatory exploration, and for semi-prepared narratives’. In regards to affect awareness, the work displays high level of awareness, with the added novelty of configuring onset points according to not only movements of the body itself, but also its topography within the dance space.

Vrengt [29]

Vrengt focuses on the dancer’s release technique, which places importance to ‘flow procedures’. In order to make best use of this technique in the context of an interactive performance, the composers utilise a sonification system as a ‘more objective approach to rendering sound in response to data than more creatively based sound design’. However, although this may suggest an indeterminate outcome, the authors describe the performance as a ‘comprovisation’, where ‘the composed aspect of the instrument and choreography provide a large amount of freedom in collectively exploring sonic interaction through the performance’, which points closer to an anticipatory outcome. In regards to system operation, this exploration becomes a focal point for the dancer, with ‘listening as the main source for decision making, while intuitively moving along with a physical play and exploration’. This relates to the mode of exploratory operation, further supported by a high level of affect awareness, with the dancer having developed ‘a gestural repertoire’ through a ‘sophisticated control of her movement, and hence sound’.

Table 3. precedent analysis

Work title/year	Affect awareness	Provision	Operation	Outcome
<i>Digital Dance Project</i> 1998	high	choreography	instruction	anticipation
<i>Arroyo/Aura/Trio de Cuatro</i> 2001	high	structured improvisation	exploration	anticipation
<i>Raja</i> 2011	high ↓ moderate ↑	choreography ↓ improvisation ↑	instruction ↓ exploration ↑	determinacy ↓ anticipation ↑
<i>Emovere</i> 2016	low	choreography	detachment	indeterminacy
<i>OtoKin</i> 2019	high	improvisation	exploration	indeterminacy
<i>Vrengt</i> 2019	high	structured improvisation	exploration	anticipation

7. CONCLUSIONS

As stated in the introduction, this paper aimed to present an efficient and inclusive manner of communicating the principles and creative potential of HCI-mediated interactive performances. It is worth stating that the symbiotic framework does not present any *new* modes of interaction, but instead collects the existing approaches that have been developed within the field, and presents them arranged across a qualifiable spectrum. Moreover, the framework employs language which is shared among the two disciplines of music and dance, which holds the potential of efficiently communicating complex concepts. For example, the distinction between instrumental and algorithmic mapping strategies refers to coupling modulation

data with parameters respectively controlling real-time and ‘higher level structural processes’ [21]. While this community may be familiar with the intentions described by these strategies, their meaning can evade practitioners whose specialisms fall outside the field of technologically-mediated performance. In the framework, instrumental and algorithmic strategies related to the parasitic and commensalistic modes. This is not to suggest that using the decontextualized biological terms would in any way constitute an efficient method of clearly conveying one’s creative intentions. However, this context is provided through the descriptors of each examined area, with the nomenclature made of terms that are shared among the disciplines of music and dance, even if their specific meaning can be perceived with slight differences, as in the case with the distinction of structured improvisation described in 4.1. As a result, familiar language facilitates clarity in communication, something which particularly welcome during the complex and intense process of artistic collaboration.

The symbiotic framework is less useful when the intention is to provide a thorough understanding of interactive systems. As well as applying on a fairly narrow area of interactive works (dancer-musician performance with real-time sound generation), there is little context on the technology facilitating the interaction, nor the cultural background of such practices. Of course, possessing knowledge in those areas is necessary for the field’s practitioners. Can the same be said for everyone engaging with interactive works? In my experience, my collaborators have often viewed detailed technical descriptions as cryptic and alienating, and counterproductive in allowing them to think of potential avenues for engaging their material with HCI tools. Similarly, omitting any description can become a barrier for engagement between the two practitioners, resulting in a directive collaboration where the musician acts as the gatekeeper of technology, while the dancer is less-well equipped to conceptualise the developing work in line with the affordances of interactive technologies. With the framework focusing on the principles of *operating* interactive interfaces, it succeeds in filling the gap between ‘too-much-information’ and ‘no-information-whatsoever’ by delimiting the range of potential avenues for implementing interactive strategies in performance. As a result, it allows our collaborators to actively participate in the development of the work, while also serving as a gateway for practitioners aiming to further their practical skills in technologically-mediated practices.

Rachel Duerden describes the relationship of dance and music as one ‘steeped in metaphor’, inviting practitioners to ‘consider the potential transfer of attributes from one to the other’ [4]. She further points out the value of allegorical debates between the two disciplines as a way of highlighting their common ground: ‘Linking two disparate entities by metaphor first draws attention to a clear point of contact between the two, and then goes further and implies or invites us to consider further connections’ [4]. In this paper, the intersecting language between dance and music makes up the highlighted points of contact between the disciplines, which emerged from conceptualising collaboration as an allegorical symbiosis. Although a highly subjective endeavour which at times verges on being a poetic novelty, the concept is best viewed as a playful provocation, a new way of thinking the relationship between collaborating practitioners and their respective mediums of artistic expression. Nevertheless, the presented interpretation is informed by a significant body of rigorous scientific knowledge. And with the biological phenomenon being far more complex than what the brief summary presented here may suggest, it holds great potential for exploring further lines of inquiry in relation to creative practice, collaborative or otherwise.

8. REFERENCES

- [1] J. Goebel. Man Machine Interaction. in Proceedings of the International Computer Music Conference, San Francisco, International Computer Music Association, pp. 41-48, 1988.
- [2] A. Horwitz. Talking to Troika Ranch. Ephemeral Objects, interview 8 July 2014, accessed 31 Jan. 2020, <https://www.ephemeralobjects.org/2014/07/05/talking-to-troika-ranch/>, 2014.
- [3] S. Sentürk. Interactivity in Contemporary Dance and Music. Accessed 31 Jan. 2020. https://www.researchgate.net/publication/266369354_Interactivity_in_Contemporary_Dance_and_Music, 2011
- [4] R. Duerden. Dancing in the Imagined Space of Music, in Proceedings of the Sound Moves Conference, pp. 26-33, 2005.
- [5] D. Risner and J. Anderson. Digital Dance Literacy: an integrated dance technology curriculum pilot project, *Research in Dance Education*, vol. 9-2, pp. 113-128, 2008.
- [6] B. Gonzalez, E. Cherry and C. Latulipe. Dance-Inspired Technology, *Technology-Inspired Dance. NordiCHI 2012: Making Sense Through Design - Proceedings of the 7th Nordic Conference on Human-Computer Interaction*, 2012.
- [7] <http://www.dance-tech.net/>
- [8] R. Nelson. *Practice as Research in the Arts*. Basingstoke: Palgrave Macmillan, 2013.
- [9] E. Moraitis (M. Moriarty). *Symbiotic Synergies: Adaptive Framework for Polydisciplinary Collaboration in Performance Practice*, Ph.D. thesis, School of Arts & Media, University of Salford, Manchester, 2019.
- [10] M. Moriarty. Symbiosis: Organisation and Mutual Exploitation in Interdisciplinary Collaboration, in *Artistic Research Will Eat Itself: Proceedings of the The 9th SAR International Conference on Artistic Research*, University of Plymouth, UK, G. Cox, H. Drayson, A. Fatehrad, A. Gall, L. Hopes, A. Lewin, A. Prior (eds) Society for Artistic Research, pp. 81-96, 2018.
- [11] M. Moriarty. Interspecific Interactions: interaction modes between sound and movement in collaborative performance. in R.A. Earnshaw, S. Liggett, P. Excell. and D. Thalmann (eds) *Technology, Design and the Arts – Challenges and Opportunities*, Springer, Cham, Switzerland, 2020a.
- [12] S. Paracer and V. Ahmadjian, *Symbiosis: An Introduction to Biological Associations*. New York: Oxford University Press, 2000.
- [13] A. Weisling, A. Xambó, I. Olowe, and M. Barthet. Surveying the Compositional and Performance Practices of Audiovisual Practitioners. *NIME18*, pages 344–345, 2018.
- [14] B. Carey and A. Johnston. Reflection On Action in NIME Research: Two Complementary Perspectives. In *NIME16*, pages 377–382, 2016.
- [15] G. Booth and M. Gurevich. Collaborative composition and socially constituted instruments: Ensemble laptop performance through the lens of ethnography. *NIME12*, 2012.
- [16] J. Klosty, Merce Cunningham. New York: E.P. Dutton, 1975.
- [17] A.V. Uroskie, From Pictorial Collage to Intermedia Assemblage. *Animation: an interdisciplinary journal*, vol. 5-2, pp. 223–241, Sept. 2010.
- [18] L. E. Miller, Cage, Cunningham, and Collaborators: The Odyssey of Variations V. *The Musical Quarterly*, Oxford University Press, vol. 85-3, pp. 545-567, 2001.
- [19] A. E. Douglas, *The symbiotic Habit*. New Jersey: Princeton University Press, 2010.
- [20] V. John-Steiner, *Creative Collaboration*. New York: Oxford University Press, 2000.
- [21] C. Salter, M.A.J. Baalman and D. Moody-Grisby. Between Mapping, Sonification and Composition: Responsive Audio Environments in Live Performance. In R. Kronland-Martinet, S. Ystad, and K. Jensen (eds) *CMMR 2007, LNCS 4969*, pp. 246–262, 2008.
- [22] J. Cage, M. Kirby and R. Schechner, An Interview with John Cage, *The Tulane Drama Review*, vol. 10-2, pp. 50–72, Winter 1965.
- [23] J. Pressing. Improvisations, methods and models. in J. Sloboda, *Generative processes in music*, New York: Clarendon Press, pp. 129–178, 1987.
- [24] E. Gómez and J. Jaimovich. Emovere: Designing Sound Interactions for Biosignals and Dancers. In Proceedings of the International Conference on New Interfaces for Musical Expression, pp. 316–320, Griffith University, Brisbane, Australia, 2016.
- [25] R. Morales-Mazanares, E.F. Morales, R. Dannenberg and J. Berger. SICIB: An Interactive Music Composition System Using Body Movements, *Computer Music Journal*, Vol. 25-2, pp. 25-36, 2001.
- [26] T. Ahola, K. Tahiroglu, T. Ahmaniemi, F. Belloni and V. Ranki. Raja – A Multidisciplinary Artistic Performance. Proceedings of the International Conference on New Interfaces for Musical Expression, pp. 433–436, 2011.
- [27] W. Siegel and J. Jacobsen. The Challenges of Interactive Dance: An Overview and Case Study. *Computer Music Journal*, vol.22-4, pp. 29-43, 1998.
- [28] P. Dahlstedt and A.S. Dahlstedt. OtoKin: Mapping for Sound Space Exploration through Dance Improvisation. Proceedings of the International Conference on New Interfaces for Musical Expression, UFRGS, pp. 95–100, 2019.
- [29] C. Erdem, K.H. Schia, and A.R. Jensenius. Vrengt: A Shared Body-Machine Instrument for Music-Dance Performance. Proceedings of the International Conference on New Interfaces for Musical Expression, UFRGS, pp. 186–191, 2019.
- [30] E. Yong. *I Contain Multitudes*. New York: Ecco. 2017.
- [31] S. Hayden and L. Windsor. Collaboration and the Composer: Case Studies from the End of the 20th Century. Cambridge University Press, *Tempo*, vol. 61-240, pp. 28-39, 2007.