

The Body Beyond Movement: (Missed) Opportunities to Engage with Contemporary Dance in HCI

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This paper argues that a significant paradigm change in contemporary dance can offer further opportunities for HCI researchers interested in embodied interaction and interactive system design. Based on the analysis of 42 HCI papers in our data set, resulting from searches in two computing research libraries, we suggest seven thematic categories that reflect how HCI researchers have been engaging with contemporary dance. Moreover, we propose a standardized usage of contemporary dance terminology in HCI literature, and discuss the current state of engagement with publications from the field of performance theory. We identify three opportunities for HCI, which can arise through further engagement with the knowledge produced in contemporary dance and performance: to engage with the field of embodied interaction from the perspective of performance research and theory; to employ contemporary dance methods and practices in HCI research; and to integrate contemporary dance choreographers and performers as researchers in interdisciplinary projects.

CCS Concepts: • **Human-centered computing** → **HCI theory, concepts and models**; • **Applied computing** → **Performing arts**.

Additional Key Words and Phrases: embodied interaction; contemporary dance; literature review; performance studies; interdisciplinarity; referencing

1 INTRODUCTION

There is an increasing interest from the HCI community in contemporary dance, often linked to the growing attention given to the concept of embodied interaction. Regarding the latter, an important milestone has been Dourish's book "Where the Action Is" [25], which set the foundation for embodied interaction in HCI as "interaction design for and with the lived body" [30]. More recently, Kirsh [42] has proposed concrete ideas how embodied cognition can enhance interaction design in HCI. Less prevalent in the HCI community is the acknowledgement of a significant paradigm change in contemporary dance. This shift is reflected in recent performance theory and the sub-field of dance studies: movement is not the sole medium of expression of the dancer anymore, and choreography is no longer understood exclusively as the organization of the movements of human bodies in space and time. Instead, much contemporary dance choreography can be described as a "collection and organization of heterogeneous materials, as an intermedial

arrangement of bodies, spoken language, texts, images, light, sound and objects” [43]. In consequence, contemporary dance practitioners frequently develop novel skill sets to collaborate in interdisciplinary artistic and scientific projects as experts in embodied interaction (e.g. partaking in the development, testing and performing of interactive systems). In summary, the paradigm shift describes how contemporary dance has grown into a heterogeneous and interdisciplinary artistic field that is very different from traditional dance, and which offers HCI researchers new and distinct opportunities for engaging.

1.1 Paradigm shift in Performance Theory

The paradigm shift (i.e. the focus is not on movement exclusively any longer, but on the body and its multimodal forms of communication) also significantly expands traditional conceptions of dance and consequently challenges any “categorizing and historically unique classifications” of contemporary dance [18]. Today, performance theory and dance scholars explain contemporary dance as an *artistic field that consists of many different dance practices or genres*, including expressionist dance, modern dance, postmodern dance, contact improvisation, (neoclassical) ballet, Tanztheater (dance theater, physical theater) [44], and recently, self-reflexive postmodern dance and concept dance [43]. We propose to add to this list digital performance [24] and choreographic performance [21] as important contemporary dance practices or genres. Dancers (and choreographers) today train, create and perform in various genres of the field of contemporary dance: for example, they may combine ballet technique classes, somatic practices and dance theater techniques during a particular dance production. This led Lampert to conclude that the ideal body in contemporary dance today is a versatile, hybrid body [44]. Additionally, dance improvisation methods have become an integral part of contemporary dance practices since the 1950s [44]. As a result, the roles of choreographers and dancers in the creative process can be very different, ranging from traditional directorial approaches to co-creation type of collaborations. Dancers, who use improvisational systems and techniques in creation and/or in performance, are not only proficient in several dance techniques, but also know how to explore and employ compositional strategies. This skill set enables them to become ‘artist-researchers’, specialists in embodied interaction who can explore numerous environments through their bodies. Cvejic in her book “Choreographing Problems” refers to the work of choreographers Burrows and Ritsema as “dancing in the state of questioning,” and their practice of dance improvisation as “progressively delineating their field of inquiry” [21]. Hybrid dance forms, intermedial choreographic processes and improvisation techniques represent great challenges for those HCI researchers who seek to classify dance and need to generalise their findings.

1.2 Challenges and opportunities for HCI

For HCI researchers, the paradigm shift represents the challenge of engaging with the complexity of recent performance theory, which by nature is already interdisciplinary and in dialogue with recent theories from neurosciences (e.g. [6, 8, 20]), cognitive sciences (e.g. [3, 33, 34, 42]), media art philosophy (e.g. [5, 24, 51, 58]) and so forth. On the other hand, it is precisely the recently produced knowledge and practice of novel methods and techniques of artistic research in contemporary dance, which offer great opportunities for HCI researchers interested in embodied interaction. This perspective leads to our main research question, which will be addressed in the main sections of this paper:

How has HCI been engaging with contemporary dance? This main research question focuses on three specific aspects: a) Which are the main themes emerging in HCI when engaging with contemporary dance?; b) How do HCI researchers understand the term ‘contemporary dance’? and c) How do the authors engage with literature from dance studies and performance theory?

By answering the main research question, pathways to future development will also be suggested, leading to our secondary research question, which will be addressed in the final section of the paper:

What opportunities for HCI can arise through engagement with the paradigm shift in contemporary dance and performance theory?

2 METHODS

In order to answer our research question, we conducted searches within two of the main online libraries of HCI-related articles: ACM Digital Library and IEEE Xplore. We limited our search to these two major computing-related libraries since we wanted to specifically focus on how Contemporary Dance is viewed in HCI literature. We ruled out publications that did not mention our search “contemporary dance” term explicitly. The inclusion of other, more specific online libraries, and of related search terms (such as choreography and improvisation etc.) would have been beyond the scope of this paper. However, we clearly see potential for further future research into these topics. We searched the term “+Contemporary +Dance” in both libraries (on the 24th October 2019). In the ACM Digital Library, the search returned 47 results. In the IEEE Xplore, the search returned 17 results. We then filtered the results based on the following criteria: usage of the composite term ‘contemporary dance’ in the paper. This resulted in 44 papers: 35 from ACM Digital Library and 9 from IEEE. We then removed two additional articles that were considered not relevant: short articles presenting a talk (2 pages [19]) and a performance (only an image and caption [59]), resulting in the final 42 papers. We considered that the choice of the ACM and IEEE libraries, and the search terms, was successful in leading to results and a number of papers that allowed for adequate scope for our study. Our survey was informed by similar approaches within literature related to HCI and dance. Peng et al. [50] conducted a survey of dance in social robotics, taking as starting point mainly the IEEE online library, but also ACM Digital Library and others. Marshall et al. [46] analysed the quality of citations in a substantial sample of CHI 2016 publications. From the former, we adopted a similar study design. We adopted the latter’s method of classification and rating of critique citations.

3 WHICH ARE THE MAIN THEMES EMERGING IN HCI WHEN ENGAGING WITH CONTEMPORARY DANCE?

Addressing the first aspect (a) of our main research question, we analysed the content of each of the 42 papers to identify their main topics. During the coding process of the papers, we looked for thematic clusters and eventually arrived at seven categories (see Table 1). Some papers could theoretically fall into more than one category, however, we decided to focus on the main contribution of each publication and allocated them in a single class.

3.1 Results

Out of 42 results, there were two categories with single articles, which we considered relevant enough not to be grouped with others. Both of these papers represent important lines of research in the field (dance documentation and archives, and audience studies). Consequently, we added these two categories despite the low number of results. Within the remaining 40 papers there were always more than one result and the categories show clearly distinguishable topics. We also looked at the potential target group of the papers as we constituted the seven categories, as presented below under each category.

The first category presented, ‘technical framework’, encompasses papers presenting low-level technical contributions for developers. The category yields 9 results (21%) and includes papers that contribute to new computational techniques, for example a visualisation system that exposes movement qualities for dance through rendering effects [1]; frameworks,

Table 1. Main topics across 42 papers in seven categories

Category	N. papers (%)	References
C1.1 Technical framework	9 (21.4%)	[1], [4], [15], [26], [38], [48], [57], [63], [67]
C1.2 Research through practice	8 (19.0%)	[28], [29], [32], [35], [36], [53], [54], [56]
C1.3 Theory and methodology	7 (16.7%)	[2], [13], [16], [27], [37], [47], [55]
C1.4 Support tools for dance	11 (26.2%)	[10], [11], [12], [14], [17], [19], [22], [31], [60], [61], [64]
C1.5 Artistic work and process	5 (11.9%)	[9], [40], [41], [49], [65]
C1.6 Dance archive / documentation	1 (2.4%)	[23]
C1.7 Audience studies	1 (2.4%)	[62]

e.g. MotionMachine, which helps with motion data interpretation through feature extraction and interactive visualisation [63]; and evaluation practices, for instance the feature evaluation and selection for phrase structure detection in dance [26]. For the most part these are low-level contributions that are not meant for end users but more likely for developers.

Category 1.2 includes papers that focus on the collaboration with dancers in an HCI research context, often with a user-centered design or co-design perspective. While some of the eight results (19%) in this second category might also fit in the first category, the focus here was on a ‘research through practice’ approach towards dance, for example: research into embodied interaction through collaborative exploration and testing of interactive environments [29]; or transfer of ideas from two contemporary dance pieces to design of interactive furnishings [32].

Category 1.3 ‘theory and methodology’ contains seven papers (17%) that lay important theoretical and methodological ground for the field. For example, [47] is a theoretical paper discussing critical appropriations of biosensors in artistic practice, whereas [13] present important classifications of dance learning practices and movement principles towards developing a novel methodology for selecting motion capture data across different dance learning practices.

The fourth category ‘support tools for dance’ comprises eleven papers (26%) presenting hardware and software solutions to support end users (choreographers, dancers, academic researchers and other dance professionals). Proposed support tools are designed for use in pedagogical environments [22, 31, 61], creation settings in dance e.g. [11, 17], or for dance analysis purposes, for example [14].

In category 1.5, we find five papers (12%) that focus on specific ‘artistic work and processes’ at the intersection of contemporary dance and various kinds of technologies, e.g. zero-gravity environments [9], interactive system design for the stage [40], or automatized and markerless motion capture for the creation of online scores [41]. This category is distinguishable from 1.2 as there is a stronger emphasis on the artistic side, and authors often present specific pieces.

As mentioned, the last two categories (1.6 ‘dance archive / documentation’ and 1.7 ‘audience studies’) were added, despite only containing a single paper each, because they represent significant research areas. The only paper in category 1.6 [23] presents multidisciplinary research in the context of an Intangible Cultural Heritage project [23]. This is clearly an area which includes several kinds of dance forms and genres (including contemporary dance) and their respective cultural and historical perspectives.

In the last category 1.7, a paper discusses audience behaviour during a contemporary dance performance based on a case study on a major contemporary dance company [62]. Again, the topic is addressed only once amongst the 42 papers, but represents an important research area and thus constitutes a category on its own.

3.2 Discussion

Out of the 42 papers identified, 86% have been published in the last decade, indicating the strongly growing interest of HCI researchers in contemporary dance. Papers in category one 'technical framework' were the first to appear (from 2002 on), followed by publications on artistic work and process (2005 and later). Papers in the other five categories only start to appear since 2009.

The most recent categories are 'research through practice' (papers since 2015) and 'theory and methodology' (from 2016 on). High percentages of total publications in these particular categories (35% together) are certainly symptomatic of the paradigm change in contemporary dance discussed above (the body as an interface for interdisciplinary engagement). Moreover, the rapid succession of these publications also evidence novel forms and methods in HCI research, including changing models and roles of collaboration with the artists, and a growing interest in methods and theories related to embodied interaction [25, 30]. Methodological and theoretical contributions can be outcomes of a larger research project [13, 27, 55] and are sometimes followed by studies, which introduce the concrete application of these methodologies [16, 17].

This latter work in the context of larger research projects is mostly connected to category three 'support tools for dance', which is the biggest group of papers in our classification. Most support tools are carefully developed based on design specifications derived from the practice of a collaborating choreographer, or a small number of choreographers (up to six artists). Theoretical reflection upon these studies addresses key characteristics in the work of these choreographers from the perspective of HCI researchers, but generally does not engage with dance studies or performance theory (more of this anon). For example, authors present user testing of a support tool [12], although it would be helpful to research further into the continued use and appropriation of these tools by the dance community. In this context we suggest to consult a reference outside of our data set: Raheb et al. have recently presented a survey of 'dance interactive learning systems', which the authors organised in five categories of dance technology support tools [52]. Other authors in our data set look at contemporary dance and performance knowledge with the intention of transferring methods and approaches in order to apply these in HCI – for example: the aforementioned critical appropriations of biosensors in artistic practice in [47] and the transfer of ideas from contemporary dance pieces to the design of interactive furnishings [32]. The question of what contemporary dance has to offer HCI is intimately connected with the question of how contemporary dance is defined and what kind of work and knowledge is produced in the field that can be important for HCI.

4 HOW DO HCI RESEARCHERS UNDERSTAND THE TERM 'CONTEMPORARY DANCE'?

This question represents the second aspect (b) of our main research question, as outlined in the introduction. It is not a question that can be answered in a simple and straightforward fashion, because none of the papers we looked at offers a tentative definition of contemporary dance. Nor does any of the papers refer back to existing definitions in the literature of the related scientific areas, such as dance studies or performance theory. Hence, our method for analysis and coding was to compile a list with all descriptions of the term 'contemporary dance', characteristics attributed to it and relevant contextual information (e.g. do the authors discuss related art works, pedagogical situations, improvisational settings etc.).

Table 2. Use of the term ‘contemporary dance’ (66 results across 42 papers, 20 papers fit more than one category)

Category	N. papers (%)	References
C2.1 Contemporary dance as an artistic field	19 papers (28.8%)	[1], [4], [9], [10], [11], [12], [19] [22], [23], [26], [36], [37], [40] [41], [47], [49], [54], [53], [65]
C2.2 Contemporary dance as a dance genre	24 papers (36.4%)	[1], [2], [9], [13], [14], [15], [16], [17], [23], [27], [28], [29], [31], [38], [48], [55], [56], [57], [60], [61], [62], [63], [64], [67]
C2.3 Contemporary dance as a dance technique	7 papers (10.6%)	[15], [22], [56], [60], [61], [64], [67]
C2.4 Referring to artistic work in contemporary dance	10 papers (15.2%)	[4], [16], [17], [31], [32], [35], [40], [41], [62], [65]
C2.5 Referring to processes and practices in contemporary dance	6 papers (9.0%)	[4], [35], [37], [49], [64], [67]

4.1 Results

Based on these results, we established five categories in which ‘contemporary dance’ is used to describe: a field (2.1), a genre (2.2), or a technique (2.3). To deepen our analysis and subsequent discussion of the results, we also included references to concrete artistic work (2.4), and references to processes and practices (2.5). In this coding scheme, multiple mentions of papers in different categories were possible to analyze more precisely how the authors understood the term ‘contemporary dance’. Across the 42 papers we obtained 66 results in five categories (Table 2).

Papers falling in category 2.1 use the term ‘contemporary dance’ as a general descriptor for an artistic field in the performing arts, for example [1, 19, 47, 53]. For Cabral et al. “contemporary dance is a domain”, which is synonymous to “area” or “field” [10]. Dyaberi et al. use the term “western contemporary dance” [26], comparable to authors in performance theory literature who understand contemporary dance as a field.

In the second category, contemporary dance is understood as a genre, a kind, or as a style of dance that has its own terminology and can be distinguished from other genres, such as tango, folk dance or ballet [27]. Several authors who use the term in the sense of ‘genre’, mention the discourse of movement qualities as an essential topic in contemporary dance, e.g. [14, 27, 29, 31]. Some authors in this category perceive contemporary dance as a very challenging genre. For example, Aristidou et al. state: “(...) no two modern dancers perform the same as there is no routine steps, elements or styles (...) Contemporary dances are freeform motions that contain extreme postures” [2].

Category 2.3 consists of papers that use the term ‘contemporary dance’ as a synonym for a technique taught as a dance class, e.g. [56, 60], or as part of a dance curriculum, for example [22]. In this context, contemporary dance is described as “(...) a corporal practice that undoubtedly requires motor skills of the highest level. To reach expert level, dancers are trained to efficiently acquire complex movements and phrases” [56]. Out of seven results in this category, six also fall into category 2.2, indicating that contemporary dance as a technique is habitually associated with contemporary dance as a genre.

All ten results in category 2.4 are referring to artistic work in contemporary dance. Some authors have collaborated with well-established contemporary choreographers, e.g. [31, 41, 65], whose work is well-documented and represents distinct artistic approaches in the field. The remaining cases of presenting concrete artistic work are also very helpful for our analysis of what HCI researchers consider contemporary dance and why. For example, [4] presents several cases

of collaborations between well-known media artists and choreographers to discuss the impact of digital technologies on contemporary dance.

Finally, category 2.5 consists of papers that address recent key topics in contemporary dance by looking at processes and practices. Hieda for instance presents a project where somatic practices are used as a technique to engage with mobile brain-computer interfaces in dance performances [35], and Hsueh et al. deconstruct the creative process and show how contemporary dance practitioners “invent and appropriate tools to achieve their desired ends” [37].

4.2 Discussion

Looking at Table 2 it is evident that the term ‘contemporary dance’ is not used in a homogeneous way. For less than a third of the authors, contemporary dance is an artistic field, while over a third of authors understand the term as a dance genre, or even narrower as a dance technique. As mentioned in the introduction section, all usages can make sense, according to the topic the researchers are investigating, and if identified properly. However, we suggest that a standardized usage for HCI terminology could employ a ‘zooming in and out’ type of logic: Contemporary Dance is an artistic field that consists of many different genres (sub-fields). Within each genre exists a set of techniques that is taught and practiced. Employing the explanation from Performance Theory presented in the introduction, HCI researchers can situate their specific topic on the respective level of detail through ‘zooming’ from the overall artistic field into the genre and even further into the techniques, or vice versa.

Moreover, our contextual analysis of all instances, in which the term contemporary dance was used across the 42 articles, shows that authors generally use the term as a mere descriptor of a field / a genre / a technique, without offering a definition or clarification of the term based on dance studies or performance theory (a notable exception is [53]). This leads to seemingly contradictory statements about what contemporary dance is, for instance in the citations we included in our descriptions of categories 2.2 and 2.3 above (i.e. [2] versus [56]).

The lack of clear contextualisation of the research topic within the broader field of contemporary dance produces additional problems for future HCI researchers who wish to build on the present research. Without a clear scope, research on specific aspects of contemporary dance will be mistaken to represent research of the entire field of contemporary dance. For example, some researchers assert that “movement qualities are central in contemporary dance” [31] or contend that “contemporary dance explores the qualities of movement and the mechanics of the human body” [14]. Within our dataset, we found that 82% of the papers (9 out of 11) that focus on movement qualities as a salient feature of contemporary dance, understand contemporary dance as a dance genre. In other words, future HCI researchers can be misled to think that movement qualities represent a central focus in all contemporary dance practice, which is far from reality, as we have shown in the introduction section. When contemporary dance is understood as a dance genre or technique, the claims made above can be considered an over-simplification, as many other important contemporary dance practices are excluded.

What is more, claims are often made without clarifying the target group (for example, for scholars, for professional dancers and choreographers, etc). For example, the two papers on movement qualities mentioned above [14, 31] do not specify for whom these movement qualities are central. If the target groups were defined from the outset of a study or paper, researchers would benefit from engaging with dance studies and performance theories, and assertions regarding the nature of contemporary dance (practices) would be differentiated to a great extent.

Table 3. Number of papers with references related to performance studies

Category	N. papers (%)	References
C3.1 Papers with 0% related references	13 papers (31%)	[10], [11], [13], [19], [22], [29], [32], [38], [48], [61], [63], [65], [67]
C3.2 Papers with 0.1-20% related references	13 papers (31%)	[2], [12], [17], [23], [26], [27], [28], [36], [37], [47], [56], [57], [64]
C3.3 Papers with 20.1-40% related references	9 papers (21.3%)	[1], [4], [15], [16], [31], [35], [41], [55], [60]
C3.4 Papers with 40.1-60% related references	4 papers (9.5%)	[14], [40], [54], [62]
C3.5 Papers with 60.1-80% related references	1 paper (2.4%)	[53]
C3.6 Papers with 80.1-100% related references	2 papers (4.8%)	[9], [49]

5 HOW DO THE AUTHORS ENGAGE WITH LITERATURE FROM DANCE STUDIES AND PERFORMANCE THEORY?

The third aspect (c) of our main research question (as outlined in the introduction) addresses the way the authors of the papers in our data set engaged with concepts and theories from performance theory, and whether the referenced theory was recent. We concluded from our analysis of the use of the term 'contemporary dance' that we needed to conduct a thorough study, which we present in this section of the paper.

5.1 Results

As a first step, we looked at all references of the 42 papers and determined, which are related to dance studies and performance theory. We found that out of the 896 references across the 42 papers, 156 can be related to dance studies and performance theory (17.4%). We considered references to publications by dance and performance scholars in their field, and papers by scholars from a different field (e.g. neurosciences, linguistics or cognitive sciences) when published in performance theory venues. Table 3 shows the distribution of related references (156) across the total number of papers (42).

The results show that 31% of the authors do not become involved with dance and performance related theory at all. Further 31% show low numbers of related references (up to 20%). Only seven papers (16.7%) include more than 40% of related references in their paper.

As a second step in our analysis of the related references, we examined the kind of engagement with the dance study and performance theory literature. To this end, we employed a method by Marshall et al. [46], which they developed to study the quality of citations in a large sample of all CHI 2016 papers. The authors suggest five categories to evaluate citations (which we adopt in Table 4):

- List ("work is cited in a list, with no further comment or detail on the individual text");
- Work exists ("the citation is an example that work exists on this particular topic, with no further discussion. It is mentioned individually, not only in a list of other papers.");
- Supports a fact ("cited to justify a factual statement made. No detail or discussion is presented on research from which the fact is derived.");
- Described ("Work cited is described, including any of its justifications, methods and findings. The research is presented as valid and reliable"); and

Table 4. Number of results (citation contexts, total = 174) in Marshall and colleagues' five categories of citation

Citation category	Results	%
List	21	12.1%
Work exists	60	34.5%
Supports a fact	26	14.9%
Described	49	28.2%
Analysis / critique	18	10.3%

Table 5. Occurrences of critique citations in papers

Critique citations in paper	N. papers	%
0 citations	35	83.3%
1 citation	1	2.4%
2 citations	3	7.1%
3 citations	2	4.8%
4 citations	0	0%
5 citations	1	2.4%

- Analysis / critique ("the work reported in the cited paper, including any part of its justifications, methods and findings, is affirmed, contrasted, or contested.")

We adapted Marshall and colleagues' coding scheme and followed their analysis procedure closely, in order to evaluate our data set and eventually compare results. Two reviewers independently analysed 174 citation contexts, in which the 156 references appeared, and classified the citations according to the five categories described above. Inter-rater agreement was substantial (Cohen's $\kappa = 0.69$). Table 4 shows the results in the respective categories of citation, while Table 5 displays the findings on critique citation in our data set.

Our analysis produced results that are positive on the one hand and disturbing on the other hand. The positive conclusions are: critique citation in our data set is more than twice as much (10.3%) compared to Marshall et al. (4.8%). All critique citation instances appear in papers from the last decade; and more than 80% of critique citations are very recent (between 2017 and 2019). Hopefully this constitutes a growing tendency. Nevertheless, Table 5 also shows an alarming result: 83.3% of all papers (35 of 42) contain no critique citations; only 16.7% contain critique citation. In comparison, Marshall et al. found 43% papers lacking any critique citation in their data set [46].

5.2 Discussion

As Marshall et al. have alerted [46]:

"Lack of discussion and critique of previous work can encourage the spread of misunderstandings and errors. (...) failure to understand and discuss prior work is already leading directly to poor quality research. A particular risk is the citation of work from other fields, where CHI's tradition of citing as fact comes into conflict with complex and not easily summarised ideas from other disciplines."

In line with Marshall et al.'s findings, we have identified different types of problems, which can arise when contemporary dance related theory and concepts are introduced and employed without proper critical discussion. We will present examples of these problems, under each heading below.

1) mis-interpretation of cited dance references: [64] claim: “In general, the twentieth-century history of dance as a performing art has two main choreographic trends: expressive methods and structural methods.” The authors present some examples for their categories and reference Bremser and Sanders’ edited book “Fifty Contemporary Choreographers” [7]. This publication however does not mention explicitly any such categories, nor does it support their viewpoint. On the contrary, the opening essay introduces several historical movements and forms of contemporary dance to discuss the existing multiplicity and variety of approaches.

2) unsupported claims and contradictions in HCI literature regarding dance references: [31] affirm that Laban Movement Analysis (LMA) is “a comprehensive language for movement description, representation, expression and performance extensively used in choreography.” Their related reference [18] deals with Laban’s modern educational dance and dates from 1963. There are no examples provided that clarify in what kind of choreography LMA is “extensively used”. [27] on the contrary state that LMA “(...) is the most acceptable systematic model for analysing the qualitative aspects of dance by dance scholars, movement analysts, and movement computing experts, though it is not widely used by dance practitioners and dance teachers.” While contradicting [31], there is no theoretical context provided, nor are examples given for the strong assertion.

3) idiosyncratic introduction of dance terms with potential for confusion: In their recent study on the creative process of six professional choreographers, [16] introduce the term “choreographic objects”, which for the authors “(...) represent choreographic ideas that are manipulated throughout the entire process.” In the field of performance studies however, choreographic objects are “not the same as the performance to which it relates. Choreographic objects attempt to provide a layer of analysis through an abstraction from the dances. They (...) disseminate dance knowledge across a wide community.” [66]. Taking on the form of online graphic scores, navigable video content, or interactive multimedia installations (amongst other possibilities), such choreographic objects let the user partake in “thinking about choreographic thinking.” [66].

While we find such examples even in the work of prolific writers in the field, there are also exemplary instances of critique citations. We present selected examples under the two types of good practice we identified in the sample.

1) clear theoretical contextualisation and scope: [37] state clearly what type and scope of performance theory they are referring to: “We are particularly interested in studies of choreography [14, 39] and music [16], which offer a different lens into the creative process,”¹ and explain how they will critically engage with the literature: “We build on these works to examine the use of artifacts in collaborative processes in music and dance: the relationships and forms of interactions that result, as well as their effect on creativity.”

2) critical assessment based on presented references: [55] build their argument based on related references, critically assess the state of the art and identify their research context: “The literature on dance pedagogy is primarily focused either on the perspective of the teacher or on the impact of motor skill acquisition. However, discussion of the practical results of the techniques and mechanisms in play during the training of dancers is largely neglected in the literature. We propose that the study of dance movement acquisition should begin with an understanding of how dancers perceive their own learning pathways.”

6 OPPORTUNITIES FOR FURTHER ENGAGEMENT

To answer our secondary research question, we will look at the types of opportunities, which arise from the engagement with the paradigm shift in contemporary dance outlined in the introduction section. Based on analysis of the 42 papers

¹References in this citation are from the cited paper, not this one.

in our data set, we suggest that three opportunities for HCI can arise through further engagement with the knowledge produced in contemporary dance and performance.

The first opportunity presents itself when engaging with the topic of embodied interaction from the perspective of performance research and theory. Seven papers in our data set address questions regarding embodied knowledge [13, 27], embodied interaction design [28, 29, 32, 37], or embodied cognition [56]. These papers are very recent (2016-2019) and indicate a growing interest in the topic, resonating with Kirsh: “The theory of embodied cognition can provide HCI practitioners and theorists with new ideas about interaction and new principles for better designs” [42]. In the field of performance theory and in related interdisciplinary research, there is a growing body of literature since the 1990s, when scholars started a still ongoing discussion regarding the virtual and live performers’ bodies in relation to digital, robotic and sensorial technologies. We propose that looking into epistemologies and theories of embodiment from the perspective of performance theory is beneficial for HCI researchers who want to reflect critically on HCI methodologies and production.

A second opportunity arises from the use of recent contemporary dance methods and practices into more applied research areas within HCI, e.g. in the field of social robotics. In this field, researchers frequently draw on HCI literature, for example in order to implement models of dance movement analysis in the design of social robots [50]. Limiting the possibilities of a dancing robot to conventional movement computing (similar to the movement quality example discussed above) can result in poor design strategies. Instead, embodied practices for roboticists, such as recently proposed by LaViers et al. [45], benefit from including recent contemporary dance methods and practices (e.g. choreography as a body-based research system [21], or the use of somatic techniques and contact improvisation). In this example of applying recent contemporary dance methods and practices both, the researchers who practice the techniques in workshops, and the design process itself benefit from introducing this more recent knowledge.

Finally, the third opportunity resides in the integration of contemporary dance practitioners as researchers in interdisciplinary projects. In areas such as HCI research projects involving novel or recent sensorial technologies, contemporary choreographers and dancers can collaborate as in the role of experts in embodied interaction. For instance, Jürgens et al. have collaborated with a choreographer to systematically explore the limitations of a markerless motion capture system in a mixed reality performance. As a result, a typology of motion capture errors has been presented. This is an example of collaborative results which can be not only applied artistically, but also serve to improve the hardware and software components of a system [39].

7 CONCLUSION

In this paper, we have analyzed how HCI has engaged with contemporary dance, by addressing the three aspects of our main research question: a) Which are the main themes emerging in HCI when engaging with contemporary dance?; b) How do HCI researchers understand the term ‘contemporary dance’? and c) How do the authors engage with literature from dance studies and performance theory? Regarding aspect a), we identified relevant recent topics, and suggested that the corresponding publications point at novel forms and methods in HCI research and a growing interest in embodied interaction. Relatively to aspect b), we proposed that a standardized usage for HCI terminology could employ a ‘zooming in and out’ type of logic. We also suggested that a definition of target groups would help future HCI researchers to engage with contemporary dance. Finally, by addressing aspect c), we detected a lack of critique citations (compared to a study analysing CHI literature [46]). We propose that there is a need for a better engagement with this field in HCI.

We answered our secondary research question by identifying three opportunities arising from the engagement with the paradigm shift in contemporary dance: (1) to engage with the field of embodied interaction from the perspective of performance research and theory; (2) to employ contemporary dance methods and practices in HCI research and development; and (3) to integrate contemporary dance choreographers and performers as researchers in interdisciplinary projects.

Given the growing attention to embodied interaction theories in HCI, the opportunities identified above can be relevant for interaction design and beyond. They can contribute to rethinking embodied interaction – towards an expanded understanding of the body in its performative dimensions and actions. Regarding future work, we detect potential in complementing the present research with other approaches that engage with the paradigm shift in performance studies. That is, looking at the body beyond movement: from an embodied interaction perspective, shifting the focus from dance movement towards choreographic thinking and intermedial performance techniques.

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