

Grappling With Movement Models: Performing Arts And Slippery Contexts

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ABSTRACT

The ways we leave, recognise, and interpret marks of human movement are deeply entwined with layerings of collective memory. Although we retroactively order chronological sediments to map shareable stories, our remediations often emerge unpredictably from a multidimensional mnemonic fabric: contemporary ideas can resonate with ancient aspirations and initiatives, and foreign fields of investigation can inform ostensibly unrelated endeavours. Such links reinforce the debunking of grand narratives, and resonate with quests for the new kinds of thinking needed to address the mix of living, technological, and semiotic systems that makes up our wider ecology. As a highly evolving field, movement-and-computing is exceptionally open to, and needy of, this diversity.

This paper argues for awareness of the analytical apparatus we sometimes too unwittingly bring to bear on our research objects, and for the value of transdisciplinary and tangential thinking to diversify our research questions. With a view to seeking ways to articulate new, shareable questions rather than propose answers, it looks at wider questions of problem-framing. It emphasises the importance of - quite literally - grounding movement, of recognising its environmental implications and qualities. Informed by work on expressive gesture and creative use of instruments in domains including puppetry and music, this paper also insists on the complexity and heterogeneity of the research strands that are indissociably bound up in our corporeal-technological movement practices.

Categories and Subject Descriptors

J.5 [Arts And Humanities]: Performing arts (e.g., dance, music)

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Keywords

Archaeologies of the Senses, Expressive Movement, Transdisciplinary Problem-framing, Heterotopias, Boundary Objects

1. THE MOTION CAPTURE CONTAINMENT CONUNDRUM

Using motion capture technologies for human movement computing means first defining one's object. This is not as obvious as it seems because our movements are inflected by the spatial and temporal, physical and social settings within which we act and evolve. Consequently, deciding on an appropriate, coherent range for analytical apparatus is a quandary at best: what we construe to be an autonomous moving body, and how we choose to situate it within or without a containing environment, are largely culturally conditioned, if not ultimately arbitrary choices.[15] Paraphrasing Barad, if apparatuses produce and are part of phenomena through their embodiment of certain concepts and exclusion of others, then optimal use of motion capture apparatus demands awareness of the cognitive values on which its design and operations are premised [5].

Such awareness can be gained by historical contextualisation and by re-framing research questions through the lenses of knowledge gleaned from other disciplines. Today's motion capture histories frequently begin with 19th century experiments by scientists like Marey and Muybridge, and are geared towards spectacular, lucrative clusters of cinematographic, special effects, and games industries. User imperatives and legacies from sectors including medicine, sports, ergonomics, and the military, feed or draw on these clusters in sometimes opportunistic tangles. Yet beyond compressed inventories of 19th-to-21st century motion capture milestones, insights into the effective and potential uses of these techniques can also be acquired more tangentially.

Modes of enquiry that transcend or transgress accepted paradigms reveal constraints of the hastily or habitually adopted parameters that generally stifle transdisciplinary energies. We need frameworks that open up fresh approaches and questions. Movement-and-computing research might draw on science and technology histories of methods for validating knowledge, to see how they ascribe value to different kinds of analytical apparatus over time [7]. Sociology's injunctions for science to get beyond "specifiable schemata of preferences and prescriptions" in order to engage with the continual reinvention of its own knowledge acquisition practices, are likewise relevant to the complex dynamics of

movement-and-computing [18]. While there are many ways to provoke original reflection in this fast evolving sector, challenging its most systematically adopted ways of framing questions may be a good starting point.

2. EXPRESSIVE MOVEMENT: RECKONING WITH MULTIDIMENSIONAL VARIABLES

The means for making and interpreting human movement traces implicate different kinds of temporal and spatial windows, and different kinds of values and scales - continuous or discrete. Techniques can be designed to reference collective actions of large groups of moving bodies or, conversely, movements of individual bodies, body parts, or covert impulses. How we capture and re-usably store the traces of human movement, and with what apparatus, depends on the goals and contexts that frame our research questions. A lot of targeted knowledge is utilitarian, as in biomechanical studies to underpin prognostics or heighten athletic performance, or postural analyses to identify orthopedic or psychological disorders. Pragmatic aims in such cases tightly drive the optimisation of measurement and calibration procedures. Artistically-driven motion research tends to be more loosely formulated - indeed, consensus regarding appropriate or optimal systems for tracking and resuscitating expressive movement is far from evident across arts communities.

2.1 Broader Problem-Framing for Transdisciplinary Relevance

For all their differences, the simplistic opposition of ‘utilitarian’ and ‘artistic’ categories of movement and computing research belies their overlaps. Studies of expressive human movement may, for example, integrate quantifiable physiological parameters like gestural amplitude in their efforts to grasp the qualitative subtleties of dynamic corporeal behaviour. Where a violinist’s virtuosity is compared with other players’ clinically monitored motor or neurological outputs, cultural and affective aspects of musical production may be considered a function of objectifiable muscular-cum-cognitive skills. Movement-and-computing research in the performing arts is made complex by their mix of more-or-less measurable skills, appreciable as a function of cultural references and emotionally charged qualities that resist quantification. A hundred years ago, Isadora Duncan’s (Western) publics lauded her capacity for immobility, which made even her slightest hand movements seem miraculous [2]. Computationally accounting for this temporal presence and its affective sway demands deep understanding and encoding to grasp an intricate weave of historically and geographically embedded cultural codes, as much as the hallmarks of Duncan’s inimitable corporeal style.

Movement-and-computing criteria that are likely to be pertinent for the arts call for scrutiny of the specific kinds of perception, reception, and general proxemic sensibilities that condition our responses to expressive movement. This is where studies from the arts can assist (hardly surprising, though what IS surprising is how far such studies are eclipsed by technicist approaches). For example, composer-scholar Denis Smalley’s attempts to forge new perspectives on movement and embodiment in - then emerging - electroacoustic music produced an analysis of gesture and its surrogates, and of the relations between gesture and tex-

ture, motion and growth, that informs notions of movement in the performing arts [28]. Similarly, informatics engineer and music theorist François Delalande’s distinction between taxonomic, figurativist, empathic listening behaviours develops concepts that are useful for current reflection - curiously, as for Smalley, despite or perhaps because of focus on ‘dis-embodied’ acousmatic works [8].

These proposals to more vigorously integrate arts-grounded criteria into movement-and-computing research are pragmatic as well as speculative. They draw on the author’s input to experiments to extend research terms and methodologies, including through design of a prototype retrieval client for users from different disciplines to consult a motion capture database via a sketch-based query system [23]. However sophisticated our tools, satisfactory correlations for the multidimensional variables of expressive gesture can only be devised if analytical scope is implemented in ways that are contextually enriched, rather than expediently (and often abortively) drained of context to comply with generic standards.

2.2 Modes of Performativity, Modes of Inscription

Champions of new materialisms and non-representational philosophies see the dominance of language and discursive systems as undermining the complexity of our physical interactions in and with the world (‘intra-actions’ as per Barad’s term). In her indictment of our subjugation to the verbal regime, Barad states that “Performativity, properly construed, is not an invitation to turn everything (including material bodies) into words; on the contrary, performativity is precisely a contestation of the excessive power granted to language to determine what is real.” [5] While the extension of concepts of performativity since its foundations in language philosophy lies beyond the scope of this paper [4], the preoccupation with conjoined cognitive and instrumental development embraced by much performativity research remains central to its concerns.

This preoccupation is manifest in debate surrounding the epistemological status of models, representations, and samplings of movement, and in the construals of such records or in vivo deployments of mediated movement as symbolic systems that hover between graphic and linguistic modes of expression and/ or representation. Prehistorian and paleontologist André Leroi-Gourhan, who argues for the co-evolution of anthropogenesis and technogenesis, sees language as a determinant cognitive instrument and proposes that mythology, a pluridimensional construct based on the verbal, be counterbalanced by mythography, based on manual modes of transmission [21]. Jacques Derrida’s ‘mythogram’ and work on grammatology acknowledges his debt to Leroi-Gourhan, and notably to his representation of the anthropos as a “precarious balance linked to manual-visual script” [9]. Linguist Sylvain Auroux distinguishes between non-conscious and explicit linguistic knowledge to challenge assertions that graphic encodings of language lead to metalinguistics, claiming instead that encounters of graphism and oral language mobilise existing, albeit previously tacit knowledge [3]. Philosopher Brian Rotman’s ‘gesturo-haptic writing’ concept arises from the possibilities of “a-symbolic mediation - a direct sampling or capture rather than a coded representation” [26], while anthropologist Sally-Ann Ness draws a parallel between performative gesture and the durable written-ness of

inscription, which “preserves its meaning by sinking deeply into an unchanging place”, whilst transforming that place by imposing upon it symbolic meaning distinct from, and indifferent to, its physical substrate [22].

Such lines of research emphasise the complexity of relations between gesture and trace, between movement and its inscription, and the need to keep open our definitions and uses of these terms. They indicate that refuting the value of language-borne knowledge systems in the search for novel approaches to modeling, cognising, and re-cognising embodied motion is counter-productive, given the richly trans-modal research currently being convened by ecumenical communities of linguists [11].

3. HANDLING CREATIVE INSTRUMENTS

Instruments of music, puppetry, and circus arts are expressive devices that contain layers of historically acquired affordances and agency. Their functional attributes - utilitarian, teleological goals and behaviours - consequently colour their use. Creative instrumental engagement implies body-object interrelations and abilities to gauge complex spatial and temporal intervals (fingering on a flute, gestural amplitude in puppetry, muscular precision on a tight rope). At the same time, it denotes attributes that are less readily quantifiable if at all, to do with expressivity and aesthetics, heuristic exploration, and the associated sense of risk. In short, creatively engaging with instruments means striving to exceed the encoded possibilities of the object, the environment, and the nexus of live, physical and symbolic relations developed by the performer/s and witnesses. In live performance contexts, epistemic action [16] differs radically from that implemented during everyday utilitarian (or vacuously idle) involvement with physical objects and tasks, insofar as it is harnessed to gratuitous yet virtuoso demonstrations, and miraculous embodiments of playful worlds [29].

3.1 Dreams of Unconstrained Engagement

Puppeteers seduced by utopian promises of seamless, transcendent cyberspace often dream that movement computing, and especially techniques like motion capture, might free them from being “afflicted with the inertia of matter” (Kleist [17]). Yet this is to naively belie our need to both animate and perceive movement through our embodied, kinetically and proprioceptively conditioned senses and cognitive references. A motion capture workshop led by the author in 1994 aimed to test these questions with puppeteers of diverse nationalities whose collective repertory of performance techniques included anthropomorphic and non-figurative string, rod, and glove controlled figures; shadow and object theatre, body masks, etc. At that time, little attention was paid to the use of motion capture for live performance purposes, and there was a case for taking traditional theatre skills as the starting point and driver of investigation, instead of anchoring it in a digital research lab. The workshop was hosted by the International Institute of Puppetry in Charleville-Mézières directed by Margareta Niculescu, who supported its aim to push gestural and instrumental skills beyond spatio-temporal patterns dictated by familiarly physical materials. Magnetic (Polhemus) and optical (Primas, Delft Technical University) systems were loaned by partners, and manned by experts sympathetic to this inhabital environment and community [24].

Use of different technologies with their own distinctive

constraints multiplied answers to queries raised by experimentation; this awareness of plural possibilities kept the research artistically open, avoiding the dead end of prescriptive systems and responses. Preoccupations with gravity and scale loomed large as the puppeteers realised that, to creatively harness new tools to existing skills, they had to negotiate carefully to make behaviours exhibited by a puppet, that strange hybrid of gesture and object, coherent enough to be all the more spectacularly propelled into the realm of the ‘impossible body’. Crude computer graphics outputs of the capture systems managed to convey deeply craft-driven assimilation of the digitally extended palette, proving magically effective when this negotiation was successful. Kenneth Gross’s plea for “The Madness of Puppets”, which “lies in the wild actions that come to belong to that object, that seem native to its being - the figure’s abrupt or rhythmic movements, its appetite and speed of attack, its talent for trickery...”, seems to apply with equal poignance to this realm of computationally ‘liberated’ movement and instrumental engagement [13]. Our undertaking at the International Institute of Puppetry, which has since been expanded upon by many participants from this group, appears two decades later as an archaeological window onto unique movement-and-computing experimentation, which can still be productively tapped.

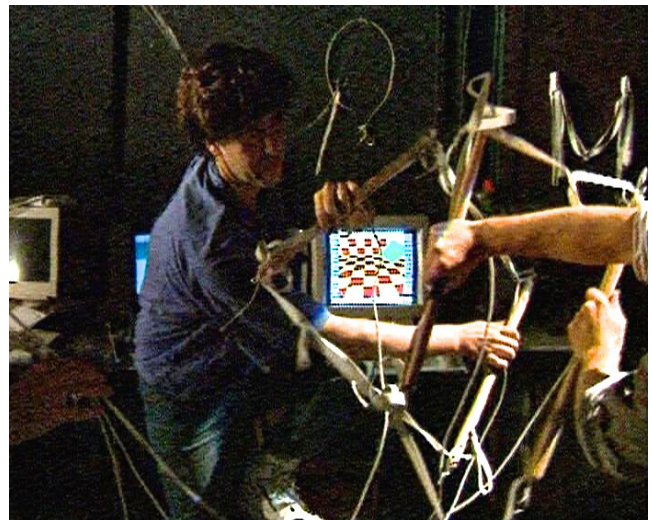


Figure 1: Javier Swedzky, Bill Stout, International Institute of Puppetry, 1994

3.2 Group Movement and Boundary Objects

One highly specialised puppetry technique that is an exciting test-bed for poetically exploring movement and computing is sannin-tsukai (‘three-person manipulation’), used in the Japanese traditions known as Bunraku or Ningyō jōruri. The three handlers act as a single organism by virtue of carefully entrained and hierarchised responsibilities : the main puppeteer controls the head and right hand, the second puppeteer manipulates the puppet’s left hand, and the third operates the feet and legs. Charleville participants conversant with this technique, and able to expertly pace their respiratory rhythms and gestural amplitude, invested in exercises in threes or fours, animating and transforming

rudimentary artefacts (paper mâché, string, geometric appendages affixed to rods, etc) and their equally rough computer graphics renderings. The simultaneous visibility of the performers, physical ‘puppets’, and motion captured digital creations made the relational trajectories between these different kinds of entities uncannily evident and alive. Not only did viewers experience a kind of perceptual ebb and flow between the collectively animated artefact and its visible handlers (as in Bunraku), but the digital puppet engendered by this ensemble of humans, materials, and digital processing also hovered in and out of the perceptual field. Their synergistic product solicited what cognitive psychologists call ‘perceptive crossing’, i.e. a mutually confirmed sense of proxemics that arises when tasks involve shared spatial positioning skills [20]. Puppeteer and audience focus on concrete bodies and their virtual correlates, thus brought to life and metamorphosed, can produce haunting, meaning-making species of boundary objects [19]. Such fundamentally relational gestural and instrumental engagement provokes questions about our interactions with digital and hybrid spaces that go far beyond this intriguing puppetry technique.

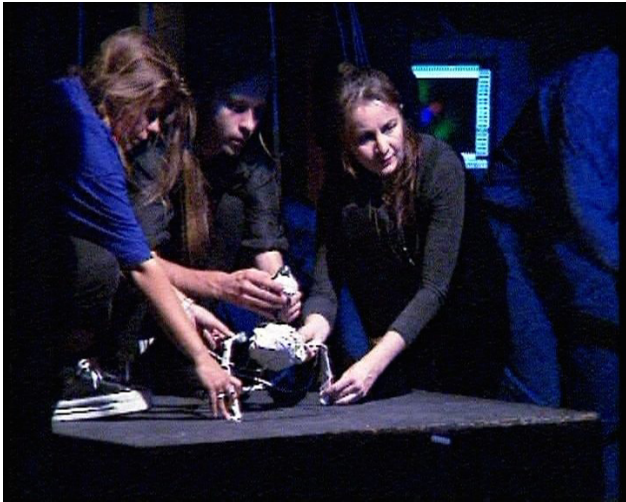


Figure 2: Céline Jaspарт, Bill Stout, Sue Wallace, International Institute of Puppetry, 1994

4. ARCHAEOLOGIES OF KNOWLEDGE, ARCHAEOLOGIES OF THE SENSES

Mobilisation of ‘archaeologies of the senses’ to reveal qualitative aspects of physical environments through multimodal research is spawning compelling holistic readings of historically embedded and embodied motion [6]. In parallel, ergonomics, design, and technics (combined social and technological innovation) allow us to infer cognitive and corporeal behaviours from landscapes, social and dwelling places, and from artefacts inherited as residues of past lives. Within this wider interdisciplinary setting, computational projections of possible corporeal movements in different historical and contemporary contexts can yield valuable insights into human actions and goals. The accompanying risk - commonplace with technologies that powerfully push and reshape cognition and imagination - is to construe as fully representative



Figure 3: Marcos Malafaia Figueiredo, Sue Wallace, CAIline Jaspарт, Adam Bennett, International Institute of Puppetry, 1994

what are at best evocations and interpretations, informed by more-or-less reasoned hypotheses. For all our plodding continuity as embodied human beings, experience of bygone artefacts or tasks is for us necessarily of a very different nature to that of our forebears. This is not to say that we should inhibit creative conjecture, which is vital for the diversification of technologies and for the enrichment of science, but rather sharpen awareness of the hermeneutic limits that condition our foucauldian ‘archaeologies of knowledge’.

4.1 Grounded Knowledge : Where Does it Start and Stop?

An ancient tradition of modeling and recording movement is vividly recounted by Piotr Ouspenski: he considers Central Asian carpet-making, described by his friend Gurdjieff, as the collective creation of a score. Patterns and colours of the finished carpet trace the actions that have gone into its making, and are legible for those whose cultural and corporeal memories hold the songs and dances that are literally woven into the fabric:

“He spoke of the ancient customs connected with carpet making in certain parts of Asia; of a whole village working together at one carpet; of winter evenings when all the villagers, young and old, gather together in one large building and, dividing into groups, sit or stand on the floor in an order previously known and determined by tradition. Each group then begins its own work. Some pick stones and splinters out of the wool. Others beat out the wool with sticks. A third group combs the wool. The fourth spins. The fifth dyes the wool. The sixth or maybe the twenty-sixth weaves the actual carpet. (...) And all the work is done to the accompaniment of music and singing. The women spinners with spindles in their hands dance a special dance as they work, and all the movements of all the people engaged in different work are like one movement in one and the same rhythm. Moreover each locality has its own special tune, its own special songs and dances, connected with carpet making from time immemorial. And as he told me this the thought flashed across my mind that perhaps the design and colouring of the carpets are connected with the music, are its ex-

pression in line and colour; that perhaps carpets are records of this music, the notes by which the tunes could be reproduced.” [19].

Ouspenski goes on to highlight his musical appreciation of the status of the carpet-as-score; this participatory art work could equally be seen as a choreographic notation device, in keeping with the enmeshed history of music and dance scores in post-Renaissance Western cultures. From a broader perspective, one might also imagine the songs and gestures recorded by the carpet as emblematic of movement across regions and continents, i.e. the flow of goods across trade routes. Experimental and, more recently, phenomenological archaeology confirms the rich corporeal, cultural, and wider social information that can be garnered from artefacts like these carpets [6]. Recourse to obdurate materialities in attempts to empirically tackle past events and actions, in contrast to the abstract grand narratives of much recorded history, makes archaeology a uniquely physically tuned vantage point for seeking original approaches to the modeling and representation of human movement.

4.2 Loaded Environments

The carpet-as-score account contrasts with the infrastructure that has hosted much movement-and-computing research and constitutes an aseptic version of the gravity-free universe of which world-weary puppeteers dream. In the main, and ideally, it consists of clean-room type boxes with level floors, materially bounded to facilitate rigging and equipment maintenance, and the marking up of well delineated test areas. Motion capture premises may contain equipment for specialist users (e.g. athletes, medical specialists, performing artists), but tend to be normative, lab-type environments set up to obtain optimally clear data. Standardised places are largely inappropriate for exploring or targeting anything other than standardised gesture. They lack the sense of real terrain that informs and infuses our corporeal behaviours - the accidents and textures, slopes and obstructions that solicit and engage us in constant interactive improvisations with our environment.

Scenographer Adolphe Appia noted early last century that “The movement of the human body demands obstacles for its expression; all artists know that the beauty of corporeal movements depends on the variety of points of support offered by the ground and by objects.” [1] Appia’s horror of garish painted sets whose perspectives conflicted with projected light and shadow, and props that could barely support their teetering actors, prompted minimalist architectonic designs whose geometries provided a solid foil for emerging choreographic forms (e.g. those of his collaborator, Eurhythmics founder Emile Jaques-Dalcroze). Transposing Appia’s plea for grounded movement, engaged with and enhanced by its physical environment - and remembering that human derives from humus, earth -, suggests there is scope for embedding movement-and-computing research in real physical environments, as in pioneering work by artist-archaeologist tandem Kirk Woolford and Stuart Dunn [10].

5. IN CONCLUSION: WILDERNESS, GARDENS, RUGS...

Motion capture techniques have undergone a paradoxical evolution: nineteenth century outdoor spaces used for Marey’s chronophotographic shoots of birds in flight, or for

Muybridge’s zoopraxiscopic studies of galloping horses, have been largely superseded by digital laboratories or studios whose pristine state is supposed to guarantee the quality of their outputs - i.e. phenomena extracted from their habitual contexts to become informative scientific constructs, or vastly adaptable avatars for film and game universes. But further insights today seem to demand the reinjection of living beings back into their live contexts, to diversify and extend the limits of our analytical apparatus. Interest in the contextual wilderness and its specificities does not denote some sort of prelapsarian nostalgia. On the contrary, acquired skills equip us to explore movement and ‘cognition in the wild’ [14], to discern qualities of the kinds of spaces we are dealing with, and thence better identify the actions and interactions they elicit.

While the computational study, modelling, representation, segmentation, recognition, classification, and generation of human movement information necessarily invokes its spatial contexts, the translation of movement across diverse kinds of space suggests the heterotopia, “capable of juxtaposing in a single real place several spaces, several sites that are themselves incompatible” [12]. Foucault describes the microcosm represented by the traditional Persian garden as a heterotopia, and points out that carpets were originally reproductions of gardens: “the garden is a rug onto which the whole world comes to enact its symbolic perfection, and the rug is a sort of garden that can move across space.” Similar translation-related questions are raised by cross-media mappings from gardens to rugs, and by remediations of fleeting live movement to make it a reproducible artefact.

Movement-and-computing research requires a constant off-setting of computational prowess and the challenges posed by its ever elusive subject. Regarding movement-and-computing’s spatial imperatives, perhaps by monitoring the tuning of gestures to local places, features and discrepancies we can devise vital creative counterpoints to the globalised, homogenised mesh of networked, locative, and social media that is increasingly part of everyday life.

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