SPATIAL PHRASES

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sam spurr (editor)

Performative Opportunities within the Parametric

It is a common architectural exercise to map body movements akin to Etienne Jules Marey's chronophotographic images of a walking man. These mapping exercises are models for working with complex, dynamic information, and have the potential to accommodate internal and external forces/flows, temporal transformations, and responsiveness. Invariably the architectural translation of mapped information is frozen into a formally exuberant result, tailoring form to the mapped body like glove to hand but without the responsiveness of either.

Marey's and Muybridges' mappings are now accomplished through motion capture, providing content for manipulation by choreographers through various digital technologies. Similarly with parametric tools architects can map and manipulate the complex variables of a collective body, site, program or other architectural constraint into a highly functional response. In *From Control to Design*, Michael Meredith critiques "…the architectural field's current use of the parametric (as being) superficial and skin-deep… lacking a larger framework of referents, narrative, history, force." The advantage of the parametric project is not the "relentless malleability of form… but the complex… relationships that produce architecture."

As semi-reciprocal disciplines addressing the body and space, parametric tools are applicable at the scale of the component-movement and at the larger scale of spatial and temporal order. This ordering of the parts may be according to some preconceived structure/narrative or effect or open-ended process/Cunningham coin-tossing. The humanism of the work occurs where a participant in the production or use has leeway with either the smaller parts or larger order, opening possibilities for manipulation, play, customization, and adjustment and adaptation over time. This paper will attempt to reveal the loci of opportunities within both the dance and architectural parametric projects to escape a mere formal end goal, and to reinvest the work with dynamic, temporal and participatory performance qualities.

Beth Weinstein

1 Introduction

It is a common architectural exercise to map body movements akin to Eadweard Muybridge and Etienne Jules Marey's chronophotographic images of a walking man. These mapping exercises are models for working with complex, dynamic information, and have the potential to accommodate internal and external forces, flows, temporal transformations, and responsiveness. With parametric tools architects can map and manipulate the complex variables of a generally geometric nature into a highly tuned formal solution. Similarly, digital choreographic tools, animation and motion capture technologies are augmenting the ability to both map and generate dances.

This paper will attempt to reveal the loci of opportunities within both the dance and architectural parametric projects to escape a mere formal end goal, and to reinvest the work with dynamic, temporal and participatory performance qualities.

2 Static Drawing

In beginning level design studios, the mapping of some human action acts as a place-holder for the mapping of complex inter-related variables influencing a design investigation. Substitute user-A for elbow joint, and one might understand how A relates differentially to the rest of the building/body across a series of frames. These exercises allow the architecture student to learn to closely study and analyze facts while also thinking about transformations of things in time or across a space.

In a seminar I taught on the topic of collaborations between architects and choreographers, architecture students analyzed a fragment of a dance performance through drawing, with the intent of their building a verbal as well as visual vocabulary relating dance-space to architectural space. The goal was strictly analytic and to facilitate interdisciplinary dialogue (fig. 1L).

Moving away from analysis, the architectural translation of mapped information most frequently is frozen into a formally exuberant result, tailoring form to the mapped body like glove to hand but without the responsiveness of either. This could be seen in examples of student work from the early to mid-90s brought about by expanded access to digital photography/video and digital drawing/modeling technology. These techniques also served as form generators outside the academic design studio as evident in an early work by dECOi in which a Forsythe-choreographed duet was translated into a metal sculptural object (fig. 1R). These exercises persist in design studios as form generators as evident in recent work of Jacoby Volk's and Messing Marcus' students, published in the January 2009 issue of *JAE* (71-79).

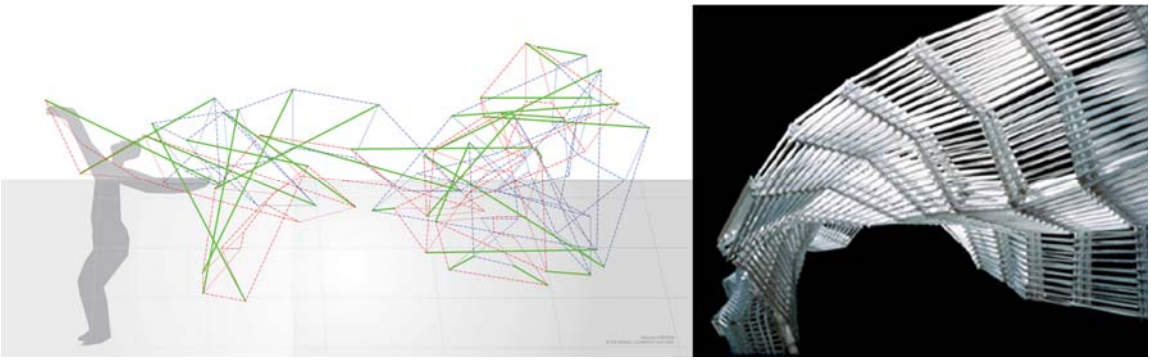

Figure 1: (L) Univ. of Arizona Student Salomé Moreno, Mapped segment of Wm Forsythe's In the Middle Somewhat Elevated*, 2007;* (R) dECOi, *Ether/I* installation, Geneva, 1995. <www.newitalianblood.com/progetti/images/687.jpg>

I would argue that these exercises are productive forms of analysis, and if form were the priority, over performance, no dilemma would exist. However, I would argue that there is indeed a dilemma whose locus is the process of literal translation of this information into a fixed, static form, undermining the greater potential for dynamic, interactive, responsive performance.

3 Drawing Dynamics

The mapping of enacted movement, following the Marey/Muybridge model, can now be fairly efficiently accomplished through motion capture. A multitude of infrared sensors located on a moving figure can be "captured" using an average of 8-16 truss-mounted cameras; the information is then cleaned of static and gaps, connected and then identified as phrases or sub-component movements (James and Qian, et al 10-16). This captured information has applications ranging from choreographic archival purposes, to movement analysis, dance composition to medical applications.

The most highly recognized early explorations into motion capture's creative potential involved OpenEnded Group in collaborations with Bill T. Jones [*Ghostcatching*, 1999] and Merce Cunningham [*Biped*, 1999].[i] These explorations focused on translating captured information into sophisticated artistic representations of dance, to be stand alone animated works or performed simultaneously with live dancers. Although the captured information contained three and four-dimensional information, the final product in these early experiments was a two-dimensional image transforming in the fourth (fig.2).

Figure 2. OpenEnded Group with Merce Cunningham; (L) motion capture process; *(C) Shelley Eshkar hand-drawn figures,* <www.openendedgroup.com/index.php/artworks/hand-drawn-spaces-1998/hds-process>; (R) still from the performance of *BIPED*, 1999, <www.openendedgroup.com/index.php/artworks/biped/essay>

Concurrent with these explorations into motion capture's creative potential, Merce Cunningham and Thecla Schiphorst of Simon Fraser University explored a new choreographic tool, "Compose," now known as DanceForms or LifeForms (fig. 3). The software's logic is that "the body is represented by joints, and the program is about the complex way you can put together so many kinds of joints" (Four Key Discoveries109-110). As the inverse of captured movement—in which body movement is constructed from the captured displacement of joints—the DanceForm program allows users to manipulate "readymade" virtual bodies, and individual joints in accordance with their programmed limitations, and play back the composed sequences. Thus, the 3D info composed in 4D finds its output in 2D animated images.

Similarly, digitally constructed architectural models contain three-dimensional information. In what I will call the first digital generation, 2D orthographic representations and 3D perspective or parallel projection representations were constructed separately, using distinct software platforms. Eventually 2D info could be extracted from the 3D models, and within various platforms, a 4D temporal transformation could be created. This was achieved [1] through the movement of cameras along a series of points or splines according to the conventions of "real" cinematic techniques—tracking, panning and zooming— or [2] through the movement of avatars or figures inhabiting the virtual space or [3] through the movement of the modeled components, as seen in exploded views. These techniques, developed by and borrowed from other industries, are now commonplace in digital architectural design and representation processes.

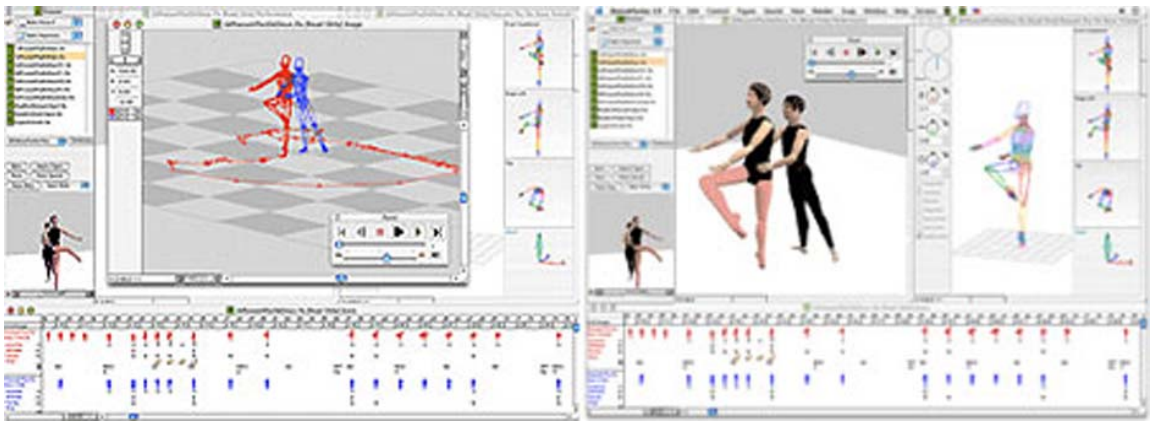

Figure 3: DanceForms 1.0 illustrations as they appear on both the Credo and Merce Cunningham Dance Company sites <http://www.credo-interactive.com/danceforms/>

4 Dynamic Drawings

I would argue that process and product have greater potential interest and performativity when the possibility for feedback, interactivity and collaboration are built into the tools and the conceptualization of the product and its lifecycle.

For instance, OpenEnded, in collaboration with Trisha Brown [*how long does the subject linger on the edge of the volume...*, 2005] explored the possibility of motion capture to inform a dynamically transforming set of images which were in no way a representation of the captured dance. Instead, a series of projected geometries had built-in intelligence and intent to "hitch a ride" across the stage on the proverbial back of the sensed dancers. Thus, the captured information sidestepped translation, and constructed a significantly different "narrative." The motion capture system had to sense and respond, and thus perform, not just make form (fig. 4).

OpenEnded Group's Marc Downie describes important aspects of their work as using rule sets, or algorithms, and abstract diagrams, "getting computers to do 'the right thing,' by themselves." Furthermore, Paul Kaiser recognizes their good fortune in having collaborators, such as Cunningham and Brown, with several decades of exploration with "abstract diagrams," incorporating "stage geometry, movement trajectories, temporal repetitions, body kinesphere, and so on" (Birringer 21, 24). Thus both OpenEnded and their choreographic partners worked with similar parametric methods—the latter with live bodies and rule-sets, and the former with these plus digital feedback.

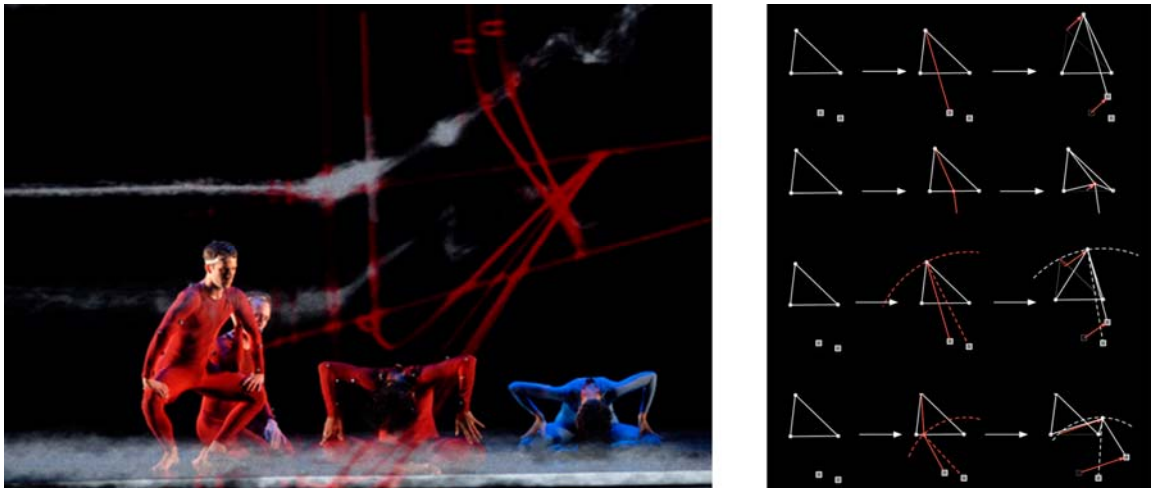

Figure 4 : OpenEnded Group with Trisha Brown, How Long…, *2005; (L) Photographs of Monte Carlo performance © Marc Ginot.*
<www.openendedgroup.com/index.php/artworks/how-long/howlong-agents/>
(R) "hitching" triangles, <www.openendedgroup.com/wp-content/uploads/galleries/how-long/triangle/triangle.jpg>

Cunningham-alum Jonah Bokaer also explores feedback between live and digital choreography in his working with DanceForms. "(It) allows you to start with a digital dancer that can appear as a series of circles, a skeletal figure, or a human one, and to move the figure using commands. You can create a virtual set of movements, and move the dancer along the horizontal, vertical, and three-dimensional planes" (Macel). But as Bokaer explored in *Nudescendance* (2005) the logic of the program was entered into, the parameters unlocked and redefined, such as the limitations of the joints and the resistance and physicality of the body's surfaces. The resulting animation allowed arms to pass through the torso, elbows to flex inversely. These impossible bodies then informed the live choreography, leading to previously inconceivable sequences (fig. 5). It is my understanding that in the current version of DanceForms default ballet figures have inherent movement constraints while modern dancers have none; "their body parts can be moved into impossible positions and even pass through other parts…" (DanceForms Practical Guide 43).

The animation of the complex human movements is far less than realistic; parameters ignored for the sake of user-friendliness include gravity, "bounce and squish," and responsiveness of the digital dancers to the surrounding space.[ii] According to Cunningham, it serves best as a memory aid or terrain for discovery (Four Key Discoveries 109-110). Perhaps its insufficiency as a realistic rendering device supports its function as a tool for an open-ended exploration, rather than for generating polished products.

Figure 5: Jonah Bokaer, Nudescendance, *2005;*
(L) drawing: <2.bp.blogspot.com/_yei2vHLa4g8/R67IQIW9h-I/AAAAAAAAAE0/YnimgojBbP0/s320/Minus_One%5B1%5D.jpg>;
(C) "impossible bodies" still from online video, <www.jonahbokaer.net/JBk/NUDESCENDANCE_VIDEO.html>;
(R) *Nudescendance* photo, © Matthu Placek, courtesy of Jonah Bokaer.

Architectural digital technologies, borrowing heavily from advances in animation, aerospace and automotive industries, have recently undergone a radical transformation, effecting conceptualization, methodologies of information input and the inseparable output of this process. Building Information Management (BIM) programs ideally serve to associate information, such as cost, weight, and so on, with each digitally constructed element. Thus points, like the joints in DanceForms, are embedded with constrains and rules. Beyond the management of embedded information, parametric modeling allows for real-time testing of the user-established variables and relationships, animating the difference between input variables. According to Neil Katz of the architectural firm SOM, parametric modeling is

> …a bit different (from older methods of drawing and modeling). Aspects of the model depend on relationships between parts of the building. Creating and modifying these relationships is an important part of the design process. A parametric model is often defined by rules and constraints, which define aspects of the building and their relationships to each other. Changing a rule or constraint, or modifying a part of the model itself, often has implications in the entire model (Katz).

Thus, inherent to the process is a chain of "if-then" relationships. The application of these tools in architecture has allowed for sophisticated form making, distorting and deforming primitive shapes into highly complex entities and/or arrays of entities. The emphasis of the investigation with these tools has predominantly been in the interest of expanding formal capabilities and, increasingly, the associated ability to "physically" output this information through fabrication (milling, cutting, printing) of the smaller parts that comprise these complex assemblies. Additionally, with economy, ecology and resource issues taking center

stage both in practice and academia, performance demands (beyond formal demands) will increasingly need to be folded into the parametric recipe. Architect Michael Meredith critiques "…the architectural field's current use of the parametric (as being) superficial and skin-deep… lacking a larger framework of referents, narrative, history, force… (The advantage of the parametric project is not the) relentless malleability of form… but the complex… relationships that produce architecture (Meredith, Aranda Lasch and Sasaki 6-9)." Taking the case of his Puppet Theater constructed below the Carpenter Center, site, material, structure, program, lighting, acoustics, as well as ease of cutting, manipulating, and assembling of the pieces factored into the parametric model. In this example project, the performative aspect of the parametric method was situated in the digital design and fabrication process; the output elements are organized into a static spatial construct of a singular use. The relationships are those that produce, but not yet those that re-produce the work of architecture through use (fig. 6).

Figure 6: MOS (Michael Meredith + Hilary Sample) Puppet Theater, Carpenter Center, Cambridge MA, 2004. (L) construction photo, <www.news.harvard.edu/gazette/2004/11.11/01-huyghe.html>; (R) complete, view from stage, <www.mos-office.net/#a>

5 Dynamic Drawing Dancing Making

Thus far I have established that in the semi-reciprocal disciplines addressing the body and space, parametric tools are applicable at the scale of the component part or movement. The dialogue box allowing one to customize parametric relationships, as in Bokaer's tweaking of DanceForms and typical of architectural plug-ins such as Grasshopper, offers one site and scale for author interaction. Seemingly minor changes to the rules effect the overall field condition and, as Meredith argues, multiple concerns beyond formal ends can inform the generative logic. Parametric tools are equally applicable at the larger scale of spatial and temporal ordering in accordance with some preconceived if-then set of relationships or be open to the type of chance operation or coin tossing associated with Cunningham/Cage work.

I would argue that strictly formal solutions give way to greater performance—performance understood as "both utility and theatrical value/relevance"—in situations allowing participants, in not only the production but also the use, to tune either the smaller parts or the larger order. These circumstances open possibilities for manipulation, play, customization, adjustment and adaptation over time. Thus a created work of architecture or dance in fact continues to be re-created through its use or performance. The second site of interaction is temporal, through the reconfigurable nature of the constructed artifact or choreographed dance. Two projects will illustrate these points.

This paper will attempt to reveal the loci of opportunities within both the dance and architectural parametric projects to escape a mere formal end goal, and to reinvest the work with dynamic, temporal and participatory performance qualities.

Synchronous Objects, a collaboration between choreographer William Forsythe and OSU's Maria Palazzi and Norah Zuniga Shaw explored the spectrum of issues put forth so far. These include "abstract diagrams" translated into algorithms and rule sets that determine relationships; captured/recorded dance information analyzed to determine key movement phrases; digital modeling and output as fabricated objects; and feedback loops, providing opportunities for reconfiguring of both spatial artifacts and choreographic phrases (fig 7).[iii] "From dance to data to objects, *Synchronous Objects* reveals the interlocking (sic. parametric) systems of organization in *One Flat Thing, reproduced* (2000). Those systems were qualified through the collection of data and transformed into a series of (reconfigurable) objects—synchronous objects—that work in harmony to explore those choreographic structures, reveal their patterns, and re-imagine what else they might look like (OSU funitureSystem)."

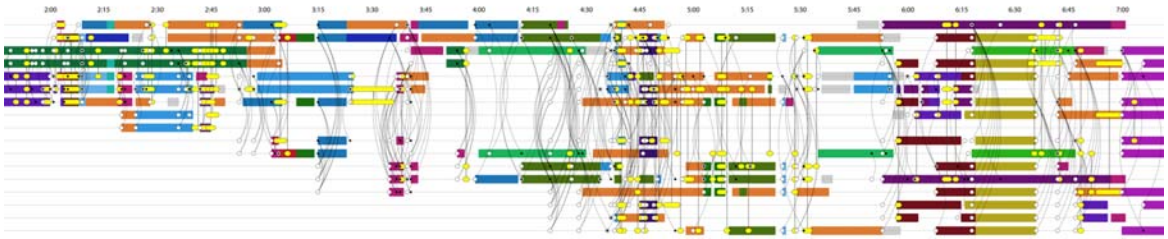

Figure 7: Synchronous Objects, Full Score of Movement Material, Cues, and Synch-ups, *William Forsythe, Maria Palazzi (OSU),* Norah Zuniga Shaw (OSU), Creative Directors, <synchronousobjects.osu.edu/content.html#/cueScore>

Much of the project's experimental output is graphic representation of the dance, manifest as indexes, scores, "alignment and cue annotations," statistical analyses, and animations examining motion volumes, sound/noise, and density. But beyond these graphical explorations, the choreographic data also generated a "FurnitureSystem"—a series of rectangular volumes, via computer numerically controlled milling according to information gleaned from the movement material index (fig. 8). This furniture system is intended to be "performative, combinatorial, and resonant with the dance itself." The multidisciplinary project is structured to foster the generation of new works, both through the generative drawing tool, through the reconfiguring of movement types from newly generated cue sequences, and the production of new furniture object/props. With over a dozen information types, there are potentially endless opportunities to feed back one information type (dance/data/object) into its own type or another. Although not explicitly stated, the fabrication team hints at the opportunities latent in this loop—to substitute the milled furniture objects for the simple tables originally used in the performance, thereby altering choreography and initiating a new loop!

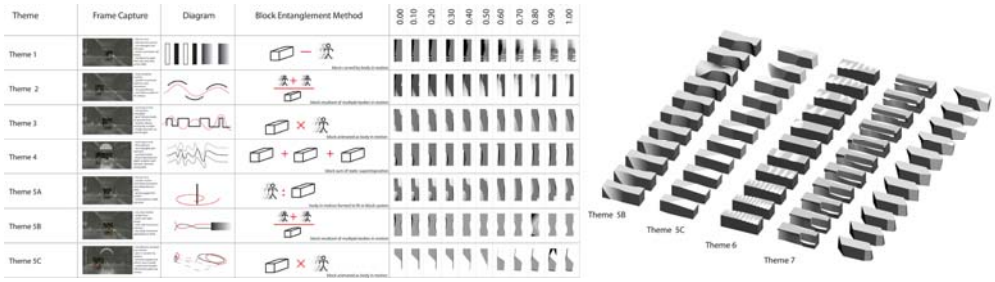

Figure 8. Synchronous Objects FurnitureSystem, Movement Material Matrix (excerpt) <synchronousobjects.osu.edu/content.html#/furnitureSystem>

The second example, Richard Siegal's *If/Then Open Source*, similarly blurs the boundary between production and use through an open source online site. A choreographer with Ballett Frankfurt experience, Siegal created the strictly for web piece that both "produces,… documents and stores" the dances while allowing visitors to create new dance sequences from archived footage or add their own for-web-cam dance fragments into the mix (Bench). *If/Then Open Source* relies upon rule sets of an if-then nature, such that one dancer's gesture dictates a singular response or pair of options, thus laying the groundwork for the narrative or sequence of dance fragments.

> The Piece: If you do x, then I do y. If I do y, you can do either z or n, etc.
>
> The Website: You can create delete or modify the dance's events or their systemic relationships…
>
> You: The site is predicated on the belief that the beauty of systemic complexity resides in relinquishing individual control...(Siegal)

Thus the user inevitably participates in the making of a new dance, merely by button-clicking, or as a highly engaged user, contributing material as well as new sequences to the every growing archive of if-thens.

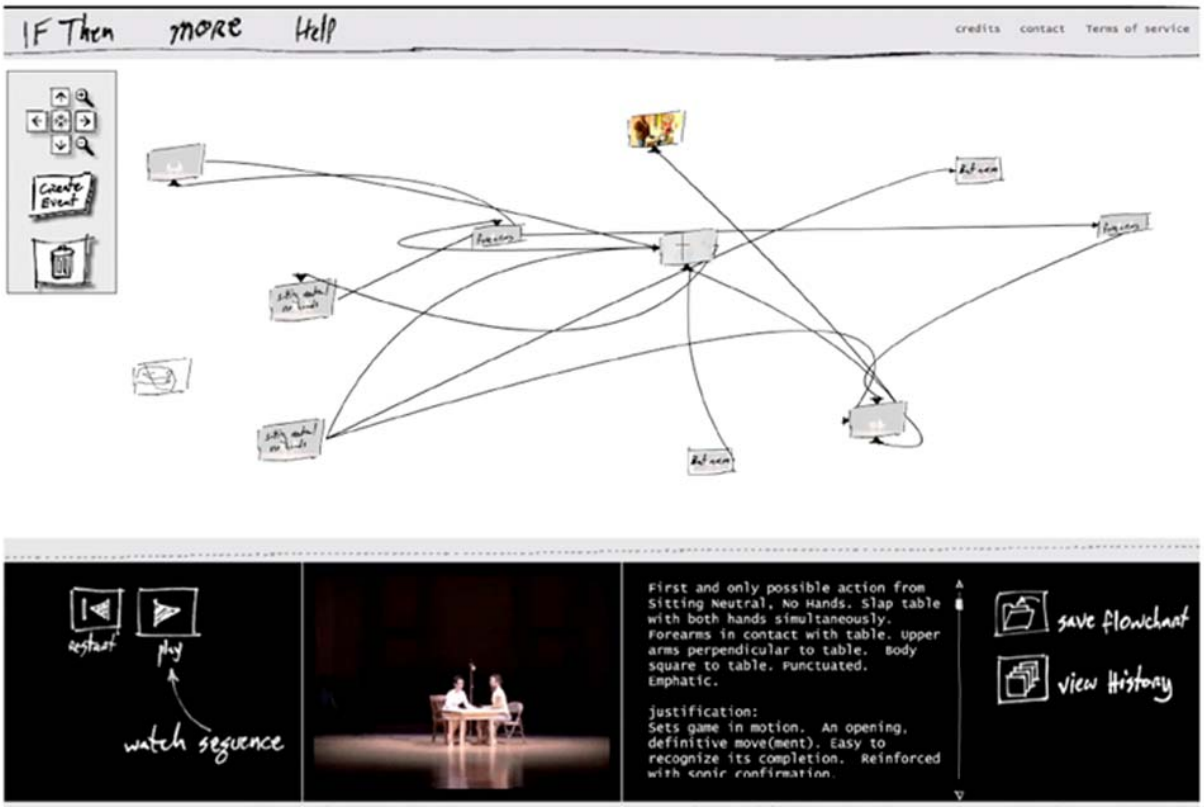

Figure 9: Richard Siegal, If/Then Open Source, <*www.thebakery.org/ifthen/index.html*>

6 Conclusions

Parametric tools inherently lend themselves to iterative exploration, which can be infinite, uncritical, "skin deep." However, given the examples of OpenEnded's work with Trisha Brown, of the Forsythe–OSU collaboration on *Synchronous Objects*, and *If/Then Open Source*, I would argue that there are indeed opportunities to escape the purely formal capabilities of parametric tools and methodologies.

Within the parametric variables at the designer's or choreographer's fingertips are opportunities to fold into the equation technologically performative constraints related to site or setting, physical limitations, sequencing, and resources such as cost, material, time, labor, and so on. These may be small parameters, but yielding significant repercussions at the larger scale. Equally important are parameters related to the social and cultural relevance of the work through human interaction. These too may be folded in through the details of the dialogue box during the generative process or be an opportunity, a by-product, to be exploited through use. Building in opportunities for information to feedback creates dialogue between the design of artifacts and their use, allowing manipulation, play, customization, adjustment and adaptation over time.

Synchronous Objects is just the tip of the iceberg, demonstrating opportunities for parametric methodologies to imbue technological performativity with social performance.

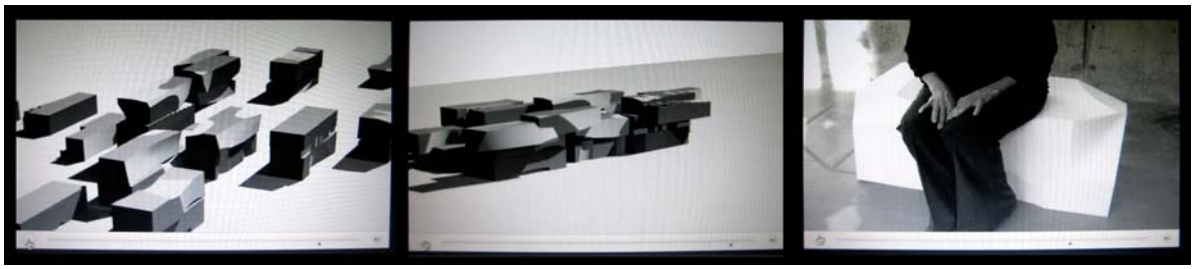

Figure 10: Synchronous Objects FurnitureSystem, stills from explanatory video <synchronousobjects.osu.edu/content.html#/furnitureSystem>

Notes

[i] OpenEnded Group is "three digital artists—Marc Downie, Paul Kaiser, and Shelley Eshkar — who create works for stage, screen, gallery, page, and public space."

[ii] Author's interview with Jonah Bokaer, April 19, 2009 @ CPR, NYC.

[iii] Both Maria Palazzi and Norah Zuniga Shaw are faculty/researchers at the Advance Computing Center for the Arts and Design (ACCAD) at Ohio State University. The project also involved faculty, students and graduate researchers in computer science, engineering, geography statistics, dance, vis-com design, and architecture.

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