

# Concerted knowledges and practices: an experiment in autonomous cultural production

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Received: 9 June 2011 / Accepted: 20 January 2012  
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**Abstract** About 20 years ago, the ecology of media art practices proliferated in two domains: those that attached themselves to high technology labs or companies like Xerox PARC, and those that took advantage of personal computing to form collectives only loosely coupled to academic institutions or disciplines. In this essay, I closely examine the diverse epistemic cultures and diverse technical, political, and generational interests in such “cyber-anarchist” networks. I sketch the economy of knowledge in recent media arts and technology communities of practice in the wake of Open Source. I use as my lens the experience of creating a responsive media space called the TGarden, with a collective that gathered more than 26 artists and engineers from 11 institutions and 7 nations.

**Keywords** Art and technology · Science and technology studies · Media art · Autonomous production · Responsive environments · Open source · Knowledge economy

## 1 Introduction: what is a TGarden? Who builds it? And why?

A TGarden is a responsive media environment, a room in which people can shape projected sound and video as they move. Upon entering a TGarden space, each person is asked to choose a costume from a set of garments commissioned to estrange the body from its habitual movement and identity. An assistant straps wireless sensors on the

chest and arm of the visitor, called a player, and then dresses the player in a vestibule. Then, the player is led into a dark space illuminated only by video projected from 5 m above onto the floor, a space filled with sound already in a residual motion. The assistant tells the player only to listen as she moves to understand what effect bodily motion has on the ambient media. As the player moves, his or her gestures and movement across the floor perturb the field of sound, modifying existing sound, and introducing new patterns. The room’s associated software processes generate a musical “cantus firmus.” Also, each player introduces his or her own “voice,” but one that is parameterized both by gesture and by the state of the event as traced by the software system. The synthesized video that is projected onto the floor provides a visual topography for the player to play. In some instances, objects appear projected onto the floor, transforming semi-autonomously according to the movements of the players (Fig. 1).

In such a space, we are experimenting with how people can improvise meaningful gestures solo or collectively, where the gestures are mapped to video and sound via a continuous, dense, dynamically varying sensuous field. We are exploring how people can make sense of and navigate a dense media environment that is constantly evolving. Think of our highways and airports that are already annotated with public display, driven by implicit processes whose logic is largely alien to the viewer’s interest and not articulated in any legible representation. These public displays typically project normative as well as informative content multiplied by networks and ubiquitous embedded computing.

A large part of the impact of the TGarden as a phenomenological and theatrical experiment derived from careful staging and costume design—we explicitly designed this space as an in vivo experimental play space.

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**Fig. 1** Non-rehearsed participants in a TGarden playspace, DEAF, Rotterdam (2001)

A crucial and central distinction between the TGarden and a conventional, singular esthetic or theatrical event is that its technical production system was designed to be an instrument that could be used to realize a certain infinity of events using similar dense flows of fluid visual or sonic media. We conceived the TGarden as an instrument of generalized writing with which people map their movement to fields of video, sound and fabric that vary richly in intensity. With such an instrument, we investigate how people can invent gestures freely and the ways that they coordinate their play without articulating in ordinary language (Guattari 1995; Harris 1995; Leroi-Gourhan 1993). I use instrument in multiple senses—as a collective prosthetic, as a means of visual and aural expression, as a machine for transcription of gesture to sound and moving image, but also as a device for observing phenomena.

Since such an instrument did not exist, the artists and researchers who wished to realize a TGarden were compelled to design and build one themselves. We can analogize the TGarden's research and development project to a composer collaborating with an instrument maker in creating a piece of music for an instrument that is custom-built during the process of composition, specifically for the performance of that piece of music. This is, of course, by no means the first time in the history of performance that such collaborations in the evolution of technologies of performance have occurred. To pick a canonical example from the history of the Hammerklavier, in the 1820s radical extensions of musical expression coincided with the more powerful resources based on the development of different types of hammer action, the increasing the number of strings per key to two or three in the lower register, and the introduction of iron frames to sustain the higher tensions of the strings. In that case, it took generations for technical and musical-symbolic consequences to be worked out among composers, performers and instrument makers over the course of a century. Moore's law and ignorance of

history hugely speeds up the mutation of instruments to the point where very few contemporary media practitioners are practiced enough with their own computational instruments to be considered virtuosic.<sup>1</sup> In our situation, the TGarden's responsive media technology, designed to sustain new forms and norms of gesture, comprised novel media synthesis software and novel configurations of hardware that in proprietary formulation constituted "intellectual property."

An instance of a TGarden, premiered as an open laboratory in Ars Electronica in Linz, Austria, in September 2001, and in V2, Rotterdam, The Netherlands, a month later. It was built over the course of 6 months by a consortium of 26 artists and researchers in 11 institutions and 7 countries, primarily Belgium and the United States. Its design followed on a year and a half of theoretical workshopping and public experiments in Siggraph 2000, Medi@Terra 2000, Banff 2001, Ars Electronica 2001 and V2 Lab 2001.<sup>2</sup>

Based on the TGarden Consortium's experience, I propose to evaluate from three perspectives the claims that the TGarden project made regarding freedom, autonomy, and play. The first is the perspective of a player inhabiting the environment, the second is the perspective of the designer-creators of a particular installation-event, and the third is the perspective of the programmers who created the TGarden's underlying *media choreography* technology.

## 2 Interests and epistemic regimes

When the designers and creators of new media and new media technologies raise the banner for freedom and autonomy, for whom are they raising it? To triangulate the discussion of political-economic interest, let me pose three roles: the *designer* composing the metaphors and dynamics and esthetics of an event, the *instrument maker* making software, devices, physical props interpreting the creative designs, and the *researcher* concerned with conceptual questions informing and refined by the TGardens, constituted as techno-scientific as well as phenomenological experiments.

For the designer, the compositional techniques associated with the TGarden's software system offered a way to choreograph time-based media that evolve according to both their composed intent and to the participants contingent activity, in a metaphorical cosmology and precise,

<sup>1</sup> See for example performances by Carl Stone, Michel Waiswiz, or Laetitia Sonami, enriched by decades of practice (Private communication, Laetitia Sonami, 28 October 2009).

<sup>2</sup> [http://topologicalmedialab.net/xinwei/sponge.org/projects/m3\\_tg\\_intro.html](http://topologicalmedialab.net/xinwei/sponge.org/projects/m3_tg_intro.html) and <http://vimeo.com/tml/12089384>.

ductile alchemy of media. That is why I dubbed this technique, *media choreography*.

For the instrument makers, the value lay not in the construction of a single event but in the techniques and technologies that would enable creators to easily express and materialize such working systems. The value of the TGarden technology, therefore, lay in the power and expressive range of its media choreography system, the legibility of the dynamics editor, and the reusability of the system's components: sensor processing, state engine, video synthesis, sound synthesis, and so forth.

For the researchers, the TGarden provided a laboratory<sup>3</sup> for conducting experimental phenomenology regarding questions such as, "How can people improvise fresh gestures in dense media that are meaningful to themselves and collectively?" and "How can people learn and inhabit a media space without articulating their knowledge in explicit language?" (Leroi-Gourhan 1993; Harris 1995; Guattari 1995).

### 3 Designers and instrument makers' interest

The TGarden consortium consciously structured itself as an entity whose members could share media and technologies generated in the course of their projects. One of the proposed organizing principles was that any media that are created in one project designated as a TGarden project may be used and freely transformed in another TGarden project.<sup>4</sup> One goal of the TGarden consortium was to disseminate not only the memories and symbolic capital of the staged events but also the knowledge about how to design and build responsive spaces. Characterizing the collaboration this way has the twin advantages of, first, leaving participants free to undertake other work and, second, providing an incentive for artists to contribute to and draw from the gumbo of media, documented concepts, and technology. More subtly, the first advantage says nothing about a person's membership in some class. Members of the TGarden consortium could adopt different, even conflicting, dispositions or stances with respect to a creation, and did.

One conventional way to identify the designers and engineers' interests would be by tracking the form of intellectual capital inhering to the TGarden system: wearable sensors, pattern analysis and tracking algorithms, temporal logics, costumes, music, video effects, and so forth. But this leads inevitably to definitional and legal

<sup>3</sup> Of course, this sort of laboratory contrasts consciously with the subjects of classic STS works such as Latour and Woolgar (1986), Trawick (1988).

<sup>4</sup> Later when I formed the Topological Media Lab, I refined this by requiring citation practice.

complexities familiar to all students of intellectual property. What we explore in this essay are other ways to address the interests of not only these classes of roles but others as well.

### 4 Researchers' interest

As I observed earlier, there is a third class of agents and corresponding interests that of the researchers concerned with expressive and phenomenological questions of art and performance. These interests occupy a meta-position with respect to the interests of the designers and engineers. For researchers, the TGarden operated potentially as a site of knowledge production, that is, as a laboratory for art research. But since the apparatus is itself an experimental structure, the subjects are not only the players but also the artists, engineers, and researchers themselves. In this respect, up to scale, the TGarden resembled less conventional theater production than a complex experiment in a high-energy particle physics accelerator facility or an astronomical observatory. In a conventional and more mature form of performance or entertainment such as an acoustic concert, many forms of the technological apparatus do not have to be invented in the course of a production: one plays the violin and one does not have to experimentally carve the wood or simulate its acoustic physics. The TGarden project resembled much larger experimental physics projects in that theory-inflected construction of the apparatus proceeded in tandem with the design of the experimental event. Like astronomical and high-energy physics (HEP) experiments, the time of the event during which the designers could actually encounter the phenomena in which they were interested was exceedingly short relative to the time of construction. Ratios on the order of one person-year of design and construction to one person-week of experiment are common in the scientific world, but not in the traditional economy of cultural production. Therefore, the TGarden represented one extreme of grafting an art installation/exhibition onto an engineering project.

So much for the interests of the designers, engineers, and researchers associated with the TGarden. Given these multiple interests, and in light of the TGarden's goals and construction, how can we evaluate the Free Software Foundation's program and the Open Source movement as a paradigm for development?

In the Free Software Foundation's literature and the General Public License (GPL) as characterized by Richard Stallman and the Free Software Foundation (FSF 2011), there is an interesting tension between two positions that I will characterize by two mottoes: (1) "The (software) code is the object," and (2) "The programming is the object."

The first position maintains that “the code is the object.” The General Public License fetishizes the piece of software code in legal language by the atomic-term “Program” and devotes a significant part of its attention to discussing in some detail the conditions of a Program’s inscription, packaging, transmission, and re-distribution, with or without fee. In such documents, the only mention of a Program’s effects, of its application and use, is in the negative form of legal disclaimers. In fact, it is interesting that whereas much of the GPL seems to expressly articulate the ideals of the Open Source movement, the disclaimer section adopts the verbatim text and typography common to commercial software. In other words, the “user” reduces to an infinitesimal in the social field of the GPL.

Treating compiled code as an artifact sufficient unto itself, as it is treated in the formulation of copyleft, privileges that artifact. In its hermetic form, we have no picture of how a Program comes to be, how it is distributed, what expectations, and what applications are made of it, in other words its use and its social embedding. The canonically cited author of the definition of Open Source, Richard Stallman, is aware of this incompleteness when he promotes free documentation, but he does not explain how or why free documentation is useful.

Restricting attention to software code ignores the social fact that the programmers must share a lot of common context in order to be able to share code. After four decades of UNIX, a dozen generations of university students have created a messy, ad hoc, non-progressive folk knowledge, and an epistemic culture, to adopt Knorr-Cetina’s useful analytic notion, around the operation and extension of this paradigmatically modular and scriptable operating system (Knorr-Cetina 1999).

The second position maintains that “programming is the object.” Code is not as important as the activity of programming, which is the privilege that must be preserved in the name of freedom. Appealing to a libertarian idea of freedom in the document, “The Free Software Definition”:

“Free software” is a matter of liberty, not price. To understand the concept, you should think of “free” as in “free speech,” not as in “free beer.” Free software is a matter of the users’ freedom to run, copy, distribute, study, change and improve the software. More precisely, it refers to four kinds of freedom, for the users of the software:

The freedom to run the program, for any purpose (freedom 0).

The freedom to study how the program works, and adapt it to your needs (freedom 1). Access to the source code is a precondition for this.

The freedom to redistribute copies so you can help your neighbor (freedom 2).

The freedom to improve the program, and release your improvements to the public, so that the whole community benefits. (freedom 3). Access to the source code is a precondition for this. (GNU 2011)

It is revealing that the FSF draws the line at modification of general pieces of writing. In “Free Software and Free Manuals,” Stallman writes:

As a general rule, I don’t believe that it is essential for people to have permission to modify all sorts of articles and books. The issues for writings are not necessarily the same as those for software. For example, I don’t think you or I are obliged to give permission to modify articles like this one, which describe our actions and our views. (Stallman, 2011)

If freedom is the ideal, on whose behalf do we aspire to this freedom? Who is this “neighbor” to whom Stallman appeals—what is she or he like? What is the community of which these documents write? Why is the line drawn between code and comments, preserving the invariance of textual documents that describe “our actions and our views?” Under the FSF’s ethos, software programming constitutes the primary activity but ordinary language commentary upon that activity is derivative, and in some way someone else’s concern. In the ideal, to the literate, well-written code “speaks” for itself. Moreover, while the heroic autonomous artist programmer figures centrally in the FSF’s social frame, a significant gulf lies between the tools, modes of production, artifacts and activities of unassociated or corporate software programmers, and the lifeworlds of, say, TGarden designers and TGarden players.

## 5 General public license and the TGarden

We have seen that the Free Software Foundation’s General Public License seems focused on pieces of code as the primary objects, more than their social effects and values. Nonetheless, Stallman himself has also explicitly analogized free software to free speech, valorizing activity in the service of neighbor and community. However, for Stallman, the privileged enunciations are the modification and transmission of software code, that is, the activity of programmers. Stallman wraps himself in the flag of the modest programmer (to borrow Steven Shapin’s archetype of the modest witness/ascetic scientist; see also (Shapin et al. 1985), but software programming is an exclusive social and epistemic activity as far as the visitors who come to play in these responsive environments are concerned. There are ring upon overlapping ring of insiders, but these regions of practice do not form any sequential chain of exclusivity.



In order to trace these overlapping fields of practice more clearly, let us examine more explicitly the economy underpinning this work of collectives of media artists and technologists.

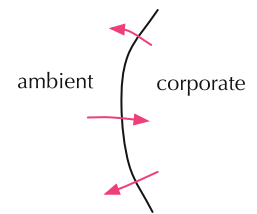
## 6 Pyramid, parasite, yeast, amoeba

It seems that at least three economic metaphors permeate Open Source discourse: the *pyramid* metaphor, the *parasite* metaphor, and the *yeast* metaphor. The pyramid is the simplest: an undirected graph version of a hierarchical scheme. Under this pyramid scheme, programmers “distribute software for a fee” set at whatever the putative market will bear. This conjures the figure of the journeyman craftsman who can sell his wares “directly” to anonymous clients in a primitive proto-capitalist economy.

Under the second metaphor, the metaphor of the parasite, programmers work in Deleuzian spirit inside conventionally managed institutions and, based on superior skill and intelligence are able to devote their excess, unexploited labor time to writing and contributing software to the free software pot. The ethos of excess for this form of work is inherited from the days when Internet was a DARPA subsidy, and most of the UNIX culture lived in research labs and universities.<sup>5</sup> This parallels the less substantial but historically remarkable public funding of the arts in post-WWII United States after World War II. This contrasts strongly with the material life and economy of performing arts in the 19c (Kreidler 1996). In the distributed version of that metaphor, nomad programmers act as osmotic pumps to leak resources from corporations into the un-incorporated world (Fig. 2).

The third metaphor is that of the *yeast*, a *non-closed* gift economy in which agents circulate material that grows in the exchange. In fact, an even stronger claim is made for the knowledge economy: knowledge’s value increases with its flux (mass density  $\times$  area/time). This yeast metaphor seems to work better when people are paid for time of association, not for the artifacts they produce, but the billable hours mechanism shows that this is no guarantee against commodification of labor. Nonetheless, the T-Garden consortium worked largely according to the political-economic ethos of a knowledge economy. This “yeast” way of working may work with a knowledge-oriented economy, but it is hard to see how it works with a commodity-based market subject to a logic of scarcity: the more you have, the less I have, and vice versa. How can a gift economy or a knowledge economy embed into an

**Fig. 2** Membrane of a firm



ambient market economy based on objects and property? Programmers still must pay rent and buy supplies in conventional markets. A more complex version of the question is how could the non-market circulation of esthetic discourse, knowledge, and social capital intertwine with the circulation of market capital?<sup>6</sup>

In light of these questions, we turn to a fourth metaphor, that of the single-celled organism, the *amoeba*. To prepare the ground, we appeal to economist Ronald Coase’s neo-classical theory of the firm (Coase 1991). Conducting business in a real market always incurs transaction costs, that is, costs in time, money, and various forms of capital, for discovering information, locating resources, bargaining and making decisions, policing and enforcing agreements, and so forth. Economist Thayer Watkins described Coase’s results in terms of contracts:

...A firm is a system of long-term contracts that emerge when short-term contracts are unsatisfactory. The unsuitability of short-term contracts arises from the costs of collecting information and the costs of negotiating contracts. This leads to long term contracts in which the remuneration is specified for the contractee in return for obeying, within limits, the direction of the entrepreneur. (Watkins 2001)

Coase showed that firms were necessary to provide protected regions within which people could share resources within a common entrepreneurial context, with negligible or relatively little transaction cost. In this way, in market economies, firms efficiently organize larger-scale activities inside non-marketized cells. In other economies other types of collectives, such as families, clans or guilds serve to protect their members from the costs of participation in the market. Coase’s theory, for which he received the Nobel Prize in Economics in 1991, does explain in grosso modo the interior economy afforded by an organizational membrane, but we should note also that although interior resource discovery costs may be low, some transaction costs still might be significant relative to the size of the project. A good example is the friction imposed by information technology infrastructure on the customization of software and hardware, especially those that tinker with

<sup>5</sup> For detailed histories of the emergence of cybernetic information systems after World War 2, see Edwards (1996), Dupuy (2000), Halpern (2007).

<sup>6</sup> For recent initiative treating this problem, I thank Niklas Damiris, Helga Wild, Marek Alboszta, Anne Balsamo and partners in the Capitalizing Communities project, begun in 2009.

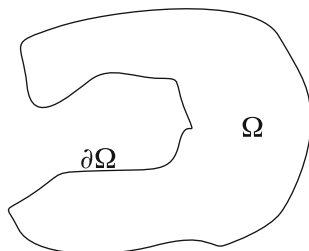
internet communication protocols, in the course of creating experimental sensor and media processing software instruments (Fig. 3).

Now let us transpose Coase's observation to the ideal organizational dynamics that inspired TGarden's constituent associations. The associations were designed for a fusion of knowledge economy and media-symbolic economy inspired by the metaphor of a single-cell amoeba whose exchanges with the ambient fluid are mediated by chemical pumps and biomechanical envelopings at its membrane. The transaction costs for artists as producers of cultural artifacts imposed by copyright and broadcast right mechanisms—mechanisms induced in turn by the dynamics of cultural reputation capital driven by single-authorship models—are so high as to impede collaborative work among creative individuals.

Under the amoeba model, an organization whose products are cultural artifacts forms a membrane around its media and technology in order to survive inside the ambient economy. This membrane could in conventional terms be seen as an intellectual property wall, although this does not fit well with a situation in which the organization does not create anything that the ambient economy recognizes as capitalizable intellectual property, or in which the organization chooses to work aggressively under GPL. The cell membrane analogy serves better, since that helps us think about the function of filtering knowledge and even norms across the boundary between an organization and the external economy. This applies to incoming resources and expert labor as well as outgoing media, technical paradigms, and esthetic/cultural motifs. But this analogy, of course, is still too simple, since the individual members of the consortium have multiple identities, roles, and allegiances that span across consortial boundaries.

To chart such a complexity, we turn our attention to the TGarden consortium's organizational structure and dynamics (Fig. 4).

The TGarden project began with a 2-week design workshop for eight core creators in March 2001, and over the subsequent 6 months, 26 people from seven countries built the components of the installation—event largely in parallel. In all, 11 institutions were affiliated with this



**Fig. 3** Organization as amoeba cell

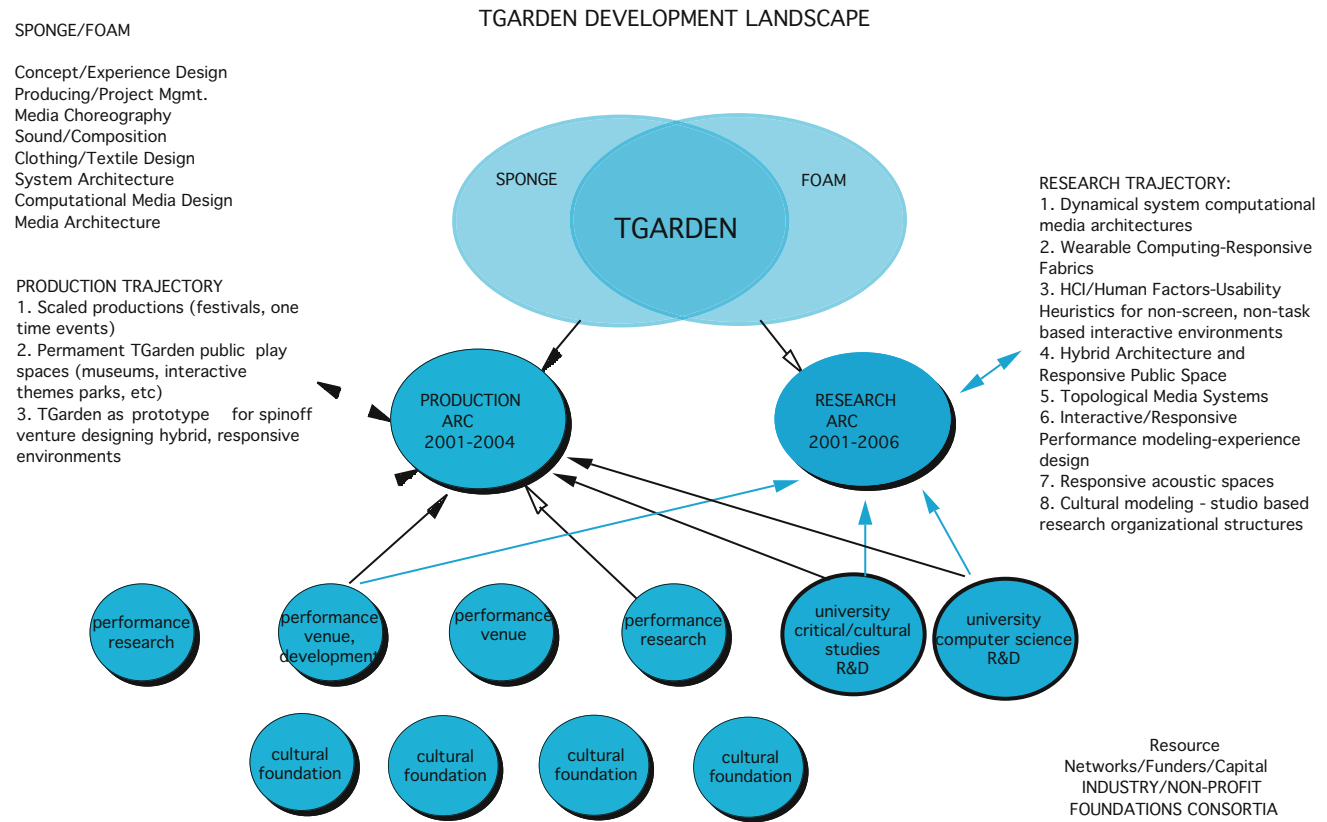
project, so this provisional network spanned and relied on multiple institutional loci. One of the gravest blows suffered by the project was the collapse of one of the host institutions, which knocked away support for day-to-day sustenance from nearly half of the core team. This ultimately cost the project two components of its media system. I will return to this account of the experience and its consequences later in this essay.

An integrated engineering team distributed across multiple locations would have conducted commercial ventures with this level of technical ambition using a clear command structure. But the TGarden consortium, by necessity and by choice, tried to sustain a different set of work relations. Unsurprisingly, given the distributed nature of the work, communication and coordination costs became a bottleneck. One challenge was to coordinate the strategic judgment of the more experienced designers with the work of expert but less experienced implementers. Another was that the designer-implementers needed to share more of a common technical knowledge base in order to communicate efficiently via the available inscriptive devices: mathematical notation, email, language text chats, telephone, and MAX code, each of which had characteristic costs in terms of time and effort.

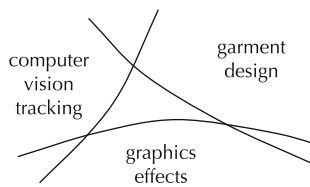
At a larger social scale, Karin Knorr-Cetina and Peter Galison have described the negotiations necessary when different disciplines, or epistemic cultures, to use Knorr-Cetina's more descriptive concept, collaborate in a laboratory environment. However, overriding epistemic conflict, resolution, and confluence is the dynamic of social commitment. In order to build enough synchrony and commitment as well as a common base of knowledge in a mutually comprehensible contact language, one pre-condition that became clearly essential was co-presence of the collective's members. It is not clear whether co-presence could have been mediated by synchronous telecommunication or could only have existed in face-to-face work, but in any case, both face-to-face conferences and telecommunications were in short supply, a consequence of the lack of funding.

Of course, co-presence alone, while necessary, is not sufficient for a successful collaboration, since a principle of charity is necessary as well to negotiate not only the diverse epistemologies, but also the values and goals of the participants. To see this, let us look at the interaction of three epistemic subgroups: the *computer vision scientists*, the *garment designers*, and the *visual effects programmers* (Fig. 5).

The computer vision engineers needed to work experimentally by iterating through a software/hardware experimental rig requiring a finely graded supply of sample materials, bodies, and lighting conditions that progressively approximated the final show conditions. The



**Fig. 4** Diagram of TGarden development. *Source:* sponge.org. 2001



**Fig. 5** Epistemic gap

garment designers, on the other hand, followed their own schedule of conceptual design and production with the delivery of finished systems late in the production calendar. The lack of continuous institutional support exposed the production to interruptions due to intermittent funding. This forced the computer vision engineers to improvise solutions on their own that technically solved the tracking problem but were esthetically and dramatically weak. On the other hand, costume designers were reluctant to accept esthetically unmotivated additions to the body of the player just to enable tracking. The disembodiment, temporal lags, and terseness of email telecommunication made it difficult to repair the supra-linguistic misunderstandings due to weak command of the project’s working language (English) and sparseness of common epistemic context. In order to have fixed target conditions in which to fashion a vision-based tracking system, the computer vision engineers also

needed video as structured light projected as it would actually be used in the final performance space, since projected video was the only illumination to be used in the TGarden space. However, institutional instability removed the original visual and 3D effects programmer and forced a reconstitution of the visual effects sub-team, so the video examples could not be delivered according to the production calendar in time for the computer vision engineers to develop and calibrate their custom algorithms.

Uncertainties about the venue locale and instabilities of the host institutions that persisted late into the production cycle made it challenging to satisfy the logistical dependencies as planned. There was no budget, as there would have been in commercial projects, to bring the fabric designers, vision and graphics effects programmers together in order to hammer out a contact language and improvise jointly acceptable solutions. It became apparent that co-presence, however, mediated, was the most precious pre-condition for synchronizing the rhythms of work and improvisation.

Motivated by a growing sensitivity to cultural symbolic valences and historical precedent, a contact language collectively and consciously evolved to avoid culturally over-coded or naive metaphors comprising a gumbo of visual imagery, micro-narratives, physics, and mathematical

metaphor. This creole sufficed to partially notate the design scenarios but could not serve as a complete operational implementation language. Mindful of Wittgenstein's unbolting of logicist as well as picture-theoretic theories of language and remembering the abortive history of artificial languages like Esperanto and Basic, one would not of course have expected to develop an operational language strictly prior to its use. But as the creole articulated notions from prior conversation, it proved to be both rich enough to register the designers' imagined scenarios and precise enough to guide the development to a significant extent.

But what were the obstacles to funding such a hybrid form of cultural production? At the scale of a multinational production like the TGarden, it is practically impossible to form a conventional legal non-profit entity that can meet the criteria for all relevant sources of funding in all the countries. European cultural foundations will not readily give money to organizations based in the United States, and the same is true vice versa. Although scientific foundations did fund some foreign collaborators, until ca. 2000 scientific foundations did not seriously fund cultural experiment, and cultural foundations could not afford even a fraction of the budget for adequate techno-scientific research and development. Corporate sources would not fund research and development unless a sufficiently large market was clearly demonstrated, and there were a way to secure intellectual property, contradicting the operating principles of the TGarden consortium. By commercial standards, the scale of the planned production budget was too small by at least one or two orders of magnitude relative to its conceptual and technical ambition. On the other hand, the scale of the production budget was one or two orders of magnitude larger than what regional art funds would typically support for such experimental media art in that era. The TGarden consortium's constituent organizations acted as independent legal non-profit entities to solicit support within their own national and continental contexts. Moreover, the consortium had to stratify its self-description according to diverse socio-cultural agendas. It foregrounded different aspects of the TGarden according to the largely incommensurate agendas of the sponsoring techno-scientific, cultural, and entertainment institutions. Consequently, all these agendas tended to pull apart the TGarden group's conception of its practice and product. Extending the chemical aspect of the cellular analogy: the boundary of the consortium served as a capital transformation membrane, so that these differently valenced sources of capital transformed across the boundary into internal forms of capital that could be combined and put to the common cause. The transaction cost to negotiating this external support though was quite high, arguably prohibitively high. One of the Catch-22's was that, while the project needed funding on the order of that required for an independent

film, there was no bootstrapping seed fund available to hire an independent producer to solicit and manage capital resources. What made it at all feasible financially was that some members of the core team worked in institutions that explicitly authorized them to engage in the project. These institutional affiliations gave vital access to laboratories, studios, office support, networks, and capital equipment. Some institutions, such as Starlab in Brussels, invited TGarden members as outside experts for hire, engaging in an organizational endocytosis. But since those experts came in the "vacuole" of a sub-group of Starlab for innovative art and design, although they brought skills and knowledge that informally fed the research activities of other subgroups, they could never exceed the roles and identities bounded by the sub-group. In other words, they were typecast by how they entered the organization. Also, at a larger scale, the sub-group's bottom-line constraint was that its infrastructure support was adequate where and to the degree that the work was accepted as consonant with the host organization's core enterprise. It had to fight against being considered relatively ornamental compared to the sub-groups engaged in techno-scientific work such as neuro-computing, nano-technology, or fiber-computing. As one might expect, despite the silo-ing, lateral connections formed because of resonant expertises and interests. But the knowledge exchange remained below the threshold of salaried work.

From the macroscopic organizational scale, let us turn to the individual scale. For the major part of TGarden's production, participants received only token fees for their work. The principals were motivated by the experimental artistic and conceptual vision. Andrew Ross, in his article, "The Mental Labor Problem," analyzes the discounting of labor by artists and academics and certain classes of designers due ironically to an allegiance to the fantasy of intellectual and artistic independence (Ross 2000). Ross calls for more politically acute organizing of interests and a consideration of how knowledge workers can modify the price system in which their work is valued. While this is indeed a useful component of a political-economic analysis, there already exist, however, other compensatory systems, namely the economies of individual reputations and of group aura. In lieu of paying creators regular wages comparable to professional salaries in the high technology industries, the discourse communities of media artists and scientists alternatively ratify creators' reputation capital—a form of social capital—by crediting and acknowledging their contribution. Participants share in the accrual of social capital by adhering to a system of scholarly citation. But since not all members of the TGarden consortium understood and were disciplined in this construction of social capital, there was not a concerted adherence to the citation ethos and mechanism. This form of social capital is



denominated in authorship and credit, not ownership of proprietary hardware, media or software, or restrictive distribution rights.<sup>7</sup>

We have sketched some of the production dynamics that had to be negotiated by the non-commercial TGarden collaborative consortium. That the consortium produced a media space as unconventional and imaginative as TGarden testified to the strength of the shared imaginary and to personal commitment. Earlier I observed that a commercial venture of this ambition very likely would be organized according to a more conventional command structure. But it is also true that subject to conventional economic logic such a cultural project would never have survived the dissolution of a host organization. Now, let us switch lenses from the economic to the socio-technical and examine more closely the multiple epistemic cultures that had to negotiate with one another in the course of this experimental production.

### 7 Epistemic dissonance, negotiating norms, and mechanisms of work

We have seen multiple norms, more generally, multiple value systems concurrently organizing the work of the TGarden consortium. How can artists and engineers decide on priorities of esthetics, experience, experiment design, and the relative investments of energy and capital? Of course, such negotiations of knowledge, norms, and capital are always entwined with the fine structure and dynamics of power.

Foucault (1972) observed how structures of power imbricate the generation of knowledge, and how certain discursive structures in a field of production coordinate and sustain generative forces within that field. A classical institution like a corporation embeds authority structures or even explicit command structures that invite or exclude participation in a project. Corporate or corporative work provides one model for coordinating a distributed network, the challenge being how much infrastructure is needed to mediate differences in time or rhythm, geography, and epistemic culture. An alternate source of models emerges from the domain of non-corporate, autonomous work. Again, the question is what infrastructure is appropriate to scaffold collaboration with a flatter power structure and accommodating more individual initiative. In this alternative, the relevant term is not management but coordination, since there is a multi-pole power structure of peers. But it is not clear what informatic technology is adequately

designed to mediate power negotiations among peers from incommensurate epistemic cultures.

The TGarden consortium used communications and informatic technologies ranging from phone conferences, chats, and email to a network-based source code revision management system (CVS) and SourceForge's web-distributed development service. These technologies served to index much technical work but did not adequately scaffold essential work like travel and event planning, grant development, and venue negotiation.

The construction of boundary objects and contact languages as devices and software as well as symbolic artifacts coordinates radically different epistemic cultures, such as those of the history-free hacker, the deeply and narrowly disciplined computer scientist/physicist/mathematician, the costume designer, the performing musician, the dramaturge, or the producer. But we all still negotiated in person the frameworks of commitment and belief that interpolated and normed those contact languages. This was made clear by how the regions of commitment tended to coincide with the regions of co-presence: your mates are those with whom you break your bread.

Earlier we already saw how the garment, vision, and visual graphics collaborators had to interpolate their work. Here, I give another example to illustrate the difficulty of resolving different normative frames. Early on, TGarden consortium chose to move development of the wearable system as well as main logic on the fixed computers to LINUX. This was motivated by a desire to work as much as possible on non-proprietary operating systems.

For the wearable component, instead of working with Windows CE as installed on the Compaq iPAQ pocket computer, the sensor component engineers decided to replace the resident operating system by LINUX. More experienced engineers cautioned against building the wearable sensors around LINUX and JAVA public domain systems, advising that the production team should allocate more of its time to working with the WindowsCE environment that came with the iPAQ and focus on the parts of the wearable component that were unavoidably novel: the sensor, the data reduction, and the wireless transmission. As it turned out, the combination of scarcity of expertise, lack of published knowledge about LINUX and the newly released hardware, coupled with shortage of hardware components, significantly delayed the assembly of a wearable sensor system.

The programmers decided to implement the media logic for the "fixed" computers (PC's and Apple computers) in an authoring system called PD. PD was a real-time media programming system with a visual "wiring" interface similar to MAX, available under LINUX (the OpenSource version of UNIX) and marginally under Windows but not the Macintosh operating system that everyone in the team

<sup>7</sup> This informed the ethos underwriting the Topological Media Lab's present working practices.

used for most of their work. We wrote the prototypes of TGardens in MAX, which is widely used in the international community of live electronic music and video performance and installation artists. Free software ideology, more than considerations of theatrical, musical, or body/costume esthetics, or considerations of the phenomenological or scientific research agenda, motivated our move to develop the core logic in PD and LINUX. In principle, we all accepted the Open Source ideology, but its practical epistemic and operational consequences fell with unequal weight on the collaborators. The net result was that only a small subset of the collaborators could implement the *behavior* of the environment, contrary to the TGarden consortium's operational goal of making media choreography authoring accessible to artists beyond the community of hacker programmers.

Returning to commercial non-Open Source media programming environments: MAX and NATO (a real-time video processing library, precursor to Jitter) and Apple's proprietary Macintosh operating system, the development activity remained inscribed in an operational notation that was (and still is) more legible and accessible to a broader community. Moreover, as borne out by the subsequent decade of continuous refinement and experimentation, the relative stability of the authoring environment sustained a broader and more robust conductance of practices and ideas and trained practitioners between performance and academic discourse communities, especially important since such communities do not have the means to retool their labs and studios, or replenish, refresh, and update expert organizational memory with every shift of technology.

Let us take stock of the foregoing accounts from a more strategic analytical perspective. In a regular managerial organization, a command structure would resolve contentions between musician, visual artist, designer, programmer, hardware engineer, and computer graphics scientist, but, again due to the consortium's interest in enacting alternative organizational strategies, the TGarden association tried to find collaboration tools and techniques to bridge the disparate axiologies and epistemic regimes. Such conflicts echo the conflicts and exchanges common in high-energy physics or astronomy experiments, which draw participants from many disparate disciplines. Peter Galison (1998) has introduced the useful notion of "*trading zones*" to analyze this sort of multi-disciplinary collaboration. Within these trading zones, people from different socio-technical cultures form contact languages analogous to pidgin and creole languages. But these contact languages are more than just notational schemes, they comprise software algorithms, physical apparatuses and technical practices, what Latour characterized as systems of inscription. In Latour's terms, the TGarden worked as a set

of inscriptive devices, as instruments of writing that re-inscribe and map from participants' activity as traced (not "described") by statistical features to the varying textures of sound and video.

Galison also introduced another analytically useful notion, that of intercalation, to describe the tight coupling between empirically oriented theory construction, the theory-laden and instrument-constrained design of experiments, and the theory-laden design of instruments for particular experiments (Fig. 6).

Galison's model replaces that of the usual circle or spiral of linearly ordered development: theory—experiment—theory—experiment, by parallel bands of non-coincident but mutually calibrated development of theory, instrument, and experiment. From this vantage, we can see that the technical, economic, epistemic, and normative negotiations that complexify development in a high-energy physics laboratory resemble in kind if not degree those of an experimental media art and technology project like TGarden (Fig. 7).

Diagrammatically, one can visualize the gap between the paradigmatic practices and norms of vision researchers, commercial media producers, and independent artist/hacker programmers. This same normative gap, however, presents opportunities and even heuristics for extra-paradigmatic work by members of each intersecting community (Fig. 8).

Let me illustrate this with an example. The TGarden system had to track the location of each player in the space. There were many constraints deriving from the esthetic and practical design of the experience: (1) the tracking system had to be very cheap,<sup>8</sup> (2) the system had to work with people rolling and jumping around in free motion constrained only by the floor and walls, the system had to work when the illumination only coming from motion video, (4) nothing other than what the costume designers integrated into their esthetic could intrude on the perceptual field of the players and break the imaginative immersion, and not least (5) it had to be a system that used the expertise and labor available to the consortium over that period of time. One way to satisfy all these conditions was to engage a graduate research assistant in the field of computer vision who was generously assigned by a colleague at Georgia Tech for this project. However, the technical problem that independent artists and hacker programmers viewed as techno-scientific research was regarded as merely "engineering," and not appropriate as research by the computer vision scientists, or their students. In a commercial media

<sup>8</sup> In terms of budgeted FTE (full-time equivalent paid labor), non-commercial art production budgets in that context could amount to as little as one-tenth those of technology research and one-hundredth those of commercial production.

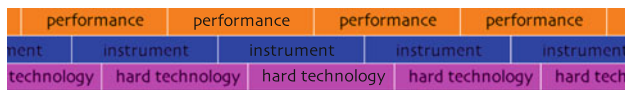


Fig. 6 Intercalation

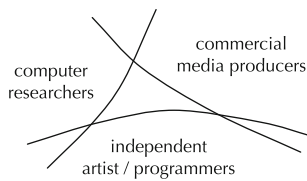


Fig. 7 Normative gap

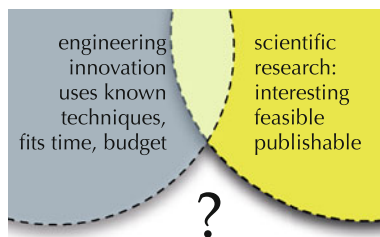


Fig. 8 Gap in practice. “What’s research?”

production, such a problem would have been solved by throwing some money at it to buy and modify a tracking system or to hire an experienced specialist engineer to build a custom solution, the solution taken by the Cirque du Soleil and other mature entertainment companies like a Hollywood production company.

The normative collective imaginary needed to attract and coordinate diverse technical and artistic talents to a hybrid project such as the TGarden hovers in an unstable equilibrium. And as in every instance from ATT Bell Labs to Xerox PARC and MIT, to the Royal College of Art or Banff New Media Institute, or the International Telecommunications Program at New York University, to Georgia Tech’s digital media program between the School of Literature, Communication and Culture and the College of Computing, the institutional context strongly tugs the equilibrium norm to one side or the other. In Bell Labs or Xerox PARC in the 1970s through 1990s, the norm was weighted by industrial technoscientific research, necessarily so under the model as envisioned by planners like Vannevar Bush at the Massachusetts Institute of Technology and his student Fred Terman at Stanford University after World War II. In a university, the norm is weighted by standards of general scientific research or humanistic critical inquiry. In the domain of art and design, esthetic norms and norms of what Pierre Bongiovanni<sup>9</sup> termed cultural

<sup>9</sup> Pierre Bongiovanni was director of the CICV (Centre International de Creation Video) Pierre Schaeffer centre for art research and creation in Herimoncourt, France, 1990–2004.

engineering come into play as well. These normative frameworks may not be independent, but they are largely incommensurate.

It should be clear by this point how the techniques and technologies deeply entangle playful activity with epistemic regimes and normative frameworks in all these domains of practice.

## 8 Public and ubiquitous play

I believe that it is naive to expect freeing software also frees the programmer, much less the player or the researcher. In fact, moving to the LINUX operating system removed development from the common platforms of media tools with which the musical and video and graphics professionals work. Moreover, the overtly technologicistic computing arcana tended to constrain the design and the media choreography of these computational media creations to hacker esthetics and isolate them from the historical currents of dance, music, theater, and literature. At the risk and expense of naively repeating the rhetoric and the experiments of the avant-garde and the romantics, it is also true that a fresh (or refreshed) esthetic current emerged in the course of the work. Nonetheless, by moving to a “free software” operating system, we merely displaced but did not eliminate our dependency on contemporary electronics hardware and information technology, which have been systemically enclosed by corporations. Although most members of the TGarden team by training and cultural habitus sympathized with the Open Source ethos, the TGarden construction strategy was not planned as a maneuver in the Open Source movement’s war against hegemonic technology corporations. The TGarden consortium’s larger political-economic goal was to provide free access by creators—who needed not be members of the original consortium—to create their own rich media events, using TGarden technologies and the techniques of media choreography. From this perspective the TGarden consortium engaged in another set of intercalated work with multiple time periods, some of which are radically incommensurate. To a greater extent than in more established areas of art practice, perhaps, TGarden creators harbored an ambition to re-invent *substrate* technologies along esthetic and conceptual lines. The greatest incommensurability of course lay at slippery coupling between the discontinuous strata of performance, composition, and instrument and the stratum of “hard technology.” This “bedrock” stratum stands in for the ambient industrial economy of digital technology, the hardware—sensors, programmable integrated circuits, the connectors, the projectors, etc.—all of which answer to dynamics not decoupled from the consortium’s design process (Fig. 9).

Now, this purported privileging of the craft of substrate engineering may resemble the hubris inhering to virtual reality systems like the CAVE,<sup>10</sup> which presumes to replace embodied experience in all its density by computed visual and, to a lesser extent, sonic data (Cruz-Neira et al. 1992). The TGarden system, instead, leverages the corporeal qualia afforded by the costume (sound and weight of the cloth), the body in motion, music, and the built space. It also leverages the theatrical effect of staging an event to heighten experience; using the barest of means, such as the ritual of being dressed in an alcove, powerfully primes the imaginative expectations of the player who enters the space.

At the beginning of this essay, we likened the instrument-making aspect of TGarden to the historical evolution of the Hammerklavier and its evolution as a complex conversation between composers, performers, and instrument builders (technologists). What is curious about contemporary media technologies is the rapid pace of such action and reaction among artists and technologists, which offers the opportunity for an unusually reflexive disciplinary craft. However, the lack of a strong socio-historically embedded notation-based praxis correlates with the lack of a class of people who can characterize their work as composers.

The TGarden should be understood as not a singular performance event or site-specific installation (though the TGarden and earlier precursor studies were to some extent singular), but as a media instrument together with a system for media choreography. The players' contingent actions synchronously interfering with semi-autonomous software processes generate the visual and aural material that constitute the tangible media in which they act and shape collective media objects.

At a larger social scale of production, the organizational scale, we discern another substrate to action: that of the experimental exercise of core competencies and project coordination (vs. project management). We are faced with some knotty questions. Could it be a higher order of hubris to believe that Open Source ethos works at this level to coordinate highly geographically and culturally dispersed work? In a closed organization (like a firm), the amount of capital needed to sustain coordination, communication, and commitment rises with the number of people and degree of dispersion. What about open social assemblages like the TGarden consortium? Does the capital scaling function even dominate that of the classical firm, or is it true that with social intelligence and tact, we could extract micro-

<sup>10</sup> CAVE is the acronym for "CAVE Audio Visual Experience" a computer-augmented environment developed by Cruz-Neira, Sandin, DeFanti, Kenyon and Hart at the University of Illinois, and reported in SIGGRAPH 1992.



Fig. 9 Five-layer intercalation

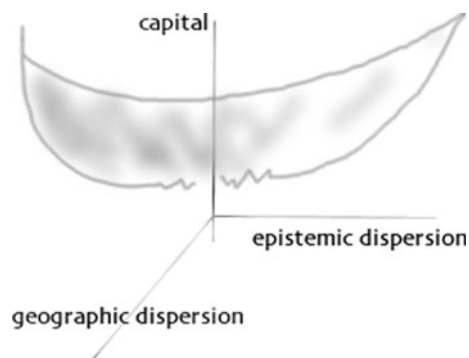


Fig. 10 Capital needed to maintain project coherence as a function of epistemic and geographic dispersion

infrastructural support—an airfare here, an algorithm there—from dynamic networks? (Fig. 10).

The TGarden consortium's success in that regard is contingent on the quality of individual members' institutional embeddings.

The TGarden consortium's production constituted an experiment in a continuing exploration of alternative configurations and modes of cultural production and technological innovation. It also materialized a vision of tangible, responsive media that may be placed in the public domain in phenomenological, political economic, and urban senses of the term.

**Acknowledgments** I am indebted to Michael Century for trenchant observations and for the opportunity to write about the TGarden experience. I thank my colleagues in the TGarden consortium: Maja Kuzmanovic, Chris Salter, Laura Farabough, Evelina Kusaite, Nik Gaffney, and other members of the FoAM and sponge creative networks, as well as the many supporters of this experiment in autonomous cultural production.

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