A Matter of Style:
On the Dialectic Between Technological Affordances
And Performance Style

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Draft

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Comments welcome!

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Introduction

Within social anthropology there has been intense work around the role of "technologies of the mind" in the transformation of institutions within society and by implication the transformation of individuals within such institutions. Taking a very broad perspective on work around the transformation of oral societies into literate societies we would like to highlight the following points to ground our discussion on the use of particular electronic artifacts. Our three main insights are as follows:

1. *Technologies do not affect people in the same way at all times and in all places.*

While writing has been used by some people under some conditions to "liberate the mind" from the burdens of memorization it has been used by other people, or maybe even the same people under different conditions to create institutions which favor memorization. Often this is associated with social stratification and the imposition of "cultural knowledge" upon others. (Goody J. 1977 and 1985) The way in which the ensemble of print resources are articulated in teaching and learning routines reflects this very same pattern. One need only compare and contrast the ways in which practises associated with "low track" students are tied into beliefs around the need to ‘follow instructions’ and an emphasis on "at least memorize the basic facts" while practises associated with the "gifted and talented" students use, often the same resources, in dramatically different ways with an emphasis on self-direction and the creative appropriation of basic knowledge. In this way social stratification is produced and re-produced in educational practices associated with the often same books.
2) Beyond “great divide theories” there are practices.

Instead of talking about Great Divides such as oral and literate cultures (which led Levy Strauss to write about "the savage mind") Jack Goody and later M.Cole have urged us to investigate the material basis for this transformation in modes of thinking. In fact, if we start to examine the many ways in which literacy at present structures our own lives and the ways in which our cognition is distributed in our writing and reading, we can start to imagine how electronic media will mediate our communication with others and with ourselves.

3) The practices that emerge are historical in origin and constructs such as style are reflective of what Bourdieu calls the "objective conditions of practice."

In other words, that style around what ought to be needs to be seen as "necessity turned virtue" by a group of people which then may attempt to ‘project’ this style onto another group.¹ Thus memorization is a response to a highly hierarchical system where challenge to authority and critical thinking are not primary motives. Conversely, thinking critically and creatively is highly valued in practises of particular working environments. (Bourdieu, 1984)

Towards understanding “Cybercy”

At present when people talk about the transition from orality to literacy to "cybercy" we often think of the emergence of cyber-society in cyberspace, a place where new social spaces are formed. Such spaces at times follow similar patterns to those we are already accustomed to and at times create a new matrix of social relationships. (Jones, 1995). However, there is another
sense in which "cyberspace" is affecting the way people work, learn and teach. This has to do with the reconstitution of physical space and concrete objects in the forms of modeling tools or simulations which scientists and more recently teachers and students can manipulate electronically to work and to learn. This talk is about the intersection between these two kinds of tools: simulation software and video-teleconference.

The Project
The overall goal of the Community of Explorers Project, funded by a three-year NSF grant, has been to experiment with the use of simulation software tools in high-school science and physics classrooms. Though they are geographically dispersed, teachers and researchers can interact in a continuously available electronic space. The project provided telecommunications software, curricular software, expertise in both content and technical knowledge. The project had two major groups of teachers and researchers: one in Cambridge, the other in San Diego. Both had very distinct histories and traditions. While the Cambridge group centered around Bolt, Beranek and Newman, Inc., a high-tech research and development firm, the San Diego group centered around a teacher education program. A series of teleconferences and e-mail discussions served as vehicles for merging these two basic groups into a larger professional community that experimented with simulation software and reflected on the results.

The RelLab software:
Relativity was selected as a topic because it was felt that much of what is called "modern physics" is in fact based upon physics from an earlier era. Writes
Paul Horwitz,

"by failing to present students with the fundamental concepts that relativity and quantum mechanics share with classical physics, our schools reinforce the myth that virtually nothing that has been achieved in the field in this century can ever be appreciated, much less understood, by the lay person."

In terms of its design, RelLab is a computer program that allows learners to visualize phenomena that are not directly observable. As an open-ended software “laboratory” RelLab affords students the opportunity to perform simulated thought experiments involving collections of physical objects in relative motion.

“Since all the calculations in RelLab are performed using the full apparatus of Special Relativity, an object may be assigned any speed from everyday to relativistic and student can observe its behavior in any inertial reference frame. Events (space-time points) can be specified, labeled and associated with local processes such as acceleration of a spaceship or the emission of a photon. This permits the creation of complex scenarios and opens the way for simulation and investigation of well-known but surprising effects, such as the Twin Paradox.”

A video-conference as an arena for joint activity

When I started to work on the paper for this session, my goal was to see what kinds of activities had been carried out in different media. I began by watching some of the initial video-conferences that had been organized by the project in February of 1993. I focused first on one in which a group of Cambridge teachers, who had for a long time been working on the teaching of Einstein’s Special Theory of Relativity through a program called RelLab, came together over video-teleconference to share their experience with a
group of San Diego teachers. The Cambridge group included people who had
developed the software, mentor teachers and a novice teacher. As a team they
had been working for a year in testing the software and helping to develop a
particular pedagogical approach based on small group work on a carefully
selected series of paradoxes. From the perspective of learning as peripheral
participation, the Cambridge group was experienced (in Lave’s terms, “old-
timers”) whereas the "newcomers" were the group from San Diego.

Perhaps because I had recently participated in video-teleconferences myself in
which I had been subjected to a series of protocols around turn-taking I was
struck by the sloppiness of the old-timers: time was wasted as the machine
crashed, the key presenter made a lot of "mistakes" (he talked to himself, and
often seemed to bump against the constraints of the software). This was
definitely not a slick demo! There was also a lot of joking and the language
used was rather informal. Suddenly I realized that beyond that demoing the
software, the key presenter, Eric was, consciously or unconsciously,
demonstrating a way of interacting with it — demonstrating a style of
interaction. This style wasn’t an individual construction but rather, as he
himself often indicated, was representative of the way in which students
engage with the software. Eric kept interjecting comments such as "this is
exactly how kids will act," or this is what will happen in class.

**Phases of the performance from which I abstracted the elements:**

*Phase 1: Introductions with a few jokes*

*Phase 2: Demo of the software.*

*Phase 3: The San Diego group gets drawn into the performance.*
Phase 4: Reflection on the what kind of learning might be involved.

Phase 5: How can the group continue to collaborate. (Initiated by the project directors)

Phase 1: Introductions with a few jokes

Jokes and talk about the weather (snowing in Boston and in the 70’s in California) start to create a collegial atmosphere within which two distinct perspectives may be enacted.

Phase 2: ‘Demo’ of the software.

At first the computer crashes. The San Diego team reassures the Cambridge team that "they understand what it is like to have those kinds of unexpected breakdowns." Nothing to be embarrassed about.

As Eric starts use the software, he starts to bump against its constraints. He tries to do certain things but the software would not let him. For example, he cannot define an event because he has not set a frame of reference. Eric comments about how "these are the kinds of situations you will face in the classroom" or "this is exactly the kind of thing a student might do," i.e. try to define an event without having a reference frame.

Vignette 1 (As Eric attempts to build a scenario, he bumps into constraints of the software)

Many of the qualities of Eric’s performance reminded me of the styles one sees at BBN as people hack through programs while talking to themselves
(or to the machine?). Eric was having fun with the program. The San Diego group gradually gets more and more into the spirit of fun and inquiry. At some point someone suggests that one of the trees in the scenario should be a cactus to represent a “California tree” and Eric comments “all right, you are getting into the spirit of this.”

In sum, in this part of the event, Eric wasn’t just demoing the software, but through his manner of acting he was enacting a way of being. It is later in the performance he pulls the San Diego group into playing a central role in controlling the activity.

Phase 3: The San Diego group gets drawn into the performance
A crucial turning point in the performance comes about when one of the San Diego teachers asks Eric to build a certain scenario and Eric refuses “until you make a prediction.” The conversation in San Diego stops, there are comments about “he refuses to show us that.” Then a few of the teachers decide to dive into the problem solving mode. From that moment on, there is a back and forth interaction between the two groups. There is plenty of joking but also intense moments in episodes where the San Diego teachers are trying to make predictions — and in doing so are publicly demonstrating their understanding of relativity (or lack thereof). [In a sense Eric has led them to imitate his style of trying out things and not being embarrassed by his own mistakes.]

Phase 4: Reflection on what kind of learning might be involved
This phase starts out with one of the teachers mentioning that they have noticed how some scenarios which learners build are used in the solution of
other problems.

**Vignette:** Teachers argue that this image becomes “a piece of confidence” for the students, who kept using particular experiences to solve about another problem. Learners would mention that it’s like “this is exactly like the light bulb.”

Significance. Reflecting on practise has been identified as a key aspect of teacher change. (Ask Bill for references)

**Phase 5: How can the group continue to collaborate.**

Initiated by the project directors, these conversations concerned practical considerations around collaboration (what kind of equipment, what kind of projects, who was available and so forth, all the kinds of conversations which extend themselves more easily over e-mail).

**B. Elements of this Style**

From this performance we isolated a number of features to characterize the performance which Eric embodied:

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<td>• Allowing Time for Tinkering, Play and ‘Fun’</td>
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<td>• Valuing Student Construction</td>
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<td>• Bumping into Constraints</td>
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<td>• Turning Bugs into Features–</td>
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- Talking and Thinking Aloud
- Making Predictions
- Articulating and Reasoning about Theories

- *Allowing Time for Tinkering and Play.* This relates to Greenfield’s comment on how cultures which value innovation arrange for opportunities to play.
- *Valuing Student Construction.* As opposed to settings where the constructions of teachers or of textbooks are at the center of attention, in this performance, the learner’s constructions are at the center. In fact, there is nothing on the scene unless and until the learner builds something.
- *Bumping into Constraints.* This feature refers to how the software won’t let you carry out certain actions, for example it won’t let you define an event without a frame of reference.
- *Talking Aloud.* Very much tied to notions of “cognitive apprenticeship.” This explicit strategy which some of the Cambridge teachers have been experimenting with, is linked to the willingness and need to “externalize thought.” It is known to be a useful strategy in joint problem solving.
- *Making Predictions.* This feature relates to the whole notion of “thought experiments” and constitutes the basis for engaging students in building scenarios that would allow them to test their hypotheses. It is in this regard that the software serves as a modeling tool.
- *Articulating and Reasoning about Theories.* This strategy forces the tinkerer to make his/her thinking explicit and share it with the group.
As the software generates data, the group solving the problem is encouraged to change and refine its theories to make them compatible with the computer-simulated findings.

C. Where does this particular style come from?

In which “world” does this particular way of acting seem appropriate? In the terms of Bourdieu, whose habitus is being projected? To whom and why? As far as I can see, the sources of structure are deeply situated in the research and development world of organizations like BBN, places where workers are paid for both finding and solving complex problems, where computers are constantly being pushed to their limits, where complex software is developed (and hence often flaky). People develop a taste for problem finding and problem solving, for tinkering and brainstorming, for hacking on computers. From this community of practice emerges an artifact, a piece of educational software-with-associated-style which in many ways embodies/ materializes BBN’s own conditions for learning and working. [Bourdieu would see this as an example two things: cultural capital being embodies in this particular artifact, and the practises it affords, evidence of the generative principle of habitus which has turned “necessity turned into virtue” and of cultural capital embodied/materialized in an artifact.]

I can recognize a few other “sources of order” in: a) the research and the development practices which characterize work at BBN; and b) the medium that is used. These are not independent. I illustrate this point by discussing “bumping against the constraints of the software,” “turning a bug into a
Bumping against constraints of the software is one of the design features of RelLab. It is interesting to note how this aspect of the style reflects practices around computers in general, and at the same time has been used by the designers to represent domain specific knowledge-in-action. This “bug” turns into a feature from the way learners are made to act, i.e., with a pedagogical intent.

Said in other words, the mindful selection of which apparent ‘bugs’ to built into the program, does reflect a domain specific assumption (often supported by formative research) on aspects of the domain knowledge which, in order to confront misconceptions, needs to be foregrounded. For example, the fact that “frame of reference” is at the heart of understanding relativity becomes materialized in the fact that you literally cannot define an event without defining your frame of reference.

Thus, domain knowledge, coupled with constructivist pedagogical assumptions, leads to an approach in which the learner’s actions are constrained and he/she is forced to think a certain way. One may say that RelLab imposes a grammar for action, and since in this environment, actions are external ways of expressing/shaping your thoughts, RelLab shapes the thought process. [In addition, because learners are working with a blank screen, they have to build the scenarios and in this way are learning the art of building ‘thought experiments.’]
E. Brief graph recapitulating how the software-in-use leads to transformation of roles and to new interpretative assumptions.

To sum up this analysis let me offer a quick overview of how we see the interaction between technology and style. In doing so let me return to the theme of the introduction: how can tools transform activity?

Figure 3

A technology associated with a particular style of use re-organizes roles and relationships. For example, it sets up constraints and conditions that induce learners to externalize what they think. Of course, making that switch, from telling learners everything, to having them assume an active role in constructing knowledge, requires that the social relationship be somewhat flexible so that the new style of interaction can emerge in practise. Once the style of interaction is established as legitimate, other pedagogical affordances of the artifact can be used. If the pre-existing scripts are too formal, it may be impossible for new styles to emerge. Both the performer and the audience
have definite expectations that make change difficult. Joking and the camaraderie sets the tone for new roles to emerge.

In Norman’s terms, the affordances of the technology are not perceived as “appropriate” in highly ritualized settings. People don’t feel right making mistakes, taking risks, sounding less intelligent than they would like. Hence willingness to engage in a new style may be a highly situated affair and depends on what the actor feels is appropriate. What is legitimate? What is appropriate?

D. ‘Projecting the style into different arenas of practice—

Our data indicate that teachers vary greatly in the extent to which they incorporate simulation software into their classrooms. The responses range from substitutions, i.e., using the simulations as “black boxes,” which basically take the place of in-class lab demonstrations, to teachers who use the simulation in a more open-ended manner. We are still in the process of trying to make sense of this range. What seems clear is that as this style is projected onto different environments, many of its assumptions about learning, teaching and science run against what teachers are used to enacting.

One might want to think in terms of a few generic conditions for transformation which either have to exist or which need to be created to let this manner of teaching and learning be accessible to students: First, the technology must be accessible and usable. Second, people must know how to use it (they must be socialized into the style, as when kids learn to speak and
think in literate terms). Third, the innovation must to be legitimate. Legitimacy breaks down into a series of questions: is this legitimate science? Is this legitimate learning? Is this something a teacher should be doing in school? Does the community approve of it?

Our findings indicate that rather few teachers appropriated the technology in a way that transformed their teaching practice and challenged their assumptions about teaching and learning. One such teacher noted:

> An important observation [I] made was that the use of sonic range finder simulation revealed confusion and misconceptions in student understanding which had not come to the surface when the Vernier software was employed as a ‘black box.’

Combinations of personal agency and structural conditions at the school allowed this particular individual to incorporate simulation technology into her teaching. In other words, the department made room for innovation, lowered constraints on time, curriculum and assessment. There was an organizational environment already supportive of inquiry, although she did continue to re-conceptualize what “fake learning” was about.

Insert teacher quote.

**Conclusions**

Let’s revisit some of the themes in the introduction.

- The word, as Ong has well illustrated, has already gone through various stages of “technologization,” from oral communication to manuscripts, to the printed and now the electronic text. As Ong has also shown, a clear, non-literacy centered appreciation of orality is necessary if we are hoping to
appreciate the “psycho dynamics” of orality. In the same way, it is difficult, if not impossible, to learn about new artifacts by reading about them. Hence, events such as the video-teleconference are essential for newcomers to be able to understand this kind of learning environment. E-mail and other text-based modes of communication simply do not give access to style.

• About “projecting” the style. In the same way that anthropologists have studied literacy in all of its varieties (Resnick and Resnick) it seems important that we continue to explore the “varieties of learning and working environments” which these artifacts are introduced and the social contracts and styles that emerge around them.

• The construct of style allows us to link personal or collective agency with institutional forms (Giddens point), while attending to how individuals embody the “objective conditions” of institutional practice. The issue of agency enables one to go beyond models of mechanical reproduction in projects that attempt reach different socio-cultural arenas of practise.

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1 P.H.Unlcear

2 PH: It might good to mention that this constraint is a necessary consequence of relativity- not a quirk of the program.

3 PH call it a way of interacting with it.

4 Much like people who talk about the e-mail world, pay attention to nettique and things like ‘flaming,’ learning by tinkering and other features of style are associated with this software.

5 PH: it isn’t a ‘bug’ (see comments above) You don’t describe this one below. Needs to be integrated with ‘bumping into Constraints’

6 Community of Explorers needs to be understood as a project in these sense that the style associated with the software is projected onto others.

7 In some cases this kind of software has been called an open-ended simulation construction kit. In terms of the sequence, it might be important to say that students do things like filming objects in motion from different reference points and so on. These concrete ‘low speed scenarios’ in fact turn out to be critical for students to be able to understand the simulations of high speed scenarios. The reason is that many deep-grained misconceptions come to the fore when the student engage in low speed experiments.

8 Need to edit: This discussion is unclear particularly to a reader who does not understand relativity.

9 The video-conference was rather impressive considering the goals of the project which was to support teachers in trying out simulations software in there classrooms. How then if this that had happened so early on in the project, id so relatively few teachers appropriate the software
in the classrooms? What had happened? Part of the answer seem to be that the new of experience which they had during the teleconference, of engaging with using the software, was a necessary pre-requisite for them to begin to appreciate what that new learning environment was about.