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# An Informal Learning Space in the Making

**Abstract**

The central players in this essay can be grouped into those belonging to formal knowledge making institutions (university, laboratory, museum) and those belonging to informal knowledge making institutions (community, after school, play spaces). This essay is concerned with the creation and maintenance of an informal learning environment where these two groups meet and dwell one in the other. I use Actor Network Theory (ANT) and Cultural Historical Activity Theory (CHAT) to investigate the nature of this complex sociomaterial object, and show that it depends on networks of interested actors in two distinct ways: 1) in order to bring together disparate elements through which the formal and the informal can inform one another; 2) in order to sustain the very rationale for its (the informal learning environment's) existence as a productive site of knowledge making and research. These are not separate processes, but are intimately linked through their expression, albeit in different forms, of "interest". I use these different expressions to link ANT and CHAT, and argue that this combined framework is a particularly useful reflexive lens on the complex sociomaterial formations which appear at the interface, or boundary, between the social worlds comprising OWA's network of interested actors.

## Introduction

> *April 2009, San Diego, California*: in the Ocean World Activity, four young children and an "adult facilitator" read about the ocean in a famous children's science book, *The Magic School Bus on the Ocean Floor*. The kids translate things from the book onto the walls, or act them out in group play, often with some ocean-themed toys strewn about, or simply with their bodies. Drawings proliferate on poster-boards, which share the wall with a projection of a virtual world the kids have filled with digital media. Kids know this virtual world well, and instigate new perspectives at will –digital artifacts approach, others move away, some rotate. Dynamic zoom, gestures, smiles, play, talk meld. The kids wear a "membership bracelet", officially marking their participation –a ritual forms. Weeks later, the kids recall texts and pictures enthusiastically –things were learned. Adults smile because the kids smile as they learn...

Many different kinds of institutions, academic disciplines, and research projects are directing their attention at understanding the pedagogical affordances of informal learning environments. These environments vary tremendously in where they can be found, what activities take place in them, and through what social and material arrangements they are constituted. The Ocean World Activity (OWA) mentioned in the thumb-nail description above is one such environment. A blend of high technology and more traditional objects are a core feature of this activity. The thematic element providing the overarching rationale is ocean science, a theme which is the direct topic of the book the kids read, but which is also manifest in the physical appearance of the toys used, and

the digital media which the kids look for and introduce into the play environment. In the image of the activity, I can be seen in my "facilitator" role, making sure the activity stays on track and helping the young participants when needed. As an informal learning environment, OWA's goal is to provide an engaging space within which play and learning can exist together in productive relationships with its surrounding social and material context, the Town and Country Learning Center.

A central point in this essay is that such informal learning environments don't simply exist. It is important to dwell on this fact, for the construction of these kinds of environments as particular objects of interest (specially as research objects) is a difficultly negotiated process between very different social worlds –in the case I analyze here, between the community and the university. From this point of view, I consider OWA a complex sociomaterial boundary object (Star and Griesemer, 1989): "These objects may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation" (p. 395). We will see that OWA exhibits these properties, but even as this is true, it does not exist in the kind of durable and stable relationships with its contextualizing social worlds in the manner of the boundary objects identified by Star and Griesemer in their classic study. This is because it hasn't achieved the status of an institutionalized boundary object, and for this reason, its existence is inherently precarious. OWA was made possible by, and since its inception has made its way into, social worlds where it did not previously figure in any meaningful or concrete way, but it is very far from being entrenched in these worlds.

There is a tension here, for the boundary objects that Star and Griesemer identify –different kinds of maps, museum repositories, categorizing systems– are concrete and largely mobile artifacts. A core argument of theirs is that such artifacts function as boundary objects precisely because they embody (materially and/or conceptually) the functional needs of local users, while at the same time retaining a core identity across sites. The same cannot be said of OWA, for the manner in which it fulfills local requirements depends on mechanisms that cannot be framed as direct material or conceptual applications. Despite its seeming concreteness when described as an informal learning environment, OWA is an unstable and ambiguous object, one more aptly described as existing in the process of becoming. It is this ambiguous process of becoming that I want to investigate, a social and material process extensive in time as well as in space, which brings together different kinds of actors and things. Doing so involves finding out how OWA *makes* sense, both in terms of its heterogeneous constitution (from the *inside*) as well as within larger contexts with which it interacts and within which it operates (from the *outside*) .

The thumb-nail above is an amalgam of ethnographic observations across these two positions (insider/outsider), and the analysis of OWA presented in this paper is grounded in them: one born of immersive participation in the activity as the "adult facilitator"; the other resulting from a kind of entrepreneurial relationship with OWA which I grew into as this activity began to move out beyond its place of origin. The claims I make can thus be thought of as a product of encounters between the social worlds which inhabit OWA and those which are distinctly (at first blush at least) external to it. On the one hand, the community center where OWA took place, the kids who participated, the materials which flow into the activity. On the other hand, researchers and institutional advocates seeking to use and understand digital technology as tools for underserved populations, both as a way to increase interest in science and technology as well as to provide a vehicle for science outreach and enrichment.

In putting to work these two perspectives, I also bring together two complementary theoretical frameworks which I think are particularly helpful in crafting this kind of analysis, Cultural Historical Activity Theory (CHAT)[1] and Actor Network Theory (ANT)[2]. Within CHAT, I am concerned with the

[1] CHAT is a xxx.

theoretical concept of *mediation*, specifically the mediational role which an unstable and ambiguous boundary object like OWA plays in the interactions between the social worlds through which it comes to exist. Within ANT, I am interested in the theoretical concepts of *network* (Latour and Woolgar, 1979) and *intersessment* (Callon, 1985). Networks refer to collections of actors whose interests have become aligned (interessment) in durable and stable ways, brought into so-called *irreversible* networks. "Interest" will turn out to be a crucial point of articulation between CHAT and ANT, and in carrying out my analysis, we will end up with modified, and hopefully usefully enriched, concepts deriving from this articulation. Succinctly then, the analysis is motivated by the following question: how can an ambiguous sociomaterial boundary object such as OWA play a strongly mediating role despite the fact that the network of actors which constitute it, and through which it finds expression, is only precariously, as opposed to irreversibly, "networked"?

**OWA**

In order to motivate and provide reference points for the relationship between OWA and ANT/CHAT, it is necessary to approach OWA as a complexly layered, historical outcome. As a localizable entity, OWA is a physical space as much as it is a conceptual space as much as it is a collection of representations. Any one of these elements can, and does, become a point of interest to outside onlookers, which is an especially important fact for us to consider. The goal of this section is to trace OWA's development in a way that highlights its presence in the social worlds of these onlookers. It is a matter of considering any one moment in OWA's chronology as a moment intersected by different kinds of histories The combined effect of these intersections is the creation of different contexts within which OWA can (and is expected) to have a presence of some kind. All of the descriptions in this section refer to the figure below, which provides a depiction of some key moments in OWA's chronology. [STAY TUNED for a MUCH BETTER, more detailed, image...]

**Figure YY**.

The bottom timeline in the figure is a typical linear sequence of events, which we'll use in the descriptions to "key" the introduction of significant new contextualizing and constitutive elements in

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[2] ANT is yyy.

OWA's story. Importantly, things are brought *in* at the same time as these additions create the potential (and expectation) of taking things *out*, for the various onlookers I introduce are not merely interested in looking, they are interested in particular results. This implies that OWA is *translated* historically –that is, brought into outside settings and locally (re)presented as well as interpreted in various ways. To incorporate these outside settings properly, OWA's chronology is also necessarily, if only partially, a summary history of its larger surrounding context. This larger context is the Town and Country Learning Center (TCLC) *as* a meeting place for the various interested parties which constitute the TCLC "collaboratory".

Figure YY contains a small barrage of acronyms, some of which are meant to represent institutions, others of which represent important elements of different kinds. I want to problematize this citational practice, especially in the case of the institutional actors, in order to alert the reader that these referents are not as stable as the semiotic effect of the acronyms might suggest. In the first place, these institutions are not of one voice, so that it isn't the whole of the University of California San Diego (UCSD), nor the whole of the San Diego Community Housing Corporation (SDCHC) which come together at TCLC. This community center is located in one of several other apartment complexes owned and managed by SDCHC, but TCLC is the only community center from among all the other complexes with which a small number of organizations at UCSD has established a substantial collaboration agreement. The TCLC "collaboratory" is in many respects an ongoing experiment, dependent on the continued good will and hard work of TCLC's coordinator and the capacity of the collaboratory to continue to send a contingent of undergraduate and graduate students every academic quarter, as well as to provide a modest amount of material resources.

The TCLC collaboratoy could not exist without the formal and legal documentation required by UCSD and SDCHC. However, these larger larger entities only rarely become directly visible, either through specific actions or funding, in it's day to day operations. Because there are no commercial interests involved, and no money with which to purchase commercial services (assuming such exist for this kind of endeavor), all of the work, managerial tasks, materials procurement, and coordination across institutions becomes the responsibility of people who all have other concerns and responsibilities. Thus, the schematic connections depicted in figure YY represent a kind of mutual commitment whose rationale operates entirely outside any simplistic notions of economic optimization or gain. The acronyms scattered about in the descriptions which follow are necessary naming conventions, for they do index actual places connected directly with participants, and from which resources of various kinds (as well as expectations of various kinds) originate. However, there is nothing guaranteed here, no contract stating explicit outcomes (or services) which any party is legally expected to provide. And yet, this does not imply that there aren't any gains to be had. One such gain, among many others, is precisely the stabilization of a social and material space within which OWA is conceivable and wherein it materialized. The descriptions which follow will flesh out this space of possibilities, some already realized, others existing only as elements of imagined futures.

*Critical Moments in OWA's Chronology*

Deep Time: This is not really a moment so much as a representation of a potentiating history, wherein all of those relatively distal set of social, material, and conceptual artifacts and outcomes relevant to OWA can be located. This is abstraction is impossible to render, for there is no way that it can be filled-out even within the scope of a single individual's life history, much less so within the scope of this essay. For this reason, it is mostly an invitation to the readers to insert themselves into this potentiating history, as well as a way of recognizing the contingency that accompanies the appearance of any human creation.

April 2007: Different senses of the term *community* are brought into play in this founding encounter between SDCHC, SDSC, and LCHC. SDCHC is a state-contracted organization charged with implementing a Housing and Urban Development[3] mandate to create community centers in HUD subsidized housing complexes. From this point of view, community is a term interpreted with respect to the needs of low-income people who could not afford housing without this HUD subsidy. The specific manner in which SDCHC sought to meet these needs at TCLC's apartment complex created the initial material and social context into which SDSC and LCHC would be introduced (see Downing-Wilson, Lecusay, Cole, in press, for a fuller analysis). For OWA, this implied the need to operate within the scope of the cultural practices established at TCLC, as well as within (or building on) the material structures already present. Scheduled homework time and free play after homework were, and continue to be, the most strongly structuring cultural characteristics around which the TCLC collaboratory has had to organize. A large part of the time spent by UCSD students at the center is devoted to homework tutoring. In addition, whatever activities beyond homework are created, they must feel like play to the kids, for they are largely oblivious to school-like discipline when at the center. On the material side, TCLC is divided into several rooms and designated spaces for activities, and already featured at the beginning of the collaboratory a small computer network, a printer, internet access, and a host of material objects such as books, toys, drawing implements, etc.. Bringing all of these elements into a functioning center is the job of the center's coordinator, Ms. Veverly. She has added to the collaboratory decade's worth of learning center history, and is *the* central figure through which communication between the collaboratory and the center's surrounding social world is mediated.

The San Diego Super Computer (SDSC) is a major NSF funded research unit at UCSD, and, as is the case with many large NSF centers of this sort, there is a certain allocation of the budget directed at fulfilling the NSF's "larger impact" and "outreach" goals in their mission statement. While there are NSF grants which are meant specifically to fund community-based research, the kinds of grants which fund organizations like the SDSC allocate their budgets overwhelmingly to basic science research[4]. Thus, *community* is nowhere near a central concern of SDSC, serving instead to name one possible way of doing outreach. Despite this, and the lack of formal outreach mechanisms and any sizable budget, individual commitment and creative networking can nevertheless become invaluable in enlarging the impact of collaboratories such as that operating at TCLC. In my three years working at the center, I have developed strong relationships with two key individuals at SDSC who have, and continue to play, crucial roles in materializing the SDSC outreach mandate, Diane and Jeff. Among other things, it was Diane who first established a link with SDCHC, and who early in 2007 contacted LCHC to ask about the possibility of collaborating at the center. In addition, another of Diane's links, this one to Cornell University's Worlds for Information Technology and Science (WITS) program, resulted in OWA's incorporation of that program's virtual world technology. Thus, even when the centrality of community for institutions like SDSC is marginal at best, individual agency is not thereby determined to be similarly marginal in helping to materialize lasting social and material commitments.

For LCHC, *community* has been both an enabling as well as a problematic category. Members past and present of LCHC have played strong, and in many cases founding, roles in formulating and creating research projects where university and community are basic categories of research. LCHC, for example, played a leading role in creating the University of California UCLinks program, whose very name stands for "University Community Links", and whose mission statement says: "UC Links fosters university-community engagement and develops sustainable after-school programs throughout

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[3] This is a federal agency divided into state agencies, through which monies are allocated to counties and cities, which in turn contract out the management of subsidized housing complexes at the local level.

[4] The NSF will appear in other guises in OWA's story.

California. In the process, it serves to integrate the University's three-fold mission of research, teaching, and community service". As of this writing, UCLinks has been in existence for fourteen years, and it is in part through LCHC's association with UCLinks that it is able to maintain a graduate student presence at TCLC, as well as to provide digital equipment for activities with the youth population at the center. In this regard, LCHC's work at TCLC is the latest iteration of a sustained research agenda highly invested in creating sustainable partnerships between community organizations and the lab, as well as the university more broadly. In this work, *community* is a highly specific category where such things as "informal learning", "interventions", "mutual appropriations", "funds of knowledge", and many others all signal collaborative goals between community and university.

On the other hand, community is also a very slippery category, for it is difficult to create open spaces where a broadly representative group of community members and university counterparts can coordinate and work together towards shared goals. This is the space where power dynamics and the obdurate nature of gender, race, and class become difficult, and at times insurmountable, boundary work. Easy to mandate but hard to implement, administrative requirements can compound this difficult work. This has been the case at TCLC in terms of the need to gather the school grades of the kids whose parents have signed formal IRB participation agreements with LCHC. To this day, it isn't clear why this has been so difficult, but it is an exemplar of more general difficulties which the collaboratory has had in connecting with parents and adults at TCLC. Periodically, the difficulty in accessing and materializing "community" becomes disconcertingly palpable at LCHC, and is a recurrent topic of discussion and concern. Nevertheless, undergraduate and graduate students, researchers, and staff at LCHC have sought to orient productively towards these issues as features of the research environment rather than as a show-stopping impediment.

This founding encounter between SDCHC, SDSC, and LCHC created a situation wherein c*ommunity* needs to be interpreted with care as part of OWA's chronology. These different senses of community become negotiated outcomes in practice, where the actual material and social elements out of which the learning center is composed meets with newcomers –their ideas (and ideals), ways of doing, as well as the things they bring with them to the center. As an outsider, I can only lens the lived experience of insiders through a series of observations, for any first person access is foreclosed. On the other hand, as an outsider working with other outsiders to materialize various interpretations, the situation is different. Though "we", the various outside collaboratory members, don't always meet all together, the very practice of talking about, and formulating courses of action with respect to TCLC is a collective practice of imagination, a fact we will come to again later. All of the activities that have taken place at TCLC through the collaboratory are always specific kinds of boundary work where imagination and practice *interfere* –in the wave-mechanics sense of this word, where interference can amplify, dampen, or simply cancel out. Though "we" are not always aware, or don't want to admit, the full extent of this imaginative work, the outsider perspective is still a privileged one from which to reflect on this fact –a reflexive exercise that is especially important with respect to such an easily taken-for-granted category, community.

Summer 2007: The most visible effect of the collaboratory during this moment was a thorough modernization of TCLC's languishing computer network and the introduction of a variety of games and technologies (the WITS virtual world, the games World of Warcraft and SIMS, network storage of digital files, distributed network printing) which it made possible. The ability to run WITS and to connect with the Cornell University sponsors of this program were crucial in OWA's chronology. It is the specific initial impact of the WITS virtual world during this summer, and extending well into the fall of 2008, that is important to understand. This impact was, initially, minimal, despite support from the program's administration and repeated attempts by LCHC graduate students to turn WITS into a self-contained virtual world activity. This is an interesting case of the unpredictable outcomes of

introducing an otherwise successful activity into socio-cultrual contexts with which it has no prior history.

The WITS program, headquartered at Cornell University, provided paid training visits to Cornell during this summer, and then in the summer of 2008, to Viriginia Tech University. In the first visit, I traveled along with a second graduate student and a high school junior from TCLC. I was absent during the second visit, but Ms. Veverly and the same high school student got to attend. Both of these visits underscored how differently WITS was being used everywhere else. In those contexts, mostly public school computer labs, WITS was used as part of larger school enrichment programs. The goal in those settings was to make virtual technology more accessible to underserved youth, especially girls, as well as to augment school-based science learning. WITS' introduction into TCLC was a sharp departure from its use in those largely school settings, a departure which, among other things, implied that WITS could not benefit from the structuring function (in both social and material terms) of the latter. At the center, WITS faced a serious "trial of strength" between its demonstrated capacity to elicit youth engagement in school settings and the demonstrated capacity of TCLC kids to dismantle activities too tightly dependent on school-like structures of discipline. By the Fall of 2008, WITS was seriously loosing this trial, as neither graduate nor undergraduate students could figure out how to get past the "wow factor" which had sustained engagement with WITS for only a couple of days.

This moment thus represents the appearance at TCLC of rich set of component elements central to OWA's chronology. Reliable internet access had first to be established in order to be able to implement various kinds of internet based digital activities. This work thus created raw technical affordances, but also allowed for TCLC's network to function in a truly distributed manner. Printing from any computer, as well as on demand file storage and retrieval, entered TCLC's range of daily practices, and thereby, also, expectations. This new and improved infrastructure would thenceforth become as important as the technologies it enabled, for it allowed a pattern of activities to be organized which could simply take the existence of a reliable computer network for granted. At the same time, and in proportion to the range of activities that depended on the network, it also meant that its inevitable periodic failure would, paradoxically, increase its visibility in ways that did not exist before.

Only in retrospect can the impact of this moment be recognized fully. In the first place, the very physical configuration of OWA, shown in the image here on the right, would rely specifically on the availability of this network. The WITS computer station depicted in blue, the three cameras, and the computer used to project WITS on the wall were all connected to the network, both wirelessly and not. From a research point of view, the cameras were indispensable, and they were configured to permit streaming of the video over the network, thus avoiding the need to worry about video tapes or other media. The ability to locate the WITS computer station in the middle of the room was also important, and this in turn depended on wireless connectivity. Finally, and most obviously, without the network in place (as well as the prior introduction of WITS), the virtual world could not have been part of OWA.

Summer 2008: Another NSF-sponsored actor, one funded under the Integrative Graduate Education and Research Traineeship (IGERT) program, appears in this moment. As part of UCSD's Scripps Institution of Oceanography, the Center for Marine Biodiversity and Conversation (CMBC)

along with "partners and scientists from other academic institutions, government agencies, industry leaders, and conservation organizations around the world, provides for a novel integration of disciplines as [it] seeks technically sophisticated, regionally appropriate strategies to prevent and reverse biodiversity collapse" (from CMBC home page[5]). It was through CMBC's IGERT program that I received a two year fellowship to explore ways of creating sustainable mechanisms of ocean science and conservation outreach. I framed my research proposal in terms of studying and designing ocean science learning activities in community centers such as TCLC.

During this summer, which included a ten week course in oceanography as well as marine economics, ethics, and law, I established personal and professional links to CMBC. Through these I was able to request funding for a visit by TCLC kids and youth to the Birch Aquarium, as a way of beginning to establish the presence of ocean science at the center. This visit was successful in two ways. First, in creating an identifiable connection to ocean science for the kids framed around their experiences at the Birch Aquarium, including those experiences with particular exhibits such as the tide-pool area where the kids were able to interact with sea creatures. Second, TCLC itself entered CMBC's set of reference points for community outreach. The association of my research with the center, funded under CMBC's IGERT, as well as CMBC's direct funding of the aquarium visit became a kind of existence proof for the potential of cross-disciplinary IGERT research to expand the scope of CMBC's marine biodiversity conservation mission. This is important, for it meant that TCLC kids could begin to speak of the aquarium and its contents as an accessible part of their lives, and, in the other direction, CMBC (and later, also the aquarium) could think of TCLC as a model for community outreach.

There is a moment in the OWA video footage which has become emblematic of the potential of this kind of mutual presence of the university world in the TCLC world and vice versa –and by extension, of the potential of the university ↔ community link represented by the TCLC collaboratory as a whole. At one point during the first day of the activity, the projection of WITS on the wall allowed one of the young girls to display an enlarged image of a sea anemone which she had found on google. She pointed straight at the center of the image and began to tell me and the other girls about the "pointy sharps" coming out of the animal. I asked out-loud if anyone remembered what these pointy sharps were called, to which I quickly received the reply "tentacles". This got the girls to talk about the experiences they remembered at the aquarium's tide-pool exhibit, where they touched a number of sea anemones. The girl who was showcasing the projected image on the wall explained that "they [the anemones] close all their pointy sharps … and they just caught onto you". This event in OWA was made possible, though of course I didn't know it at the time, by the introduction of CMBC into OWA's history, a theme more fully fleshed out in the chronological moment described next.

Fall-Spring 2008: This moment was a bridging period in two ways. Academic requirements external to my work at TCLC competed for my attention. At the same time, I struggled to figure out how to bring several disparate commitments together into a common thread of study, in order to make discernible progress around a concrete research objective. The best way to describe this period is to think of the confluence of four different perspectives, each corresponding to different research orientations, which I will discuss much more fully in the discussion sections. For now, I simply name them in connection to this chronological moment.

My participation at LCHC involves weekly visits to TCLC as well as lab discussions on my and other members' research and writing. Historically, LCHC has been a nexus of research and theoretical thought seeking to extend Cultural Historical Activity Theory (CHAT). CHAT is a central topic of discussion below, and is an easy way of qualifying my LCHC perspective. In addition to LCHC, I am

[5] http://cmbc.ucsd.edu/About

invested in my home department's, the Communication Department's, Science Studies Program. It too has been a historical focal point of development and contributions to the multi-discipline[6] of Science Studies. Within the broad range of concerns Science Studies encompasses, I am especially interested in knowledge making and applications of Actor Network Theory (ANT). Within the scope of this essay, ANT captures well my Science Studies perspective. At a broadly aggregating level, these two perspectives suffuse my specific research goal of developing and studying learning environments augmented with digital technologies. One of the reasons why WITS arrived at TCLC in the first place was precisely because (in the summer of 2007) I expressed interest in using it to do this kind of learning environment research. WITS can stand for this perspective, digital learning environments research. Finally, CMBC can be thought of as a mechanism whereby these three perspectives came to be deployed around a common theme, that of ocean science learning. CMBC's interest in marine biodiversity conservation, as well as its IGERT program mandate to create "broader impact" and outreach mechanism, are both realized in the material and social constitution of the Ocean World Activity (OWA). This CMBC perspective is OWA's "gluing perspective".

This bridging period was thus an extended moment of intense cross talk between the CHAT, ANT, WITS, and CMBC perspectives, all negotiating their place with respect to TCLC and the entire chronology described so far. There is a kind of excessive freedom which comes with this kind of multi-perspectivism, especially before concrete objects come into focus on which to anchor some of this multiplicity. While I now conceive of this perspectival confluence as a reflection of the multi-faceted nature of my research project, OWA was not yet available for this confluence to reflect (and surely also refract) on. Rather, it served to create and condition a future space of possibilities, and to privilege the lensing of some aspects of the world over others in my perception. I think these two things are actually one and the same, a point worked out more fully below. TCLC provided the ground, both literal and experiential, upon which to project this space of possibilities. Hutchins describes how "material anchors" (2005) can enter into complex blends with conceptual spaces (Foucaunier, 199x) out of which new and useful conceptual tools can be derived. For example, a fence extending out into the horizon can blend with the thought of movement to enable the imaginative projection of running into the horizon along this fence. One "runs the blend" to arrive at results which only make sense in a blended space. In some sense, this period of multi-perspectivism was a heavily blended conceptual space in search of anchors. It is wrong to think that there could be any simple one-to-one correspondence between these complex conceptual spaces and any given set of anchors. Rather, a process of elaboration (and purification) takes place, where aspects of one's experiential history in some setting can begin to condense into descriptive talk and the refinement of theoretical relationships.

Contact with social and material settings mutates, shapes, and adapts these complex blends, in historically, socially, and materially contingent ways. This process is a constant cycle, as imaginative projections erupt into lived experience, feeding back and modifying imagination. New blends emerge, and in time, some of these blends will be materially and socially anchored in ways that begin to appear as a "just so" story. But this is merely the (dis)benefit of hindsight, which reconstructs this process, which is often an agonizing process, as a more or less perfect match between some perspectives and some concrete setting. But there is no such one-to-one correspondence, and constructions of some kind are always involved. With this moment, the conceptual stage was set for the situated construction of OWA within its larger context.

March-April 2009: On May xx 2009, a group of four girls, all denizens of TCLC, got together

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[6] See *A Nice Derrangement of Epistemes* for a very thorough and critical overview of the history of this discipline. Also, Chapter 10 of *Looking Back, Forward*, takes up the issue of whether there is such a thing as a discipline of Science Studies.

for a final "show and tell" party to celebrate their completion of the first OWA informal learning activity. It ran for one hour in each Tuesday and Thursday of the last two weeks of April. The celebration was the fifth official day of the activity, taking place on the third week. I leave for another essay a detailed analysis of this activity based on video footage and ethnographic data. The elements internal to this activity are the important thing here, for they are the concrete anchors of the perspectival confluence described above, a confluence which is at the same time an expression of a range of institutional interests. OWA *is* a further conceptual and material blend for this reason; a discernible and indexable sociomaterial object wherein the *sense* of this confluence of perspectives and interests, in the larger surrounding historical context we've been exploring, can literally be "read off". OWA comes into being as a research object when, and at the same time as, it stabilizes in itself a set of heterogenous elements through which multiple interests are accounted for *within* a single coherent thing –OWA as an informal learning activity.

It is a dense context which, in a manner, receives OWA. TCLC is its proximal manifestation, but medial and distal constituents have been identified above. Science outreach, community ↔ university collaborations, underserved populations, science learning, biodiversity conservation, and HUD housing are all constitutive of this context. As OWA represents also my own object of research, it responds in addition to the CHAT, ANT, WITS, and CMBC perspectives already outlined. Finally, as I have hinted above, I needed to introduce the virtual world in a way that did not reproduce the failed attempts of the past. This failure too was a crucial contextualizing element. From this point of view, the preceding are all thick descriptions recovered from a 3 year-long entanglement with the prehistory of OWA, all of which now allow me to present what was accomplished during these three weeks of April and May of 2009 in a fuller manner.

This "internal" view of OWA is meant to convey the obvious multiplicity of the constituent elements. Perhaps a better, bigger one, later.

One of the items in the collage image above is a picture of *The Magic School Bus On the Ocean Floor*. Like all other books in this award winning children's science series, it features a fantastic journey of exploration where Ms. Frizzle, along with her students, use the magic school bus' morphing powers to enter worlds out of normal reach. This time, the bus morphs into a submarine, taking the kids on a trip which starts off at the intertidal zone (the beach), extending all the way to the ocean floor. At TCLC, a group of young girls with whom I've interacted weekly for the last three years, join with me in reading this adventure story, encountering all sorts of animals and facts about the ocean. One of

the facilities of the activity is the introduction of digital images and text into a virtual world that is projected on the wall (an image of this appears just below the book image in the collage). These images and text are inspired by the animals and facts encountered in the book, of which only four or five pages are read at a time, keeping pace with the calendar for the activity, pictured above (after the intertidal zone come the continental shelf, the continental slope, and finally the deep ocean floor). The other images in the collage illustrate the use of puppets and of a computer terminal where google searches are done and the virtual world is manipulated. There are a couple of images in the collage from the summer 2008 visit to the aquarium, which the kids remember and refer back to in the course of the OWA learning activity.

Through this essay is not concerned with a deep and detailed analysis of the activity as a unit of investigation, it is relevant to mention how OWA repurposed WITS in a way that could overcome the trial of strength mentioned above. The crucial step was to decenter the use of the virtual world away from the all inclusive nature of the activities I had witnessed at the WITS training sessions. In those activities, the participants spent all of their time in direct interaction with the virtual world and, through it, with other participants and the various topics and themes that constituted the activity. At TCLC this kind of use had failed repeatedly. In its new role within OWA, WITS served as only one component, which, furthermore, was recruited into the activity only after the kids read from *Magic School Bus* book and decided what they images and information they would look for on google. In this role, which may appear marginal but is in fact indispensable, the unique affordances of the technology (e.g. dynamic movement in simulated space, panning and zooming of content, and dynamic injection of content) could be realized productively in the context of a larger activity that was able to engage the kids. Or, to put it another way, only when a different context for WITS could be found, one which could productively incorporate the kid's play-orientation at TCLC, was it possible to resuscitate the use of WITS.

The small vignette which introduces OWA at the beginning of this essay mentions that “adults smile because the kids smile as they learn”. Besides me, these adults include TCLC's coordinator, Ms. Veverly, Diane and Jeff at SDSC, and CMBC, WITS, and LCHC researchers and students. To these adults, OWA is a successful mechanism of community outreach which depends on enabling infrastructure to anchor, through a concrete ocean science learning activity, the perspectival multiplicity created by the multiple interests the project is expected to account for. This mouthful of a sentence is literally made up of the main points highlighted so far. Sense making takes place for a set of onlookers highly tuned to extract from their interpretations of OWA the fulfillment (or not) of their interests. OWA literally binds together its constituent elements in a way that enable this sense making to take place.

The WITS virtual world is judged to play an important constructive role in the activity, as it hosts a multitude of digital images and text. Ocean science and marine biodiversity is the actual theme of the book used to thematize the activity, reflecting the impact of CMBC. Underserved kids in an economically depressed area of San Diego can be heard talking about plankton and the use of microscopes (or simply “pointy sharps”), a strong indication that successful science outreach was achieved, which is both a CMBC and a SDSC goal. All of this takes place via internet technology in a HUD-sponsored, SDCHC managed, community center where one of the main goals if precisely to facilitate access to the internet and the opportunities it affords. As an object of research, OWA fulfills the demands which spring from the confluence of the CHAT, ANT, WITS, and CMBC perspectives, which is at the same time a measure of progress in my home department and at LCHC. In a broader sense, however, it is a complex sociomaterial object which could not have come into existence without all the other elements presented so far.

A multitude of voices can be heard together here. Problematically, one voice (or many voices, I

don't know) cannot be heard, that of parents in the community. The slippage of this latter category appears again here, speaking loudly about the difficulty with this kind of research. Whose success is this? Kids and adults benefit, right? Which adults? Which kids? Interpretation is needed. My years of experience at TCLC still leave me unprepared to analyze the non-presence of adults in the collaboratory's research, but it *is* a concern, which turns absence into the possibility of presence, voicelessness into the possibility of voice. Surely, some of the reasons for this are to be found in deep time, some more from the immediate past of this community. To treat this carefully will take me away from OWA and the discussion below, but for this reason alone it would be irresponsible to characterize OWA as an unproblematic success. The lesson here is that OWA's materialization is the, surely temporary, stabilization of a poly-vocal set of concerns, but not of all concerns. On the other hand, I would not know how to describe the stabilization of all concerns (of all voices). It seems to me that hidden in the very fact (and facticity) of stability is precisely the fact of inclusion *and* exclusion.

Summer 2009: This last moment in OWA's chronology is the period immediately following the first iteration of the project. Video footage, pictures, and artifacts produced during the activity allowed me to (re)present OWA away from the field. There is nothing extraordinary in all of this, of course, it is a basic academic reporting and accounting mechanism. I made the expected presentations at LCHC and CMBC, the two academic institutions most directly interested in being informed on my progress with this project. Beyond these, however, and as an unexpected result of them, OWA began to take part in (re)presentations in settings to which I formerly had no connection. This moment in OWA's chronology marks the introduction of the project into the social life, and imagined future, of these settings. I will focus here on two particularly important aspects of this movement: the social mechanism through which it occurred; the effect of OWA in these settings.

After the first presentation of OWA at LCHC I became aware of, in Granovetter's (1973) social-network nomenclature, a “bridge” between the lab and the Birch Aquarium's executive director. Ginny Gordon, a long time member of LCHC and, as I soon found out after the presentation, a Birch Aquarium and ocean conservation enthusiast, was impressed by OWA in much the same way as the smiling adults mentioned above. In addition, however, she was positioned differently from these adults. With no direct investment in OWA, she looked at the activity not as a fulfillment of expectations, but as a way of enticing the aquarium, as well as a host of other “nodes” in her extensive social network, to think about extensions of OWA and the possibility of jointly authoring a NSF Informal Science Education grant. According to Granovetter, “the strength of a [social] tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie” (p. 1361). I would not know how to qualify the “services” that are characteristic of Ginny's various friendships, but the other three elements do characterize rather well her presence at Birch Aquarium and a host of after-school programs outside of UCSD. After a couple of month's travel during which I joined Ginny in visits and talks with people in these various places, it was no surprise at all when OWA was eventually, in August of 2009, incorporated into a jointly authored NSF Informal Science Education grant (to be exact, grant No.-1011049, which was submitted in November of 2009).

Through a series of face-to-face interactions –a presentation at UCSD's Biological Sciences Program, two at the Birch Aquarium, two at an after-school program in San Diego's Barrio Logan, two at CMBC (in the context of this NSF grant)– as well as a long sequence of email messages containing ever more refined drafts of the grant, OWA entered a set of social worlds beyond my own network of connections. It is a certain kind of movement that is important here, a movement composed of a series of actions which recruit OWA in some way, and which add-up into a larger effect. Ginny becomes interested in OWA. This creates a connection between OWA and the various networks of people to which she has strong ties. This connection becomes the conduit for a growing flow of ideas and

coordinated tasks, all becoming more and more concrete as the grant nears its final form. From exploratory sessions to the many tedious details which go into submitting a full NSF ISE grant, this traffic of interactions literally framed and reframed OWA in relation to a variety of interests and the stabilization of a set of future possibilities where the major coordinating element was not OWA as an historical presence (that is, as a well understood, obdurate, and predictable sociomaterial object), but rather, as a component of an imagined future.

It is this outcome, the creation of an imagined future in conversation with OWA, complete with defined roles for the project, that is of particular interest to me[7]. From the title of the grant, "Adding Science Enrichment Through Locally Invested Adults in Support of Neighborhoods - AScEnT LIAiSoN (LIAiSoN)", it is immediately obvious that the very themes that have been recorded in this chronology in relation to TCLC and OWA surface again, even if worded differently. It is worth quoting the opening paragraphs of the "Rationale" section of the grant grasp more fully the shape of this imagined future:

> This Pathways project addresses some of the challenges to increasing participation in STEM [Science, Technology, Engineering, and Mathematics] by underrepresented minorities from low-income communities, who traditionally test below average in these fields. Children from these communities often have smaller scientific vocabularies, perform poorly in formal educational settings and rarely take full advantage of local, family-based, informal educational enrichment programs such as aquariums and museums. Children interested in science may face both economic and family awareness barriers to full participation in community-based informal science education activities. Caregivers and guardians may not know how to access local science education resources and lack confidence to facilitate science learning themselves. While museums and aquariums generally succeed in connecting to diverse student groups through school-based programs, their outreach efforts to families in low-income communities are more difficult to develop and sustain.
>
> The LIAiSoN project will develop a model program to create teams of locally invested adults (LIAs) to serve as informal science facilitators for small groups of children. A network of educational resources and experts will support these LIAs in cultivating ocean science awareness and understanding among the children in their communities through afterschool enrichment programs at community-based learning centers. The project strategically couples the 2009-piloted Ocean World, an IGERT-supported integrated ocean science experience that built upon a NSF Broadening Participation in Computing (BPC) project using virtual worlds in education, with a nationally recognized oceanographic and informal science institution, Scripps Institution of Oceanography's Birch Aquarium.
>
> The seminal Ocean World activity was grounded in current research about how children learn and how learning takes place in informal settings ... Science LIAiSoN will expand this seed project by involving cognitive and technology science students, informal science educators, and ocean scientists to serve–tangibly and virtually – as mentors, teachers, and coaches to LIAs and children in the community.

It is useful here to recall Granovetter's thesis: "the analysis of processes in interpersonal networks provides the most fruitful micro-macro bridge. In one way or another, it is through these networks that small-scale interaction becomes translated into large-scale patterns, and that these, in turn, feed back into small groups" (p. 1360). I suspect he would not take the existence of the grant as evidence for

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[7] It is unimportant in this respect that the joint authors –Birch Aquarium, LCHC, and SDSC– were notified by NSF in June 2010 that the grant would not be awarded.

qualifying OWA as a "macro" entity. On the other hand, OWA does play an undeniable "bridging" role, one whose large-scale effect is the coordination of a number of people (and ideas) in the process of imagining a concrete extension of the project. This effect is registered everywhere and whenever OWA is locally interpreted as fulfilling some particular imagined need.

The effect of OWA here is to facilitate a concrete expansion of possibilities. "Locally Invested Adults" is a direct enlargement of the role that I can be seen playing in the OWA footage. Yet, notice how much bigger this refigured role has become –it is allied with "a network of educational resources and experts" who will support these locally invested adults. Notice also how much larger OWA's presence becomes in the proposed partnership, and how densely it is connected to other NSF concerns and outcomes, as well as to the Aquarium itself: "The project strategically couples the 2009-piloted Ocean World, an IGERT-supported integrated ocean science experience that built upon a NSF Broadening Participation in Computing (BPC) project using virtual worlds in education, with a nationally recognized oceanographic and informal science institution, Scripps Institution of Oceanography's Birch Aquarium." It may not be a macro object in sociological terms, but the set of associations which OWA helps to bind together *is* large, and it is this effect that is crucial to keep in mind in the discussion which follows.

*In Summary*

In this section I have presented OWA's chronology as a series of moments whose overarching logic cannot be understood without reference to the role of various entities (institutions, people, perspectives, interests, material things) in creating the conditions for OWA's existence and in structuring (or conditioning) the project's inception. In describing how OWA came to be I have provided an abridged history of the TCLC collaboratory, as well as introduced a set of guiding "perspectives" for which I personally became responsible when designing the project. All of this was necessary in order to express the *sense* of OWA as a particular outcome, rather than as an activity with a particular set of features. The next section relies on this chronology to motivate an interpretation of OWA in terms of Cultural Historical Activity Theory and Actor Network Theory.

**Discussion**

The following discussion is divided into two parts. Exploiting the plurality of elements in OWA's chronology, the first section provides an analysis in terms of Actor Network Theory and Cultural Historical Activity Theory. I have chosen these two theories because I consider them to be complementary ways of talking about different, but interconnected, aspects of OWA's coming-to-be story. I will give selective attention to those aspects of the story where each of these theories shines brightest. In doing so I hope to both illuminate important issues amenable to this kind of analysis in OWA's story, as well as to give a sense of where only a tenuous light is cast. The goal of the second discussion section is to bring these murky areas into view. It is there that *interest* can be used to articulate an extension of ANT and CHAT into a common domain of analysis that is not reducible to either of the two separately.

**Part 1: OWA in ANT and CHAT Terms**

Because description is also already explanation, the chronology above is not merely a neutral rendering of some object. The acronym OWA appears throughout the description in at least two modes: first, as a historical outcome; second, as a representable and interpretable thing. In the former, the names of institutions and the manner of their coming together, as well as the particular interests

they aport to the OWA story, all combine to facilitate an understanding of the teleo-logic of the ocean world activity as a sensical end in itself. In the latter, many of the same names reappear, but this time their coming together is of a different kind. They come together as members of a particular kind of audience that interprets OWA *into* a local set of activities which becomes in that same interpretation an expanded set of possibilities.

The moment in April 2009 when the project finally takes concrete shape as an informal learning activity is thus an important demarcation point between two very different social, material, temporal, and spatial configurations across which OWA plays different, and yet still mutually referential, roles. The events leading to the concretization of OWA belong to its *potentiating* phase, in which a temporally and spatially extensive binding of a large number of heterogenous elements can be seen in retrospect as the necessary precursors to the inception of the project. What characterizes this phase is a kind of funneling of these elements in the general direction of OWA. After OWA appears, as it were, on the TCLC collaboratory scene, it can thenceforth be scrutinized and co-opted into future plans. These events belong to OWA's *proleptic* phase, in which the learning activity is projected forward into the future and assigned specific roles. What characterizes this phase is a focused collective imagining which, in its incorporation of OWA, reveals important ways in which the latter mediates this process.

*OWA and Actor Network Theory*

Drawing on a wide range of theoretical perspectives including semiotics, French post-structuralist thought, symbolic interactionism, ethnomethodology, and retooling/reworking sociological network analysis (ala Grenovetter), Actor Network Theory[8] has had a decisive impact in the field of Science and Technology Studies. Since the 1990s, ANT has moved beyond STS into feminist studies, health studies, geography, anthropology, and sociology to name a few. The theory's wide adoption reflects the flexibility of its core theoretical categories, of which *network*, *interessment*, and *translation* I consider to be the most important and the most relevant to OWA's analysis. It is beyond the scope of this essay to attempt a thorough presentation of this theory. Instead, I introduce these three categories, and relate them to OWA, by arguing for a kind of "space" within which OWA can be undestood as a complex socio-material object as well as a historical outcome.

In suggesting this frame, of a complex thing and an outcome, I envision two simultaneous relationships between the elements in OWA's potentiating phase. First, they create between them a set of anchors for interpretation (e.g. relative to this or that anchor point, OWA is this or that), and it is here that OWA figures as a sensical and meaningful outcome. Second, the internal make-up of OWA itself reflects the elements in its chronology, so that, as a complex thing, it internalizes these elements in specific ways. These relationships match up with David Harvey's notion of "relative" and "relational space": "The view of relative space proposes that it be understood as a relationship between objects which exists only because objects exist and relate to each other. There is another sense in which space can be viewed as relative and I choose to call this relational space –space regarded in the manner of Leibniz, as being contained in objets in the sense that an object can be said to exist only insofar as it contains and represents within itself relationships to other objects" (Harvey, 1973, p. 13). Thinking metaphorically, I find it productive to work through how ANT maps, and in the process refigures, analogous aspects and properties between physical space (or "absolute" space for Harvey) on the one hand, and relative and relational space on the other. For the purposes of my argument, it is enough to collapse relative into relational, and discuss only the mapping from physical to relational

[8] ANT originates with Bruno Latour, Michelle Callon, John Law, and others at the Ecole de Mines' Centre de Sociologie de l'Innovation (CSI), in Paris, France.

space.

Just as translation in physical space becomes a vector under the operation of a force, so too the movement of things and people (or "actants" and "actors") become oriented in the direction of a desired outcome through the mechanism of interessment –or the forcible alignment of interests. While forcible movement in physical space is always a matter of brute force, such is not the case in relational space. While in the latter, "forcible" can, and often does, take the form of brute force (e.g. wars, incarceration, sexual abuse, racial violence), it can also take other, much more nuanced forms. For example the moving power of reading a good book or watching an inspiring movie, or acceding to a powerful argument, or, in another vein, the taken for granted rationality of sexual norms, hygiene, and, for example, the need to be "something" in life. In relational space, these are all forcible, though not by this token always brutish, forms of alignment. ANT makes the important claim that the particular ways in which actors and actants align in relational space create at the same time complexes of sense and meaning –these, together with the material and social products issuing from them, are all linked elements in networks of heterogeneous social and material elements.

The physical metaphor can be used further. If through some magic all of the world were to disappear except for the particles in a particular river, and if these particles were instantaneously frozen in time, what would be left would be a three-dimensional "mold" of the river's channel. Depending on the river, this mold might be thick, thin, broad, or narrow. Inside the frozen mass will be found other things, in different concentrations and differing local densities. Around a boulder, the outlines of an eddy might be detected, and it is fascinating to know that if the river were not frozen this eddy would nevertheless maintain its shape, even when "it" is nothing more than pure flow, for in the absence of movement there can be no eddies. Magically adding the world back in, the channel through which a river flows can thus be conceived of as a kind of extended envelope wherein such interesting things as eddies and spawning salmon can exist. Within this envelope, despite (or, better, because of) the constant movement, certain things can be expected to occur and recur. In the vocabulary of ANT, the river is an "envelope of mobility and durability" (Law, 1987) for the things that go on within its dynamic structure.

In relational space, this envelope can ensure the mobility and durability of complex socio-material artifacts. From a stark, and reductive, hydrological point of view, a river merely follows a course of least resistance. Flows in relational space don't necessarily, or mostly, follow paths of least resistance, even when "least" and "resistance" are easy to see, and they are usually very difficult to see. In gathering up the elements necessary to create sense and meaning, in materially and conceptually fleshing out relational space, human beings follow complicated paths in complicated ways. To actually live out meaningful experiences, humans create the conditions within which these experiences can be had. Theaters, space shuttles, canoes, informal learning environments. Such creations are sometimes all by themselves envelopes of mobility and durability, like the scientific laboratory for the production of facts (Latour and Woolgar, 1979), or a playground for the production of fun. Others, like canoes (or portuguese galleons, or a navy war vessel), are complex artifacts inside much larger envelopes within which mobility and durability are maintained by ordering the world in particular ways (Hutchins, 1987, Law 1986, Star and Griesemer, 1993) –no ships without at least ports, fuel, food, and navigation charts.

It is purposeful creation in the service of producing, or attempting to guarantee, particular outcomes, that is important here –a teleologic movement vastly different from the blind course of a river. Things, people, knowledge, practices, move to an fro in relational space, across physical *and* conceptual dimensions. People and things are not attracted to some goal the way water is attracted down-hill. Goals require advocates prepared, and equipped, to do the hard work of convincing others of their goodness or necessity, advocates strong enough to *translate* (physically and conceptually) the interests of others in the direction of the goals (Callon, 1986). These teleologic movements are just

another way of describing *interessment*, the process whereby the resistance of some actor is overcome (willingly or not, consciously or not), so that he/she acknowledges the need to move through some third thing in the course of fulfilling a given desire[9]. All of this requires what Law has dubbed "heterogenous engineering", in which "bits and pieces from the social, the technical, the conceptual, and the textual are fitted together, and so converted (or 'translated') into a set of equally heterogeneous scientific products" (Law, 1992, p. 381). Here is how Law formulates ANT as a sociological theory broader in scope than science and its products:

> Thus what is true for science is also said to be true for other institutions. Accordingly, the family, the organization, computing systems, the economy and technologies –all of social life– may be similarly pictured. All of these are ordered networks of heterogeneous materials whose resistance has been overcome. This, then, is the crucial analytical move made by actor-network writers: the suggestion that the social is *nothing other than patterned networks of heterogeneous materials*. (ibid)

If we agree with Harvey that sense and meaning is created and experienced in relational space (in social life), and we agree with ANT that social life is a "patterned network of heterogeneous materials" which require translation (always in the double sense of physical displacement and conceptual re-interpretation) of interests to produce desired outcomes, then sense and meaning themselves depend on these heterogeneous networks. I argue in the second part of this discussion that, beyond dependence, there is equality between

**sense and meaning ↔ patterned networks of heterogeneous elements**

For now, I think it is uncontroversial to claim that particular networks, depending on their constitution, allow for (or potentiate) particular kinds of sensical and meaningful things. And this, finally, allows me to cast all of the different movements of things, institutions, and people through time and space in OWA's chronology before it materialized in the form of an informal learning activity, as the piecemeal and difficult creation of OWA's patterned network of heterogeneous elements. This implies that the appearance and, crucially, the sustainability, of OWA as a sensical and meaningful learning activity at TCLC cannot be understood separate from its envelope of mobility and durability.

Referring to the chronology, how was this envelope constructed in the case of OWA and what did it achieve? Starting from the learning activity's physical space (the tech room) and moving outward into its larger relational space, the patterned network can be seen at work. First, there is the physical reconfiguration and adaptation of TCLC, and the tech room in particular, so that adequate internet connectivity could be guaranteed and the introduction of an array of artifacts facilitated: wireless computer station, projector for display of virtual world, posters, drawing markers, puppets, a book, cameras to gather video data. In order to be able to park outside the center without risk of having our cars towed away, SDCHC granted all UCSD students parking permits. My very presence at the center, never mind working with the group of young girls in the learning activity, itself only made sense within the scope of the collaboratory as a whole. Furthermore, I am convinced my friendship with the Lady Bugs, the use of puppets, the free-play style of the activity, the multiple references to the Aquarium visit, and the ability to select, search on google, and draw images of interest allowed for the successful incorporation of WITS[10]. The latter was provided by the most geographically distant node on the network, Cornell University's SciCentr, and yet, in the form of the virtual world, it is literally constitutive of, beyond being co-present with, OWA.

From small to large efforts, cheap to relatively costly, simple to relatively complex, the

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[9] Callon has called this the "sociology of translation".

[10] I address these issues internal to OWA as a learning activity proper in another essay.

reconfiguration of physical, and the enrichment of relational, space requires the active involvement, to different degrees and at different times, of all the parties involved in the TCLC collaboratory. At any moment, these things are simultaneously history, in that they are remembered as having occurred for some particular reason, but also, importantly, also the literal stuff of expected outcomes. Nothing gets reconfigured at TCLC without answering the question "Why, or for what, is _____ necessary?". Behind every change at TCLC that is related to OWA (and other projects), there is at least one answer to a question of this form, which is at the same time the creation of a tick-mark in at least one, but usually more, timelines. Anchored on these tick-marks are a set of promises about things in the near, medium, and far future. As Bahktin says, time is in this manner "fleshed out...". Networks gobble up physical and temporal scales, imposing their own rhythms and specific sense of distance.

From a complete absence of possibility before the TCLC collaboratory was formed, to the appearance of a fully formed learning activity, this process is one of consolidation and stabilization across time and space. At the end of this phase, OWA can be talked about as a concrete object, presented and scrutinized, and taken to unexpected places –it can be translated. OWA's envelope of mobility and durability was created through the alignment of different kinds of institutions and people interested in various ways in binding university and community. These alignments did not follow any paths of least resistance, quite the contrary. The effort and difficulty in creating OWA's envelope makes it highly attuned to the fruits of all this labor. Within the envelope, smiling children talk about the "pointy sharps" of a larger-than-life sea anemone projected on a wall. Within the envelope, video of these smiling children is interpretable as fulfillment, which allows actors with aligned interests to smile as well.

The achievement of OWA's envelope, or what is the same, its patterned network of heterogeneous elements, is precisely the very possibility of sensical and meaningful interpretation of OWA as one way to fulfill the interests of the TCLC collaboratory. In OWA's potentiating phase, aligned interests are registered most strongly as a set of expectations: as an outreach mechanism; as a university ↔ community collaboration; as a way of serving undeserverd youth; as a learning activity; as a WITS activity; as a way of creating awareness around marine biodiversity conservation. Hovering around OWA, these make sense, together, only within the chronology presented above. As an historical outcome, OWA internalizes these expectations, and literally binds together a set of material and social elements which satisfies them in the form of an informal learning activity. In physical space these elements have little or no sense at all, no mutual implicature. In relational space (social life), a patterned network of heterogeneous elements potentiates sensical outcomes, for the network is patterned precisely because it results from aligned interests attuned to these sensical outcomes.

*OWA and CHAT*

There are different variants of Activity Theory, but all trace their roots first to L. S. Vygotsky and, after his death in 1934, to extensions and refinements by A. R. Luria and A. N. Leont'ev (Minick, 1997). Cultural Historical Activity Theory (CHAT) was developed after the introduction of Vygotsky's work into the West in the early sixties. Historically, it responded both to the massive social crises of the sixties and seventies, whose shocks were felt in every discipline in the social sciences and the humanities, as well as to the then burgeoning cross section of disciplines that would later fall under the umbrella term of "cognitive science". It is beyond the scope of this essay to delve into this history, but it is important to say that as a result of it, CHAT can be seen as a sustained attempt to take history and culture seriously in the formation of consciousness and thought, while eschewing mentalistic universals and reductive, computational, models of thought coming out of the growing cognitive sciences. It is on the work of Vygotsky, Luria, and Leont'ev that CHAT develops the framework to carry out this task

(Cole, Engestrom, 2006).

I will not attempt a thorough presentation of CHAT principles here[11], but will instead follow a similar strategy as in the section devoted to ANT, and will pay selective attention to just three theoretical categories which I find most useful in analyzing OWA's proleptic phase –*prolepsis*, *artifact-mediation*, and *intersubjectivity*. Because it is a common theme between ANT and CHAT, I work out what these categories mean and imply through a discussion of goals and interests. The aim is to arrive at these categories by exploring how goals and interests are expressed within the foundational Vygotskian tenet of the indissoluble link between consciousness and activity. I will then be able to refer back to the proleptic phase in OWA's chronology through these categories in a manner that will make clear why this phase is an especially good case to consider within the CHAT framework.

The willful subject in ANT is an interested (as a noun, interested *in*; as a verb, interested *by*) subject, and therefore (from the Latin *inter-* 'between' + *esse* 'be') always a subject "in between"[12]. If interested-in, she imagines a future point of satisfaction different form the present moment. If interested-by, she experiences the force of a governing goal towards which she is headed, or within whose logic she is forced to operate. Either way, goals in ANT follow from a kind of arithmetic (subtractions, additions) of interests, and are registered as the achievement and stabilization of patterned networks of things and people, which are the target of analysis in ANT. By contrast, the willful subject in CHAT is a developing and thoughtful actor, and while also an interested actor, it is the relationship of goals to the development of consciousness and thought that is important. Thus, the specific manner in which goals are achieved in activity with things and with other people is of particular interest. ANT cares about what settles out of adding and subtracting interests, while CHAT focuses on interests and goals shape consciousness and thought.

The Cultural and Historical terms in CHAT are a recognition of the fact that goals are contingent on contexts which are able, in a sense, to "host" them. For example, a banquet cannot be had if there isn't an appropriately sized room containing the necessary accoutrements. The goal of having a banquet tomorrow is only realizable if there is such a room which can host the banquet. Other things besides might be necessary, depending on what kind of banquet is intended, or where in the world it is taking place, or in what historical period. The point is that goals, as specifiable things, makes sense only within concrete and specifiable historical and cultural contexts. The connection of goals with activity, and through this, the linking of the social and the psychological, emerges with the further step of conceiving of the development of thought and consciousness as a movement of socio-cultural structure from concrete material forms outside the body into internal (or internalized) conceptual structures within. The mechanism through which this development takes place in the course of human life is joint activity involving coordination between people and between people and things in the process of achieving some goal.

What is the role of goals here? They account, first of all, for the desire to exit the in-betweenness that is *prolepsis*. In CHAT, "the name of the cultural mechanism that brings 'the end into the beginning' is prolepsis, meaning, according to Webster's dictionary, 'the presentation of a future act of development as being presently existing'" (Cole, 1996, p.183). As a projection of some possible, but as yet unrealized, future, prolepsis obviously implies a goal. As a category, it names a state of being

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[11] Please see Cole, Engestrom, and Vasquez (1997) for an excellent compendium of historical, analytic, and theoretical essays pertinent to this discussion.

[12] It is interesting to think of these two forms of interest as a *disposition*: both to be disposed in some way, as well as to be positioned in some way, to *have* a position. The first is an always-on filter for identifying those things which can fulfill expected outcomes –it is an outward explosion of desire, a general parceling out of the world into a spectrum of potential fulfillments. The second assigns the subject a place in relational space, an inward collapse of lived experience into a location *somewhere*.

identical to an actor with an interest-in some thing or another. But there is another role for goal, and it is related to the difference Leont'ev draws between activity and action (Axel, 1997). Activity is made up of actions that are, at the same time, proper sequences of movement through space and time. This is in contrast with actions which have no proper sequencing, or, what is the same, which do not belong to a sensical and meaningful context within which they can be judged as appropriate or inappropriate. Actions are to activity what words are to sentences. The former can exist without the latter, but only the latter elevate the former into the realm of semantics. Harkening back to Harvey's distinction between physical and relational space, actions without activity belong in the physical world, while only activity can elevate action into meaningful relations with things, people, and other actions. Goals allow activity to contain actions as sensical and meaningful constituent parts.

The beauty of this connection between activity and goals is that it also accounts for actors interested-by. An actor who is interested in doing and/or achieving some thing enters into activity, and once there, he/she is held "in between" by the teleology of that activity. The difference with interest-in is important, because to enter into activity is to experience the flow (or lack thereof) of the activity as a meaningful sequencing of action toward some end, whereas merely being interested in doing something without actually participating in activity is an entirely different state of being. Thus, being interested-by implies participation in activity. But, as a matter of development, participation in activity implies at least two people, one a naïve newcomer, the other an experienced old timer. And, as a further matter of development, the newcomer experiences the difference his/her newness makes to the competent performance of the activity. How? CHAT says this takes place through the creation of *intersubjectivity* between the participants –a binding between participants through mutual loops extending from one to the other in both directions. The newcomer recognizes (and accepts) the old timer's capacity to judge how well (or not) the newcomer is performing some action and intervenes accordingly. Newcomer – Old Timer – Newcomer (loop 1). The other way around, the old timer is aware that the newcomer expects the old timer to play this role. Old Timer – Newcomer – Old Timer (loop 2).

So, *prolepsis* implies goals, and goals (within specifiable historico-cultural contexts) allow actions to be meaningful constituent elements of activity. Activity, as development, implies a minimal social situation of at least two people between which *intersubjectivity* is established. Where does *artifact-mediation* come into this picture? It expresses the simultaneous ideal and material character of activity. Old timers go about intervening in the performance of a newcomer's actions not just, or even mainly (if we pay attention), by saying things, but rather, by doing things. And both newcomers and old timers do things with and through yet more things. Sentences are done with words, flying with wings, drawings with paper and pencil, conversations with sentences, and all of these with hands and bodies. When an old timer corrects and guides a newcomer, she does this while manipulating the very things that the newcomer is tasked with learning also to manipulate, and does this in coordination with the newcomer. The other way around also takes place via things, for in not manipulating things correctly the newcomer makes available (or legible) to the old timer the points where intervention is needed. Activity without these things (these artifacts) does not exist, and neither does intersubjectivity.

We thus arrive at the unique manner in which CHAT builds its framework for studying consciousness and thought while bypassing the universal mental structures posited by mainstream cognitive science. Consciousness and thought develop through lifelong participation in goal-directed activity that is culturally and historically situated within particular social assemblages. Goals, as prolepsis, allow actors to be interested-in and interested-by activity, within which intersubjective coordination of participants through artifacts creates "playces" in relational space wherein consciousness and thought emerge as dynamic processes. And this, finally, allows me to cast OWA's proleptic phase as the creation of a proleptic space dependent on OWA as a mediating artifact (as both

a complex socio-material object and a historical outcome).

The NSF grant in the chronology is a literal and material residue of the projection of OWA into a future collaboration between LCHC, SDSC, the Birch Aquarium and a host of community organizations mentioned in the grant. It is significant that this work of collective imagination is done far away from where OWA first materialized. In a sense, this work is characterized by a movement which starts at the coordinates in relational space where OWA first appeared, and thereafter moves away from them towards a different set of coordinates. Where is this movement headed, and how can all of this activity of future projections of possibilities take place in a few conference rooms at UCSD while at the same time starting at a set of coordinates outside of UCSD? The key here is to consider what kind of mediation takes place through an object like OWA, and how this depends on the very translation mechanism (of both physical displacement and conceptual interpretation) identified in the ANT discussion.

In CHAT terms, the meetings in the various conference rooms which led up to the crafting of the NSF grant are situations of intersubjective alignment between participants mediated by OWA. For this to happen, OWA must first arrive at these conference rooms in the form of video footage. After this physical translation, however, OWA must still remain anchored in the "community" as the crucial second pole in the university ↔ community dyad. The way this takes place, even though (or actually, especially because) most of the conference room attendees did not physically visit TCLC or the tech room, is through interpretation (the second form of translation) of the video footage as a kind of window into community life. It is here that OWA allows for a kind of collective imagining necessary to push the project away from its mooring at TCLC and into that set of figured future relations, commitments, and roles which are expressed in the grant –this is OWA's proleptic space. How does it mediate this collective imagining?

The creation of this proleptic space depends on the conceptual meeting of different worlds through the particular elements of which OWA is composed, which, it is worth remembering, are already internalized counterparts of OWA's network of heterogeneous elements. This movement is important. First a funneling of interests into OWA, followed by an expansion of interests through, but away, from OWA. The grant promises that OWA will be implemented in other community centers. That community adults (called LIAs) will play the role that I can be seen playing in the video footage. These LIAs will be trained at the Birch Aquarium, and will be provided with resources from LCHC, the aquarium, and SDSC. Imagined into this proleptic space, OWA is extended, modified, and translated to coordinates different from its original TCLC coordinates. Yet, for all of that, it is crucial for TCLC to remain (intact) in this picture, for it is the only living socio-material referent for what would otherwise be only an abstract category, community.

All of the elements which the potentiating phase links together and within which OWA makes sense as an outcome travel with OWA into these new settings. In addition, because OWA internalizes these elements into a complex whole wherein science outreach, technology mediated learning, underserved kids, university, and community can all be seen working together, it can bind together the different worlds of the Aquarium, LCHC, SDSC, and community. To the extent that this expresses intersubjective alignment, its direction is not, as in the potentiating phase, towards OWA as a concrete thing, but rather towards a space wherein OWA figures prominently but which contains many more things besides. In the conference rooms where this proleptic space is created, coordination and alignment moves through OWA's multiplicity of elements in a kind of mediation that cannot be described as the achievement of a simple goal. In fact, the latter is entirely imaginary, but not without objective effects for all that. From a physical space point of view, this goal does not exist. In relational space, however, it is big, bigger than OWA itself. From a CHAT perspective, what is achieved in mediation through OWA is a kind of expansive intersubjectivity that cannot be framed as a simple dyad

between newcomer and old timer. The complexity of the mediating artifact creates a situation where none of the participants can claim expertise in its use, which has the interesting effect of allowing the goal of the joint activity to exist entirely outside of physical space –that is, the creation of future possibilities, of a proleptic space.