Working Out Work: Learning, Identity, and History from the Perspective of Cultural-historical Activity Theory

by

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ABSTRACT

This dissertation builds upon and extends theorizing in cultural-historical activity theory (CHAT), which is a recent addition to the sociocultural analysis of learning, identity, and history. Drawing largely on longitudinal fieldwork conducted in a salmon hatchery in British Columbia, specifically, and the Department of Fisheries and Oceans, more generally, the present studies affirm the possibility of learning in mundane work environments as well as discovering what it means to learn and be an expert in the workplace. In addition, the results show how institutions that aspire to be learning organizations have to provide access to participation to all its members. The findings reported here also sensitize workplace researchers to issues of identity inherent during the process of interviewing besides articulating a new, non-dualistic conception of organizational identity and organizational identification. The necessity of examining the cultural-historical dimensions of work activity situates the activity of salmon enhancement in context in a final study. All these different but related investigations of work indicate that unless a strongly dialectical stance is maintained throughout activity-theoretic analysis, cultural-historical theories will not advance. This important methodological and theoretical principle has manifested itself in the following dialectical tensions underlying this dissertation: subject|object, individual|collective, and agency|structure.

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Acknowledgments

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Chapter 1

Introduction : Theoretical and Personal Commitments

At the risk of appropriating a bad joke and suffering the consequences that follow, this dissertation can be viewed as a long elaboration of why I love work and could spend the whole day just looking at it. In exploring diverse aspects of work, work practices, and workplaces broadly defined, I draw heavily upon sociocultural lenses and other analytical tools to better understand three canonical themes that preoccupy sociocultural theorists: *learning*, *identity*, and *history*. Because this program is a comparatively youthful one compared to behaviorist paradigms for instance, much in terms of theory remains to be fleshed out, which is one of the primary contributions arising from this research.

The field site that all the substantive chapters in this dissertation save one occur within Shallow River Hatchery (a pseudonym), which is a workplace devoted to artificially producing salmon fish to supplement wild populations in British Columbia. In the pages that follow, I therefore put under the microscope the trajectories of expertise that workers take as they become competent in their workplaces. Among other things, I consider the inevitability of learning in seemingly routine or mundane work environments, tease out the implications of assembling a *learning organization*—a new buzzword circulating in business circles—and argue for the value of comprehending workplace learning and expertise directly from the discourse of workers themselves.

I further make the claim that regardless whether they are modestly educated fish culturists employed in a hatchery or top scientists performing cutting-edge research in a laboratory, workers' identities are always co-constituted during the process of their

learning. Even when asked to talk about their learning or work, issues of identity and self-management in both interviewer and interviewee are constantly at play during the process of research interviewing. The phenomenon of identity can certainly be approached from many other ways that might be at variance with a sociocultural perspective. However, I show here how a recent addition to the sociocultural family—cultural-historical activity theory (CHAT) or activity theory—can help clear much of the unnecessary confusion surrounding this phenomenon as well as provide more convincing explanations of learning in the workplace. An attempt is also made to trace the path of one particular activity—making salmon—over 120-year period using cultural-historical analysis to gain insight about change and stability of this particular work practice. Having this telescopic survey over long timescales enables one to better contextualize the fine-grained albeit atemporal nature of studies in work, work practices, and workplaces that characterizes much of the present literature.

By exploring the themes of learning, identity, and history in the area of work, the findings presented here suggest that we need to rethink the importance of the collective entity (e.g. society, community, group) of which an individual is part if we want to understand his or her learning and identity over time. These notions go against much of Western philosophy and psychological practice that have traditionally relegated and analyzed these phenomena at the level of the individual. To support these claims, I make salient the potential contribution to the learning of the collective or organization by all workers no matter how low or high they stand within the organizational hierarchy for everyone matters. And, because learning is intimately tied to issues of identity, I show how identification with the collective arose whenever learning and the expansion of

action possibilities[1] occurred at both individual and collective levels. Conversely, it was found that deidentification with the organization was associated with non-learning and stasis experienced at these levels.

Many of the arguments in this dissertation present novel, alternative viewpoints and sometimes challenges established wisdom. Although colleagues, journal editors, and reviewers may debate the merits of my findings, I offer this dissertation as my unique contribution to apply and advance sociocultural theory, especially CHAT. At the very least, I endeavor to deepen our understanding of work, which occupies, and perhaps governs, such a large proportion of our adult lives. Based on this reason alone, this work takes on a larger significance to audiences beyond educators and trainers. This then, is the scope of investigation that the chapters here will encompass.

In this introductory chapter, I first describe and account for choosing the primary theoretical framework used here—cultural-historical activity theory (CHAT)—as it pertains to the themes of identity, learning, and history. The purpose is to familiarize the reader with some of the basic assumptions and concepts rather than providing an exhaustive review of this still evolving paradigm. Other aspects of CHAT will be elaborated in later chapters where relevant and the final chapter indicates how research informed by CHAT can be advanced. One analytic tool that I have used in this dissertation is discursive psychology (DP), with which I acquaint readers in the following section. I later recount autobiographical aspects that bear on the writing of this dissertation, which will allow readers to locate the author and my research agenda more

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[1] It is a term derived from German *Critical Psychology* that refers to the human ability to assess and to act in fulfillment of one's needs (Tolman, 1991). Increasing one's action possibilities is equivalent to learning and development.

precisely. Finally, I provide some guidelines on how to read the six different but related substantive chapters that form the heart of this project to work out work and in the process better understand CHAT.

Theoretical framework – Cultural-historical activity theory

The sociocultural perspective is a loose alliance of different schools and movements that together elevate human social interaction as both the medium and outcome of institutional life and culture (Cole, 1996; Rogoff, 2003). Said to be a well-kept secret hidden from Western research communities, cultural-historical activity theory or activity theory is the latest addition to this fold (Engeström & Miettinen, 1999). By allowing scholars to analyze social action and cognition holistically, CHAT assists in uncovering how people go about their work in effortless ways and in collaboration with others. This makes CHAT ideal for what this dissertation attempts to achieve—broadening our understanding of learning, identity, and history in the area of work while simultaneously improving theorizing in CHAT.

General introduction

The origins of CHAT can be traced to the pioneering work of early twentieth century Soviet psychologists who strove to formulate a new basis for their discipline that was consistent with dialectical materialism. While there were intense pressures for conformity within the prevailing political and professional climate there, Soviet researchers saw themselves free of being encumbered unnecessarily with many competing paradigms (present in the West), which they felt had prevented focused problem solving in any single area (Wertsch, 1981). It was only in the last two decades

that CHAT has earned serious attention in the Western world and Latin America (Engeström, Miettinen, & Punamäki, 1999). In part, this had come about after the discovery and revival of Lev Vygotsky's work in psychology, which acted as catalyst for the search for holistic explanations of human cognition and action. This lateness in arrival perhaps has been compensated by the diversity in which activity theorists have been engaged in workplace research that include studies on: product innovation (Engeström & Escalante, 1996; Hyysalo, 2002), software design (Fuentes, Gómez-Sanz, & Pavón, 2004; Nardi, 1996; Turner & Turner, 2001), private and public sector organizations (Blackler, Crump, & McDonald, 2000; Foot, 2002; Virkkunen & Kuutti, 2000), and work environments (Helle, 2000; Saari & Miettinen, 2001).

One of the guiding principles in activity theoretic research is the notion of activity as the essential determinant of cultural change and psychological evolution. According to Marx, whom activity theorists count as a foundational philosopher, labor is part of the authentic existence or *species being* (*Gattungswesen*) that humanity cannot but perform (Marx & Engels, 1846/1970). Accordingly, activity is taken to be the molar or minimal unit of analytic interest and can encompass large frames of reference such as *schooling*, *doing commerce*, *making war,* and smaller frames such as *gardening*, *driving*, *feeding fish* in a hatchery and other mundane aspects of life on the opposite end of the spectrum. What unites these diverse levels and settings is the focus on the concrete, situated, and processual nature of the activity rather than forms of armchair theorizing or clinical experiments to gain insight into human psychology.

Through activity, always mediated by culturally produced tools (both material and psychic), human consciousness (e.g. cognition, emotions, memory, perception, identity),

and society arise. These claims about the tight linkage of human consciousness with activity have not been exclusively promoted by those sympathetic to a dialectical materialist worldview but have been articulated in different ways by philosophers as contrasting as Hegel, Bourdieu, Dewey, and Wittgenstein (Ratner, 1996; Rubinstein, 1981). In a nutshell, activity theorists take tool making as integral to and constitutive of the historical evolution of human culture while tool use in activity is the central defining aspect of human consciousness. Unlike other animals, human beings no longer stand in an unmediated relationship to the world but always mediated by social interaction and tools (Holzkamp, 1991). In this process of transformation and interaction with the physical world, the environment mutually changes the tool user, too—humankind is as much a product of circumstance as a (potential) change agent of these circumstances. Therefore, activity theorists do not dichotomize the material and the social world, for culture and human action are deeply embedded in and enmeshed with materiality.[2] For example, fish culturists could not perform an action like feeding fish without a physical body nor can verbal communication be orchestrated without the production of physical sounds.

Does this then imply a circular form of reasoning that does not account for cultural change and evolution? Or do we need to ascertain which came first, the knowledgeable individual acting in culture or the social world that educated that individual? One concern in CHAT is how actions are both produced and reproduced in social life, never quite the same and never quite sufficiently changed to see them as

[2] In this, CHAT follows similar lines as actor network theory, which also collapses the artificial distinction between human and non-human agency (Latour, 1987).

different. This creates a dialectical[3] tension, for all agents both conform to existing practices in society (the primacy of structure) and continuously produce and modify them (individual or collective agency). During these actions, people recursively produce the very conditions for these activities—social structure—to be possible in the first instance (Erickson, 2004; Giddens, 1984). Indeed, without individuals orienting to pre-existing social structures, all actions would be meaningless. At the same time, actions are not reproduced in exactly the same way; novelty and contingency are always inherent. Rather than acceding to structure or agency as the sole determinants of everyday practice, I build on the argument in this dissertation that the two are non-identical aspects of the same unit, activity (Sewell, 1992). This then simultaneously accounts for change and stability in social systems whether one discusses issues of talk about learning (Chapter 5) or organizational development (Chapter 8). Therein also lies the attractiveness of CHAT to many critical scholars that betrays its indebtedness of Marxian thought; culture and institutions arise in and from human activity as much as they are taken as given. If true, then change is possible through the same processes that constituted them in the first instance—human agency.

In trying to convey something of the counter-intuitive nature of this dialectical relationship between two entities (e.g. the individual and the social or collective, subject

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[3] A dialectic has been described as occurring whenever "a whole is a relation of heterogeneous parts that have no prior independent existence as *parts*" and "the properties of parts have no prior alienated existence but are acquired by being parts of a particular whole" (Levins & Lewontin, 1985, p. 273). Other definitions describe it simply as a unity of non-identical entities or two sides of the same coin. The popular three-step formula of *thesis*, *antithesis,* and finally *synthesis* that is associated with Hegelian dialectics is partially correct in its insistence on perpetual flux although this does not capture its full complexity. For newcomers to dialectical thinking, I recommend Ollman (2003) and the exposition of Hegel's master|slave dialectic by Butler (1999).

and object), I will sometimes adopt the Sheffer stroke that is represented by "|" (see Roth, Hwang, Lee, & Goulart, 2005). It expresses the fact that the two entities concerned exist not in an either-or relationship but concurrently stand in an X *and* not-X relation. According to traditional logic, this would be inadmissible for it constitutes a logical contradiction. However, in a dialectical perspective, this unity of non-identical entities represents their necessary interplay and reciprocal nature. This form of rapprochement[4] I believe is crucial for

> one of the most relevant questions researchers have been facing in this last century concerns the ways of conceiving, understanding, and/or explaining how culture constitutes individual subjects. This problem has required intense conceptual work on the relations between the collective and the individual, the collective within the individual. (Smolka, 2001, p. 365)

Conceptual vocabularies and heuristics

How does one proceed to analyze work, work practices, and workplaces using CHAT? What are the conceptual vocabularies and heuristics that are available? Human activity in CHAT is always understood as motivated towards some collective *object*; when objects are absent there is no activity to speak of. In the *activity system* of salmon biological research for instance, the object or motive of the activity system is to perform research, to produce some salient experimental findings so that an acceptable publication like a journal article emerges as an *outcome* (Figure 1.1 below). Cultural-historical activity theory differs from other sociocultural theories in that it specifies a range of entities that may provide structure to human actions (Engeström, 1987, 2001). For instance, within the unit of activity, one finds structure in the form of the *subject* (that

[4] It is interesting that normally oppositional and dualistic concepts in disciplines such as cognitive science, psychology, biology, and anthropology have now begun to overlap and become indistinct (Sampson, 2002).

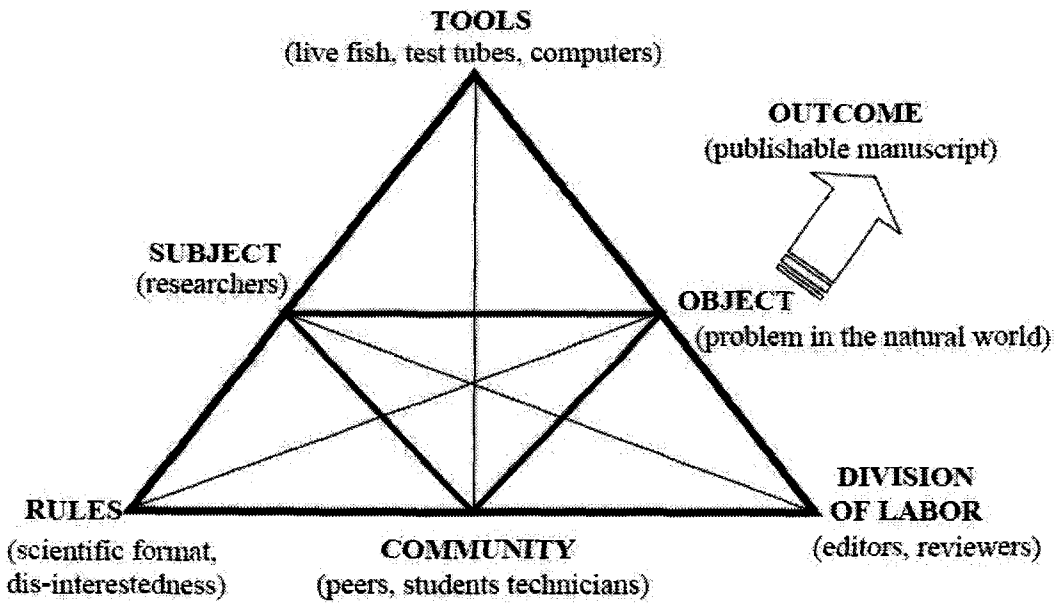

Figure 1.1. A depiction of an activity system—the minimum ontological unit of analysis—using a hypothetical example drawn from conducting scientific research in salmon biology from Lee (2004). This is a commonly used heuristic in CHAT known as the "activity triangle." (Engeström, 1987).

which possesses agency) and the object (that which is transformed). Subject and object are not two different things but have to be considered as the non-identical aspects of a unit—in activity, there is no object without the subject, and no subject without the object, the two co-constitute each another, that is, they are dialectically related. This becomes a little clearer when we realize that object embodies two concepts in German philosophy that are obscured in English translations: *Gegenstand,* the object of thought, and *Objekt,* the object of practical activity (Marx & Engels, 1846/1970). Hence, the subject is in effect interacting with two separate but interrelated elements at the object pole, which makes this relationship inherently dialectical. Returning to the salmon biological research example, the object exists on two planes; once in materiality as *Objekt* (e.g. actual fish specimens) and another as a vision of what is to be done as *Gegenstand* (e.g. the research

plan of attack). In addition, this vision of the object cannot exist independently of an individual, and is thus present at the subject pole as well. Now, we have yet another dialectic in the system for the object (as *Gegenstand*) is also appearing at the subject end.

In Figure 1.1, we can see how the other four entities belonging to an activity system further mediate the relationship between the primary axis of subject|object. *Rules*, for example, might denote the literary conventions or norms demanded for a paper for the scientific *community* while the *division of labor* indicates the different roles that people can assume (e.g. as editors or reviewers) in the activity system of scientific research. *Tools* can either be material (e.g. computers, test tubes, documents) or psychic (e.g. formulas, concepts, sign systems, cultural models). As each of these mediating elements in the system evolves during activity, so do the relations between them, and as a corollary, changes the entire activity system as well.

In activity theory, *actions* serve the collective motive of the activity system, whilst being constituted by unconscious *operations* (Leont'ev, 1981). Goal-directed actions therefore exist in a double relationship: on the one hand, they constitute concrete and meaningful realizations towards the collective motive of the activity and on the other hand, they are themselves constituted by embodied operations. An example from my experience in driving in North America will demonstrate the differences between activity, actions, and operations. Although I have had twenty years of experience driving in Asia, I had to relearn how to drive once again due to the differences in the laws of the road. What had been an unconscious, automatic operation to signal left or right with the flick of my right hand previously became a conscious goal not to activate the windscreen wiper now in the activity of driving.

Within individual entities, the entire activity system, or between different systems there are structural tensions that are historically accumulated. Such tensions that are theorized in the concept of *contradictions* are potential sources of learning, change, and development, which I explicate more in Chapters 7 and 8. Suffice to say here that contradictions are inner or structural tensions that are distinct from the everyday sense of paradox, conflicts, or troubles although the latter phenomena are indicative of contradictions latent in the system (Engeström, 1987). A similar dialectical concept—*deep structures*—has been expressed by Sewell (1992) and refers to the ongoing interplay of social and material tensions within a system. A physician, for example, faces a contradiction in wanting to reduce suffering on the one hand although requiring disease and ill-health in order to earn a living (Leont'ev, 1981). Rather than a peripheral feature of activity, they are central aspects for "any concrete, developing system includes contradictions as the principle of its self-movement and as the form in which the development is cast" (Il'enkov, 1977, p. 330). Contradictions per se do *not* cause change; instead, they act as both resources and products of human agency during transformations of activity systems that I describe in Chapter 8 (Sewell, 1992).

Certainly, the "activity triangle" in Figure 1.1 has been a useful heuristic and has served to guide many beginners in CHAT. However, it has oftentimes ironically served to stifle theorizing in CHAT in that it presents a static and reified view of the system (Roth, 2004). Some workplace researchers have tended to adopt a formulaic approach in identifying the various components of the activity system and then proceeding to describe the activity in those terms (e.g., Artemeva & Freedman, 2001). Two consequences follow: the dialectical nature of activity is downplayed and a static, atemporal view of the

situation is promoted. In writing this dissertation, I have tried to avoid the use of the activity triangle except as a thought heuristic and instead emphasized what I felt are the core principles of CHAT that speaks of dialectics, the relationship between individual|collective, socio-material resources, historically formed dynamic systems, and so forth. Having articulated some of the general terminologies in CHAT, I now describe its particular relevance with regard to the three key motifs in sociocultural research: learning, identity, and history.

Learning as a social process

Human consciousness is believed by activity theorists to be woven into seemingly mundane tasks like writing a letter, cooking, using a spreadsheet, or even rearing fish, which past psychological analyses had either privileged social or cognitive factors to explain behavior. Understood this way, psychology had dualistically opposed the two, or made one the causal effect of the other (Ratner, 1996). As some scholars have reported, much of the power in accounting for mastery was lost when researchers had to choose between "smart people" or "smart contexts"[5] to explain skilful actions, ability, and talent (Barab & Plucker, 2002). In contrast, activity theorists recognize that cognition arises neither from the environment itself nor from within the individual; instead, it is co-constituted during the transactions between the socially constituted settings of activity and the individual. This position highlights the importance placed on sociocultural factors over one's genetic heritage or unseen psychological phenomena. The Soviet psychologist Lev Vygotsky (1981) built upon these ideas and proposed that the origins of higher

[5] These are environments that are highly conducive for allowing excellence and giftedness to develop.

mental functioning proceeded from the inter- to the intrapsychological plane. By way of example, a child begins by learning (i.e. acquiring pre-existing cultural knowledge) with the assistance of an experienced peer or adult. In time, the child is able to perform the same tasks without guidance once the knowledge or tools of culture are internalized (see Lave & Wenger, 1991, p. 47–52). In this theory of semiotic mediation, competency is especially marked by the concept of the *sign* (e.g. language which Vygotsky regarded as the "tool of tools"), which is a psychological device that is used in regulating internal mental behavior. It is my understanding that this use of language as a mediating tool in human cultural evolution forms the nucleus of current sociocultural research throughout North America (see Wells, 1999).

Some activity theorists,[6] however, deny that there is an "interior" or "exterior" for learning to traverse and that human thought and behavior always contain both elements, dialectically. For instance, actions like classroom discussions involve the use of language, which is fundamentally a social tool (*langue*), and at the same time, a concrete realization by a student of the myriad possibilities of speech that are available in that culture (*parole*). And since actions relate both to collective activities while being realized by chains of embodied operations, this further makes it impossible to partition what is interior or exterior or for that matter individual or collective. This means that activity theorists will instead describe those learning situations such as that in the hatchery workplace as joint participation in a common activity (i.e. making fish) using historically situated tools and artifacts with the outcome being to increase salmon populations. Learning and expertise,

[6] From my interactions with some of the leading CHAT scholars based in North America, activity theory seems accepting of diverse theoretical concepts such as mixing psychotherapy with CHAT. Accordingly, it is difficult to find two scholars that share exactly similar sentiments with regard to what should be definitive in CHAT.

which are better defined as knowledgeability, are now seen as stretched over people, artifacts, events, and generations (Hutchins, 1995; Lave, 1988).

This cultural-historical perspective of knowing and learning as socially mediated offers insights into workplace learning and expertise. Various theoretical disciplines such as ecological psychology, ethnomethodology, symbolic interactionism, and critical ethnographies of work have already converged on the view that learning and knowing cannot be found by looking into peoples' minds. Rather, knowing and learning are instead coextensive with changing participation in continuously changing social relations that make mundane, everyday living. Mastery and skills are viewed in terms of degrees of being an insider, of the continued production and reproduction of oneself as a member of a particular community and of constituting the relevant practices that are valued there (Sfard, 1998). Learning becomes a process of engaging with others using culturally available artifacts (e.g. language, schemas, technologies) in practical activity that simultaneously contributes to reify social practices and provides room for innovation and change. In fact, these cultural-historical tools and artifacts suggest a means of bridging the individual–collective antimony in learning for socialization (learning) is but a process of using pre-existing know-how. Each newcomer or newborn does not have to reinvent or relive the long process of evolution in culture and institutions from scratch; instead, the past and present of their nurturing society are literally thrust onto them moment by moment during their lives.

Because expertise develops with participation in activity, inherently mediated by social and material relations that make the world, knowing and learning always exceed the individual. As mentioned, this knowing or knowledgeability is always both individual

and collective. Any possibility that exists and develops for an individual is a concrete realization of a possibility existing in a generalized way at the collective level. Possibilities for action always exist in a dialectical form: concretely existing to the practitioner who realizes them in his practical actions and understanding and generally existing at the level of the organization, which makes them possible and therefore available in a general sense. I build on these claims about learning from sociocultural perspectives in explaining learning in seemingly mundane work environments in Chapter 3 and organizational learning in Chapter 4. Chapter 5 comes from a different angle in that it shows how analysts' concepts—schools and workplaces as activity systems—have been used as discursive resources by research participants in their accounting for workplace learning and expertise.

Identity emerges from activity

By engaging in work activity (and learning), *identity* (which is a sense of who one is in relation to others and self) emerges. "Workplace learning is best understood, then, in terms of the communities being formed or joined and personal identities being changed" (Brown & Duguid, 1991, p. 48). This coupling of activity with identity in occupations as diverse as fishermen, students, midwives, naval quartermasters, tailors, recovering alcoholics, or construction workers can be appreciated when we consider how identity is conceptualized within traditional psychology (Lave & Wenger, 1991). Here, identity is correlated with particular developmental stages or phases in a person's life that manifest themselves in what is commonly known as *personality traits*. In contrast, a sociocultural perspective positions identity within activity—the self is viewed to emerge "as a mirror to the social processes in which it participates" (Côté & Levine, 2002, p. 55). Identity

therefore becomes contextually dependent and dialectical in that it serves as a "pivot between the social and the individual, so that each can be talked about in terms of the other. It avoids a simplistic individual—social dichotomy without doing away with the distinction" (Wenger, 1998, p. 145).

In addition, because learning in the hatchery—as in any other contexts from shop floors to boardrooms to classrooms—is dynamic and fluid, this similarly implies that aspects of identity are changeable and evolving. In fact, because each action of a human subject on the object of activity is mediated by other entities in the system, the identity of the subject is produced and reproduced in every practical act (Roth et al., 2004). Changing identity, as learning, is coextensive with changing participation in a changing world of practice; one presupposes the other by membership in organizations and communities (Lave, 1993). This is the mantra that I repeat throughout this dissertation. Besides exploring identity from a CHAT perspective in Chapter 6, I expand on this claim of identity in/from activity in Chapter 7 by arguing that organizational identification comes about through the provision of new social and material resources that are made accessible for the collective. These new resources change the modes of participation in the activity system, which in turn transform organizational learning and identification although organizational identity always remains as a structural feature by virtue of membership in a group.

Activity systems in history

> Men [sic] make their own history, but they do not make it just as they please; they do not make it under circumstances chosen by themselves, but under circumstances directly encountered, given and transmitted from the past. (Marx, 1885/1958, p. 247)

It seems alien that an attempt to understand human psychology and behavior should ever consider questions of history. Yet, this is not accidental for the "H" in CHAT signifies that all activity systems are temporal; they have a past, present, and a future. When any researcher considers materials collected during a research project, what he or she encounters is the "analytic present," a frozen slice that remains as the residue of a dynamic and coordinated activity that is now past. Unless effort is made to examine its diachronic aspects, analyses would be always incomplete.[7] Furthermore, each of the elements within the activity system has their unique developmental history that requires explanation rather than assuming any apparent stability and permanence (Engeström, 2001). Because of the long time-scales that might be involved in some activity systems (e.g. capitalism, schooling, child-rearing), some of these elements might therefore appear as "given and transmitted from the past" that are "directly encountered" (Marx, 1885/1958, p. 247). This reflects what is known as *la longue durée*—events and structures that persist over long timescales with which historians are well acquainted. It has only recently been recognized by developmental psychologists that what happens on global historical scales intrude on the everyday lives, cognitive development, discourses, and identities of individuals[8] (Erickson, 2004; Holland & Lave, 2001; Rockwell, 1999). In fact, global history does not exist independent of our personal realization of cultural possibilities at hand (Roth, Hwang, Lee, & Goulart, 2005). This situation is probably best

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[7] Besides looking backwards for historical precursors in the activity system, the examination of lateral connections and projections about future possibilities is also imperative. This has been called the "dance of the dialectic," which is a quintessential Marxian method of analysis (Ollman, 2003).

[8] Social anthropologists, sociologists, and microhistorians have long spearheaded exploring the links between individuals or small communities with macrohistorical forces (Burke, 1992).

captured in the aphorism: culture and history make people, but people make culture and history as well (Roth, personal communication, March 31, 2005).

Indeed, people are not mere robots or passive recipients to structural forces. Through human agency, people marshal given resources that are at hand, which then result in contingent and unpredictable outcomes (Ortner, 1984). Now, we can observe a dialectical, interweaving process at work: historical outcomes or situations constitute and construct subjects (i.e. people live history and culture) just as subjects orient to these situations and create new forms of culture (i.e. people make history and culture). In Chapter 8, I interrogate this longstanding yet intriguing problem of how people make history but not as they please when I discuss one particular activity system—salmon enhancement in British Columbia. I argue that there are three persistent contradictions throughout this process of making salmon that have been used as resources for action by decision makers that were warrantable and practical.

Why cultural-historical activity theory?

Readers might be curious as to my choice of theoretical framework when there are other readily available, possibly more accessible methodologies to examine learning, identity and history. My response is that I do not pretend CHAT to be a master theory that can explain everything in the social sciences nor a framework that is flawless[9] though it is sufficient for the purposes at hand. Indeed, it has provided me with the necessary conceptual vocabulary to articulate how identity arose from concrete activity in Chapters

[9] Its inherent complexity and some unresolved conceptual issues have been a barrier towards greater acceptance among scholars (Stetsenko & Arievitch, 2003). Some of these tensions include understanding the nature of object transformation, contribution of biological factors in social evolution, structure of activity, and the relationship between individual and collective among others (Davydov, 1999).

6 and 7. I did not have to presuppose any psychological factors whether in individuals or collectives to account for identity, identification, and deidentification but instead I examined what people did and what socio-material resources were created or denied during work activity.

Having a strongly dialectical and dynamic framework also benefited the analyses in significant ways (Yamagata-Lynch, 2003). In dialectical thinking, one has to accept that entities or phenomena are unities of non-identical elements—a contradiction—that traditional logic would have deemed illogical and thus rejected. Therefore, analyzing the evolution of making salmon in British Columbia in Chapter 8 without this notion of internal contradictions would have made for poorer, deterministic, and certainly less interesting forms of accounting. Besides, without a dialectical understanding of learning, I would not have been able to formulate my two assertions in Chapter 3 nor the idea of socio-material resources influencing organization learning in Chapter 4. Chapter 5 was an investigation of the phenomenon of workplace learning and expertise from participants' discourse and revealed that analysts' conceptions such as activity systems figured prominently in the accounting of fish culturists without the latter explicitly using this technical nomenclature. The results from this chapter demonstrate the extent of these culturally available discursive resources in society that were concretely realized by research participants during talk.

Analytic tools – Discursive psychology

In Chapters 5 and 6, I have extensively used discursive psychology (DP) as an analytic method, which I will now describe. It is one out of many versions of discourse analysis for talk and written texts and has been developed by the Loughborough School

of scholars (including Derek Edwards, Jonathan Potter, David Middleton, Margaret Wetherell). With roots in sociology, sociology of scientific knowledge, and social psychology, theorists in DP consider how people orient to talk, produce their versions of the world, and how the accounts produced are legitimized by various rhetorical or argumentative means. Practioners of DP understand that action does not follow from words because words themselves perform actions (as in J. L. Austin's sense) during social interaction. It is believed that the construction of social reality during talk ultimately is as much *how* (form) it is said as *what* (content) is said. The concern in DP then is on the variability and production of accounts (e.g. being factual, justifiable, persuasive using discursive resources), whereby social phenomena, events and identities are co-constituted rather than primarily assessing the content matter of talk (Edwards, D., 2005; Potter, 2004). This focus on the *doing* of talk makes DP suitable for integration with CHAT.

The DP method is largely anti-realist and constructionist in that it focuses on the practices or institutions that are being reified, transformed, or resisted by speakers. There is, however, little danger of muddle or incoherence in combining DP with other (realist) frameworks in this dissertation, which was a legitimate warning raised by one of DP's leading practioners (Potter, 2003). This is because I have mainly used DP as an analytic tool to foreground everyday discourse as being adequate and useful in its actional aspects rather than judging its validity or correctness of content. Indeed, I see DP as fruitfully complementing research based on CHAT (see Korobov & Bamberg, 2004) for discourse is a form of activity that achieves the larger motives at hand in which actions such as talk are situated (Roth & Lee, Y. J., 2004). As such, DP was an ideal means for me to

demonstrate how identity was played out during interviews (Chapter 6) as well as what workplace learning and expertise meant from participants' perspectives (Chapter 5). I have relied on three essential analytic concepts in DP, which I will now clarify in turn: discursive or interpretive repertoires, stake or interest, and footing.

Discursive or interpretive repertoires

Early research in talk among scientists by Gilbert and Mulkay (1984) highlighted a rhetorical device called *discursive* or *interpretive repertoires* which are "systematically related sets of terms that are often used with stylistic and grammatical coherence and often organized around one or more central metaphors" (Potter, 1996, p.131). It was found that scientists engaged in an empiricist repertoire when they described matters regarding science as truth, which gives the impression that there is a reality "out there" in "nature." These types of devices were used when scientists spoke at conferences, during the writing of scientific papers, and other formal occasions. However, when they wanted to ascribe doubt or error about others (e.g. rival laboratories or scientists) they used a contingent repertoire. Use of this contingent repertoire was confined to speaking among friends or colleagues in informal settings. These discursive repertoires highlight the situated nature in which something that is normally presented as monolithic—like science—can take on different meanings in different situations.

In another seminal study of discursive repertoires or resources, it was found that there were three repertoires present among white New Zealanders when talking about race relations with Maori peoples. Whenever the former used a culture-fostering repertoire, for instance, they presented arguments that called for Maori culture to be promoted, encouraged, and preserved. At the same time, there was an implicit and subtle

element of deficit involved; Maori culture was constructed as inferior to European culture and civilization and thus needing compensation (Wetherell & Potter, 1988). Though useful in showing how people skillfully managed[10] their concerns and identities through talk, interpretive repertoires recently have been criticized for being rather difficult to implement as an analytic tool (Silverman, 2001).

Stake or interest

The management of *stake* or *interest* is a fundamental concern of the two offshoots of ethnomethodology—discourse and conversation analysis. Here, we are concerned with how people manage blame and responsibility by means of talk-in-interaction (i.e. being justifiable, rational, normal or believable). Stake can be used as a *rhetorical device to discount the significance of an action or to rework its nature* (e.g. a player claiming disinterestedness in sports after loosing a game or buying a present by a colleague for the boss is sucking-up rather than a friendly gesture). In other words, stake attempts to present a version of the world that things are just the way things are or should be in the world according to the speaker. However, in the *dilemma of stake* or *interest* there exists a real tension between participants to produce accounts that maintain and preserve vested interests without being seen as doing so.

The use of an "I dunno" was used to minimize the late Princess Diana's stake in her account of her involvement in the publication of a book that portrayed the royal family in a bad light. Rather than an uncertainty token from a linguistic or cognitive psychological perspective, the "I dunno" functions to camouflage or rework one's stake

[10] No form of conscious intentionality on the part of the speakers is implied here; I simply highlight the subtlety and complexity of discourse as they are employed during the business of talk (Potter, 1997b).

in the discourse as in the other examples of a jealous husband and a psychiatrist's justification described by Edwards and Potter (1992). This prevention of the potential undermining of one's accounts has been termed *stake inoculation,* which functions in a similar fashion as in the medical sense—to prevent something untoward or threatening from occurring in the future (Potter, 1997a). Scientists also use one interpretive repertoire to justify facts in their own formal writing while using another to undermine the claims of competing scientists (Gilbert & Mulkay, 1984). In sum, these attributions of blame and responsibility in stake provide people with grounds to legitimate their courses of action.

Footing

During talk, accounts or reports are constructed as (come to be) factual and therefore rhetorical effort has to be made to prevent these from being construed as false. It is this active management of how people attribute blame or responsibility that is called stake. *Footing* is another rhetorical device embedded in these accounts that plays a major role in constructing believability and undermining possible alternatives.

> What the speaker is engaged in doing, then, moment by moment through the course of the discourse in which he[sic] finds himself, is to meet whatever occurs by sustaining or changing footing. And by and large, it seems he selects that footing which provides him the least self-threatening position in the circumstances, or, differently phrased, the most defensible alignment he can muster. (Goffman 1981, p. 325)

In the study of narrative, footing is described as *the situation whereby a speaker adopts multiple and different roles or presentations of the Self during speech or story telling which is itself often multi-layered.* This can happen, for example, when narrators switch subject positions between that of conversationalist and storyteller or from "stating something ourselves to reporting what someone else said" (Goffman, 1981, p.151). Other

instances of changes of footing occur when one adopts an accent in order to mock it, embeds a proverb or adage during speech to gain credibility, or when members of the British royal family tell family stories or personal experiences on television to project an aura of commonality. Ultimately, these negotiations and changes that occur in footing grounds both speakers and listeners in who they are and what they are at that moment of interaction.

More critically, such shifting should not just be taken as accounting of truth, half remembered fragments, verbatim or gist versions but instead can be fruitfully seen as rhetorical devices for managing participants' interests or stake in the process of producing some account. These threats to participants' identities, motivations, biases, institutional loyalties have to be defended in order to protect one's stake through the medium of discourse:

> [T]he attribution of views to others does not offer a transparent window into what an individual "believes", nor does it reveal the sources of their information: rather, footing is a conversational resource used by participants for managing interactional difficulties. (Wilkinson, 2000, p. 450)

In a study of women experiencing breast cancer, it was discovered that footing for speakers had served certain functions, namely to avoid, challenge, or ridicule potential arguments or occasions that might be problematic to self-identity (Wilkinson 2000). Attributing a statement to somebody else renders it another person's opinion and removes accountability that minimizes stake and interest from the speaker. These issues of negotiation and protection of identity similarly occurred during an interview with Princess Diana in the *Panorama* television documentary series where many particularly challenging and probing questions were posed to her. After analyzing the program transcripts, it was seen that Diana had changed footing repeatedly thereby shifting the

need to be embarrassed, a move that actively protected and maintained her identification as a legitimate member of the British royal family (Abell & Stokoe, 2001). Footing is an important analytic category for understanding the way discourse is oriented to action for "people can emphasize their distance from a particular attitude or evaluation by sharply making the animator/origin distinction or they can align themselves with it by blurring or ignoring the distinction" (Edwards & Potter, 1992, p. 38).[11]

As a concept, footing is still in the process of theoretical development, for it appears to be difficult to operationalize (Levinson, 1988). However, through this concept I have gained much insight in the subtle and composite roles that one can take during speech. As such, the three analytical tools of discursive repertoires, stake, and footing will be used to examine how identity, self-presentation, and believability were constructed and managed in Chapters 5 and 6.

Autobiographical aspects

It is necessary to share part of my personal commitments, biases, and life experiences that I carried to this research. Without this background understanding, readers would fail to appreciate some of the motivations that prompted certain trends of inquiry and methodologies that I adopted to achieve these aims. Because the personal *is* intertwined with the professional (Roth, 2005), I take a more informal tone in writing this section.

I like doing qualitative research; but this had not always been the case. My masters of education degree had utilized item response theory, demanding highly

[11] Animator is the person doing the talking while origin is source of the words (e.g. press secretary and speech writer respectively).

developed mathematical skills for proficiency, to probe teachers' comprehension on the topic of biological evolution. Being a trained zoologist, the subject matter had fascinated me. Evolution was capable of generating divisive conflicts with religious beliefs besides being conceptually elegant and difficult to comprehend at the same time. However, I felt I was unable to answer the truly interesting questions that the master's study partially alluded to. Such questions included "How do I feel teaching this topic when it disagrees with my beliefs?" "How do I teach something I do not believe in?" and "Do I have to 'believe' in evolution?"

A series of events then caused a slow change of heart towards qualitative research. When I later became a teacher-educator, I attempted a piece of action research using a paper-and-pencil survey on views of science and religion that I administered to some pre-service teachers. One reviewer from *School Science and Mathematics*, the journal that I submitted these findings to, rejected the manuscript citing the inadequate choice of methodology adopted. In his view, I should have conducted at least some interviews with the participants, which I earlier thought was unnecessary for it lacked rigor. I did not take the rejection personally but instead found the four pages of painstaking critique most helpful, and a true revelation.

On browsing the journals one day, I came across a reference citing a co-authored paper by Michael (Roth) that encouraged me to revive the possibilities of embarking on qualitative research in my pet area (Roth & Alexander, 1997). I requested a reprint from Michael that promptly arrived in the mail, which I then read cover to cover. The upshot of this proposed investigation on teachers' views on teaching evolution is described at the beginning of Chapter 6. Sufficient to say here that although I found qualitative research

in general difficult to fathom, I was beginning to see something of its merits and power. Taking one of Sun Tzu's aphorisms[12] to heart, I read as much as I could about qualitative methodologies and philosophy in the hope of understanding the "enemy" better. Undertaking this current dissertation on work using CHAT was thus the enactment of a battle plan that had a long gestation period. I was rearing to go.

Of course, this has not been an entirely smooth journey. I had no familiarity with CHAT before beginning the doctoral program and I still remember Michael telling me in the first few days of my arrival in Canada that at the end of 36 months, I would be spewing sociocultural talk glibly from my tongue. I recall his "yakking" gestures with his right hand placed in front of his mouth when he was telling me this and my own feelings of incredulity.[13]

After about six months of searching for a researchable topic, I jumped at the opportunity to begin my multidisciplinary work with Shallow River Hatchery. This seemed like a happy merger of my background skills in biology together with an important rite-of-passage into the world of ethnographic field research. While working on this dissertation, I also developed a love-hate relationship with CHAT. I appreciated that it seemed to hold much promise but being a new and evolving framework, access to CHAT was almost solely through arcane journal articles and book chapters. For a long

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[12] Sun Tzu was allegedly a 6th century B.C.E. Chinese general who wrote *The Art of War*, which was a book on military strategy. One of the most quoted pieces of advice inside stated, "If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle."

[13] Although I now may be seen to have accomplished some degree of success to an observer, it often feels like a form of Bakhtinian ventriloquism to me for the journey has barely started.

while, I was inclined to abandon CHAT in favor of another member of the sociocultural tradition—practice theories—as these were conceptually less complex with shorter philosophical ancestry (and readings). And so, I flitted at intervals from being enthusiastic with CHAT and disillusioned with it the next. How I finally settled my choice of framing can perhaps be even explained by CHAT for in the process of reading, writing, and trying to explain to different audiences what I myself was wrestling with, I grew to understand. These episodes thus became small steppingstones for confidence, familiarity, and eventual acceptance of CHAT.

A road map for reading

In the six different but related Chapters 3 through 8 that form the heart of this dissertation, I "work out work" from a CHAT perspective (see Table 1.1 below). Here I present a road map for reading these six chapters. I classified each chapter under the three main themes of learning, identity, and history followed by their potential contributions towards workplace practices and towards extending theory. Each chapter in this dissertation, originally written for publication as an article, is prefaced by a reflexive, "natural history" account of how the text had developed. This is similar to the argument that I made in Chapter 8 about the necessity of capturing science-in-the-making, as this approach affords valuable insight into problems, learning experiences, and breakthroughs *during* the conduct of the research. Since every chapter has either been published or is undergoing peer review for different publications across the disciplines, it was necessary to highlight how this has influenced the style and tone of the chapters as well—lest it be seen as an inconsistency in writing. In contrast to most other genres that present the final polished outcomes, it is my contention that readers benefit more from this approach.

Theme	Contributions to work practices	Contributions to theory
Learning		
Chapter 3	Learning is inevitable even in mundane work environments. Need to rethink possibilities of learning in such places.	Extends beyond participation models of learning. Learning arises from subject|object transformations.
Chapter 4	In a learning organization, contributions from everybody are important. People learn, not abstract notion of organizations.	New socio-material resources can change the activity system (organization) and foster learning. These resources connect individual|collective learning.
Chapter 5	Workplace learning and expertise as participants' concerns.	Analysts' concepts are sometimes culturally available resources that will be used by participants in the dialectic of agency|structure.
Identity		
Chapter 6	Interviews are never neutral data gathering devices for identities are at stake.	Identity arises from subject|object transformations. Emphasizes analyzing the activity (e.g. doing interviews) holistically rather than the individual elements separately (e.g. what participants said or did).
Chapter 7	Organizational (collective) identity is a structural feature but organizational identification depends on opportunities for learning and expansion of action possibilities.	Organizational identity and identification articulated from CHAT perspective for the first time. Relates and points to the importance of the individual|collective dialectic in learning and identity.
History		
Chapter 8	Work practices have to be examined from wider perspectives and not in isolation from culture and history.	A focused attempt to use the concept of contradictions and the change from quantity to quality for analyzing an activity or sociotechnical system as it undergoes change over time. History is the interplay of agency|structure across time and space.

Table 1.1. Outline summary of the six substantive chapters in this dissertation showing the main themes and potential contributions towards workplace practices and extending theory.

To elaborate, Chapters 3 to 5 analyze different aspects of the theme of *Learning*. I make the case that learning is inevitable even in the seemingly mundane and routine workplace environments in Chapter 3 (*The [Unlikely] Trajectory of Learning in Shallow River Hatchery*). This chapter thus extends existing models of learning based on participation in some community, which most sociocultural theorists have adopted. I then examine what it means to learn from an organizational or collective perspective in Chapter 4 (*The Individual|Collective Dialectic in the Learning Organization*). I suggest that while people are doing the actual learning in organizations, new socio-material resources that are created (or denied) through human agency transform the overall modes of participation within the organization and therefore constitute a form of collective learning. Because the activity system has changed with the addition of new resources, the organization can be said to have learnt. I maintain that these socio-material resources are analogous to the cultural-historical tools and artifacts mentioned earlier, which dialectically link the learning of individual|collective. The nature of this relationship is what most organizational theorists (my intended audience) have not appreciated and thus they fail to adequately conceptualize how organizations can actually learn. Furthermore, all members and not just elites (e.g. managers) have the potential to create new socio-material resources for the collective, which is a reasoning workplace managers are slowly beginning to appreciate. A more reflexive concern with methodology is made salient in Chapter 5 (*Learning about Workplace Learning and Expertise from Jack*) whereby I consider workplace learning and expertise directly from members' talk. It has been a concern of mine that my interpretations of workplace learning and expertise in Shallow River Hatchery have been based on my pre-existing stock of sociocultural tools and

concepts. Hence, this chapter used DP to analyze learning from the participants' perspective. By minimizing the imposition of analysts' categories and concerns, I tried to show that at least over the duration of our research, some of the fish culturists had contrasted school- and workplace-based learning as discursive resources to account for their learning. Being culturally available categories in society, the results make salient how people can selectively adopt, modify and resist these resources in accounting for their own learning and identities.

I further develop the theme of *Identity* in Chapters 6 and 7. The former chapter (*Making a Scientist: The Discursive "Doing" of Identity During Research Interviews*) discusses the in-built interactional problems associated with interview methods and provides a timely reminder for researchers and workplace learning evaluators. I show that rather than an unproblematic data gathering device, issues of identity and self-management are constantly at play during the interview event. For CHAT researchers, this chapter highlights the importance of analyzing the activity as a dynamic process[14] first and then choosing to focus on the separate heuristic elements that constitute that activity. Failure to do so runs the risk of dichotomizing people and environment, which is deeply antagonistic to the goals of sociocultural research. Chapter 7 (*Organizational Identity and Identification from the Perspective of CHAT*) is an attempt at explaining organizational identity and identification from a CHAT perspective. As far as I can determine, this is the first time organizational identity and identification have been articulated in terms of learning and the expansion of possibilities using the individual|collective dialectic. At one glance, we can see that the concerns in this chapter

[14] It is always helpful to consider the activity as a verb; for example, *making* music, *schooling*, *doing* commerce and so forth.

are closely aligned to Chapter 4 although socio-material resources are less prominently featured in Chapter 7.

Chapter 8 (*Making and/or Saving Salmon: The Transformations of a Sociotechnical System*) is the sole chapter that takes the theme of *History* as its principal focus. Here, I analyze how a particular work practice—making fish in salmon enhancement—has changed over the years in British Columbia. For workplace researchers, it foregrounds the need to understand any activity in its cultural-historical contexts with regard to methodology. Scholars who use CHAT would find the rigorous use of the concept of contradictions and the change from quantity to quality interesting for I make the claim that the contradictions do not cause changes in the activity or sociotechnical system per se. Instead, they provide resources for human agency. At the same time, human action is always constrained by the perceived resources that are available. This dialectical explanation of structure and agency across time and space rounds off these six chapters after which I discuss the conclusions and implications of this dissertation to "work out work" and thus extend activity theory.

Chapter 2

Research Settings, Forms of Engagement, and Data Analyses

Before readers can fully understand what this dissertation sets out to accomplish, it is imperative that the main field site of the salmon hatchery becomes more than just a name. It has to be a place where people in flesh and blood are found and spend the best part of their working lives there. Accordingly, I now attempt to generate a vivid portrayal of Shallow River Hatchery by introducing some background information and the staff that work there. I then provide two snapshots of everyday work practices as reconstructed from my fieldnotes.[15] The first describes what happened during one visit to the salmon hatchery and gives a flavor of a "typical" day during the off-peak work season (see Lee & Roth, 2004b). The other narrows the focus down to a specific work practice known as an "egg take" and depicts something of the sense of marvel that non-specialists like myself experienced upon encountering it for the first time.

I intend these texts to give a "feeling for the place" to borrow (and transpose) Evelyn Keller's book title (Keller, 1983). I deliberately chose to use the term "texts," for I acknowledge that these descriptions were but (re)constructions at all stages of the writing process. Indeed, I critique the non-reflexive use of ethnographic studies in

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[15] Chapter 6 presents somewhat of an anomaly as the research setting was not directly connected with Shallow River but was part of an another project on knowing, learning and identity across different work communities. There was no "setting" to speak of other than the scientific laboratory where my interview with the participant was conducted and hence this location will not be described here. Some scholars have however claimed that interview settings play a critical role in the joint construction of social reality during such events (Herzog, 2005).

Chapter 5 that ignores its persuasive and rhetorical features of production[16] (Clifford & Marcus, 1986; Hammersley, 1992). Following the section on research settings, I devote attention to the general data collection process or what I call the "forms of engagement." Here, I describe my initial entry into the field and my strategies for data collection. I conclude this chapter by describing some of the criteria that I used to ensure quality during the data analyses.

Research settings

Hatcheries in British Columbia are a vital part of the Salmonid Enhancement Program[17] (SEP) started in 1977 by the Department of Fisheries and Oceans (DFO).[18] Such is the centrality of the seven species of salmonids in the life and culture of the Pacific Northwest that the region is often viewed synonymous with any stream where these fish can be found. During the last century, however, many salmon runs were severely depleted due to habitat destruction, pollution, over-fishing, and dam construction. The original aim of SEP[19] was thus a determined attempt to double salmon production with economic, social, cultural, and recreational benefits for British Columbians.

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[16] Burke (1992, p. 129) names these kinds of writings as "fictions of factual representation."

[17] There are five indigenous species of salmon in the Pacific Northwest: coho (*Oncorhyncus kisutch*), chinook (*O. tshawytscha*), chum (*O. keta*), sockeye (*O. nerka*), and pink (*O. gorbuscha*). Closely related anadromous steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*) are not true salmon though grouped under the generic term of salmonid, which is often loosely used as in this dissertation. The term "enhancement" is generally understood as the process of artificially augmenting and producing fish to improve some quality of fishing in an area.

[18] A cultural-historical account of SEP is articulated in Chapter 8 and details of hatchery technologies can be found on page 203.

[19] Strictly speaking, a definite article should precede this acronym (i.e. the SEP) but will not be adopted here following everyday use in British Columbia.

Hatcheries, which are literally "fish factories," are one of the most efficient means of enhancement within the technological arsenal of SEP. Their raison d'être is to rear millions of juvenile salmon from the egg stage until the young fish are ready to begin their migration to the saltwater to complete their development. Shallow River was one such hatchery that specialized in manufacturing three species of Pacific salmonids—coho (*Oncorhyncus kisutch*), chinook (*O. tshawytscha*), and steelhead trout (*O. mykiss*). It employed two managers, five fish culturists, some support staff (e.g technicians and maintenance personnel), and a seasonally varying number of temporary helpers. This hatchery stands out not only among those that I studied but also among all of the hatcheries on the Canadian Pacific coast. Scientists and support biologists from DFO consider its personnel as highly competent not only in their day-to-day jobs but also in the occasional scientific experiments they designed and conducted, although the fish culturists, whose primary job is to rear fish, were high school graduates with minimal further training.

Besides the reputation of its staff, Shallow River is considered somewhat atypical of most hatcheries because of its strong commitment to outreach programs and integration in the life of the nearby town. According to a long-time DFO employee, an ex-manager in Shallow River had set this precedent years ago, which has been continued ever since. For example, during fall when thousands of adult salmon return to spawn, staff members from the hatchery assist in the local salmon derby, which is a friendly competition whose aim is to net the heaviest fish swimming up the main waterway. Not only is it a widely anticipated event for fishing enthusiasts and tourists alike, the data collected on returning fish assists hatchery staff in predicting salmon runs later in the

season. Furthermore, nearly every school-going child in the town either has visited the hatchery or has been involved in rearing salmon eggs donated from Shallow River in the immensely popular classroom incubation program. It is not without some pride that Shallow River employees have told us that the hatchery has provided needed employment opportunities that have served to strengthen the bonds with the local town.

The practice of fish culture in the hatcheries seems best portrayed as a blend of manual labor and craft knowledge (Barley, 1996). Some tasks in the former category include hand scattering up to 50 kilograms of fish food per pond per day (some workers throw up to 200 kilograms per day), taking eggs from female does, hauling water, repairing machinery, setting fish traps, launching boats, and cleaning ponds among many others. Calculating the correct quantities of feed or antibiotics, plotting fish growth on a graph, monitoring water quality with probes, or tinkering and improvising equipment are some aspects that could easily belong to the latter aspect. There is no typical day or routine as fish culturists contingently attend to the most pressing things, so that each day usually includes a mixture of manual and craftwork (see "One 'Typical' workday" on page 38). The work is further characterized by a seasonal flavor: fall and winter, the busiest periods of the year, are dominated by "egg takes" and by the "sampling of returning adult fish" whereas spring sees heavy feeding schedules to get the juvenile fish up to size before their release around May. Large-scale maintenance in the hatchery and an opportunity to take a long holiday are normally reserved for summers.

Unless working on a task like "river seining" or "water sampling," most fish culturists work alone or in small groups. Lunchtime might see a coincidental gathering of the hatchery staff, though this is never guaranteed given the many unpredictable aspects

of their work. Not that this hinders the flow of information or gossip amongst them, for unlike Julian Orr's (1998) photocopy-machine technicians, who are geographically separated, hatchery staff interact frequently with each other as they go about their individual chores. In the past, a fish culturist specialized in one, at most two salmonid species; today, hatchery managers encourage job rotation to promote higher levels of expertise regarding all salmon species. Each fish culturist certainly has his or her favorite species of fish to which they feel more strongly attached than to the others, though they always substitute for any absent colleague in a very competent manner. This does not imply that the level of skill needed is rudimentary and thus interchangeable. On the contrary, they all embody fish culture knowledge in general, and, more importantly, they always check with colleagues what the idiosyncrasies of their particular fishponds are. Fish culturists have a large say in the decisions regarding the particular fish species they are placed in charge of. Some managers, who rose up through the ranks beginning as temporary helpers, appreciate that these workers by virtue of spending nearly the entire day with the fish understand fish husbandry and biology better than they or even scientists do.

Jack (all names of participants are pseudonyms in this dissertation save for author and supervisor), one of the most senior fish culturists in Shallow River, was the main informant in my research. Trained as a plumber but with proficiency in carpentry and electrical work, he thoroughly enjoyed plumbing as his first job in a big city where he grew up. There he remained for fourteen years until he said that "the trade wasn't a trade anymore. You got plastic pipe and everything getting quicker and quicker and doesn't matter what it looks like—just get it in!" After a brief part-time stint as a park naturalist,

he landed a job at the hatchery where he has remained as a fish culturist ever since. A DFO biologist once commented that Jack deserved a medal for his rearing work concerning chinook salmon; the number of adult returns has increased so dramatically in Shallow River that scientific research on this species could be resumed. His reputation as an expert—nearly an icon of Shallow River—was never in doubt, because we often heard his name being mentioned by scientists and other DFO staff associated with the salmonid program.

Another participant who contributed to the research was Erin. A fish culturist with about a decade of work experience, she was the hatchery's self-confessed perfectionist and "geek." Although she had dropped out of a college business program after completing high school, she used her self-taught computer skills to maintain scientific databases and use various forms of statistics to find patterns in her data on the salmon fry. Always eager to improve her work practices, she participated in an online genetics course during my last year of research in the hatchery. During this course, she complained that she had to consult a scientific dictionary for every second sentence that she read in the lesson because the terms were so unfamiliar to her. The last fish culturist who consented to participate in our research was Gerri. I have interacted less frequently with her and she therefore does not figure to a large extent in my field notes and interview transcripts.

One "typical" workday

I provide one episode of the variety of tasks undertaken by fish culturists when I visited the hatchery during a lull period in late summer. Again, there is no typical workday in the hatchery to speak of but the description below from my fieldnotes

(Emerson, Fretz, & Shaw, 1995) gives a snapshot of the mixture of manual and craftwork that fish culturists can engage in.

> On arrival in the morning, I found two fish culturists and a student of fish culture from a nearby college engrossed in sorting out the different species of salmon caught on their way upstream to the spawning grounds. Based on a projected figure supplied by biologists in DFO headquarters, any surplus for that season was to be given freely to the two bands in the nearby aboriginal communities whereas the remaining fish were either captured for brood stock or allowed to spawn naturally. A mechanical "brailer" was used to lift the fish up from the creek that then emptied them onto a long metal sorting table. Above the din of thrashing fish, the fish culturists silently pitched salmon into huge tubs that were moved by means of a forklift onto a waiting truck. Processing about 2,000 fish daily in this manner, this task is a daily routine for the entire month. Arriving early at the hatchery to feed his fish, another fish culturist set off to a nearby lake for a lake-fertilization experiment that a DFO biologist had requested. This task involved steering a liquid-fertilizer-filled boat into the upper reaches of a 50-square-kilometer lake, where the contents were gradually released. He completed the task by lunchtime and then spent the rest of the day feeding fish and planning a "major expedition" to a nearby river to obtain new brood stock later in the fall.
>
> Another experienced fish culturist doubled-up as "boss" for the day for the manager and his assistant were away. I saw this person coordinate the "fish sort" mentioned in the previous paragraph and interact with the rest of the staff by chatting with them at intervals throughout the day in his capacity as temporary supervisor. With new information signage erected at this hatchery showing the various work activities that were carried out by the hatchery, the fish culturists, pressured for time on this day, ignored the handful of visitors freely wandering about and touring the hatchery. (Fieldnotes)

Our research[20] revealed considerable expertise among fish culturists who, upon cursory observation, appear to merely feed fish and clean ponds. Indeed, there was an

[20] If I am consistent with the activity theoretic stance adopted here, the conduct and outcome of my research cannot be strictly attributed to my solo efforts but is the end product of a community including the supervisor, committee members, scholars in my field, funding bodies, and peers among others. An identical point has been expressed within the contexts of how society has often rewarded the contributions of talented scientists as individuals while ignoring the structural relations (i.e. community and material resources) that made their breakthroughs possible in the first instance (Roth, Hwang, Lee, & Goulart, 2005). This dissertation is my own at the same time as I acknowledge the debt to Michael, Stuart, and Leanna, upon whose previous field research in Shallow River I grafted my personal interests into the project. Details of how I took

apparent incongruity between their high levels of practical knowledge and relatively low levels of formal training obtained in fish husbandry. From what I gather, there were few taught courses nor textbooks on fish culture that were provided by DFO in the past, although now there exists a college-level course (with internship opportunities) in this vocation for aspiring entrants.

Fish culturists do more than feed fish. New staff would in fact face considerable difficulties in competently carrying out many of the activities that old-timers take for granted. Examples abound of such embodied workplace knowledge that includes (a) knowing when the fish are satiated during feeding by observing their swimming behavior in ponds, (b) successfully monitoring water flow and temperature without the use of any instruments, (c) accurately estimating the weight of inch-long fry without instruments, and (d) knowing when fish are ready to be released to the ocean by scrutinizing their behavior and external appearance.

The egg take

Based on my fieldnotes, I now reconstruct my impressions of an "egg take" performed by two fish culturists. This everyday work activity encapsulates for me in miniature what all hatcheries do on a far grander scale—the artificial fertilization of salmon eggs.

> Jack and Pete (another fish culturist) had already donned their drysuits, thick gloves and felt boots that are the standard gear of fish culturists spending long hours in cold water. These hatchery workers nimbly jumped into the twelve-foot plastic tubs containing about twenty steelhead trout and began moving around its perimeter to herd the fish into their dip nets (Figure 2.1 below). The steelhead were immediately transferred to another smaller tank that had previously been

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over this project and steered it are described in the next section on "Forms of engagement."

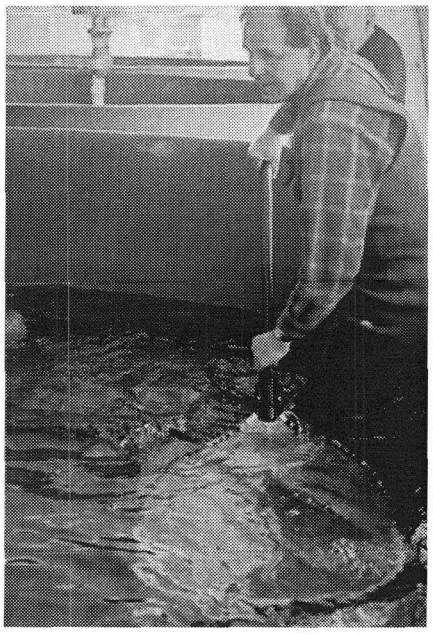

Figure 2.1. Using a dip net to herd steelhead, which are reared in twelve-foot plastic tubs unlike the other salmonid species that are kept in outdoor ponds in Shallow River Hatchery. Photograph used with permission from Wolff-Michael Roth.

saturated with carbon dioxide from a small pump. Due to the lack of oxygen, the thrashing fish soon calmed down over a period of ten minutes. Jack now began to look for female does; he lifted each doe by the tail with his left hand and massaged the belly with his free hand. After examining them this way, he threw a couple of fish in quick succession into another tub filled with fresh water for those fish were the "rejects." They were the "unripe" ones that lacked the precious eggs—the objective of this egg take.

All of a sudden and without saying a word, Jack maneuvered the head of one doe he was checking towards Pete who then hit it hard over the cranial region with a child's baseball bat. With a loud metallic sounding "thump," it was killed instantly. Pete then severed an artery in its gill region and the carcass was placed head downwards in a sloping tube to drain its blood away. Over the next twenty minutes about six such "ripe" does (with bellies feeling like "Jell-O" according to Jack) were similarly dispatched for they would be mothers of a new generation of steelheads. Male fish were later harvested for their milt; Jack bent the fish into an arc, bellies on the outside, and squeezed the bellies from the middle region to tail. The milt squirted in a thin, long and high arc toward Pete, who caught the white fluid in small, sterile plastic containers.

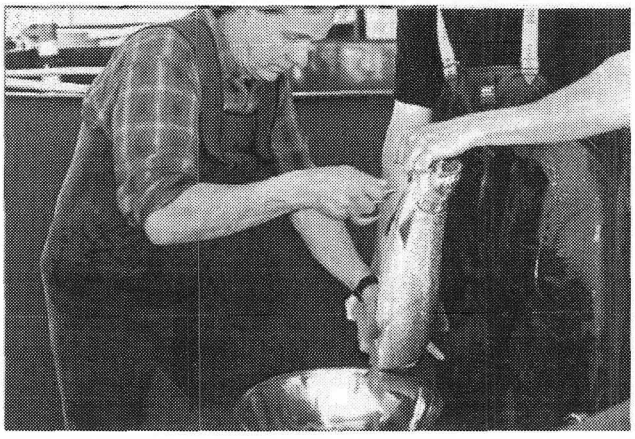

Figure 2.2. A critical moment in the egg take when the eggs are removed from the female doe. Immediately after the hooked knife has eviscerated the fish, most eggs fall straight down into the container without assistance. Fish culturists will then carefully scoop out any remaining eggs that are stuck to the body wall of the fish. Photograph used with permission from Wolff-Michael Roth.

> The two men now cleaned their hands and prepared their equipment for the next step in the egg take. A large aluminum bowl and a small hooked knife were placed in front of them. Pete then held the first ripe doe over the bowl while Jack quickly inspected the fish, for disease as he said, and cleaned off the external slime and blood with tissue paper. Pete now turned the fish upright for Jack to insert the hooked knife into the anal pore of the fish. The incision was quick and unwavering, resulting in the fish being slit upwards all the way to the gills. Voluminous amounts of large red eggs fell straight down into the bowl (Figure 2.2 above). Jack used his hands to scoop out whatever eggs remained attached to the body wall, taking care not to contaminate them with surrounding slime, coagulated blood, or fish tissue. As he explained later, these are ideal substrates for fungal infections and hence have to be carefully avoided, which also explains why the carcass of the doe has to be drained of blood prior to egg removal. The emptied carcass was then placed back into the tube and the process repeated for the remaining ripe does. With an allowance of two hours or so before the germ cells became unviable, the two fish culturists later mixed the eggs and the milt together and thus were the midwives for a new brood of steelhead in Shallow River (see Figure 2.3 below). (Fieldnotes)

Throughout this activity there was hardly a word exchanged between the two fish culturists, who seemed so attuned to one another that they anticipated each other's next move. This was a rapid and seemingly choreographed interaction of the type that I have seen played many times in the hatchery. When asked about the rapidity, the sureness, and

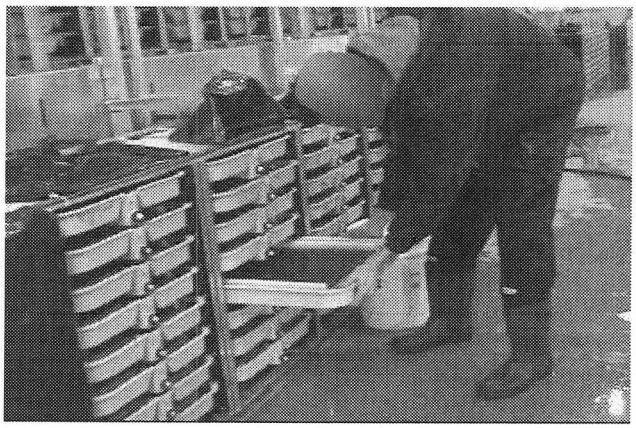

Figure 2.3. Newly fertilized salmon eggs are laid in plastic Heath trays that have a constant supply of clean, oxygenated water running over them. The eggs will remain under these rearing conditions until they hatch and then deplete their internal yolk supply. Face of unidentified fish culturist has been blanked out to ensure anonymity.

accuracy of every action, Jack responded, "Well you asked me we seemed to be fast. I don't even think about it as being fast, it's just normal. . . . Yeah, we know, we don't ask. We just do it boom, boom, boom!" This response hides more than it reveals. Having participated in egg takes and salmon fertilization tasks, I know that the work is intricate and requires much skill; the same work had taken myself twice or three times as long, and at the elbows of experienced fish culturists. These differences show that there is work involved, work that only became apparent in my own awkward attempts at participating. As such, it is therefore not surprising that part of this dissertation desires to answer questions such as, "How did Jack and Pete coordinate their work so smoothly and efficiently? How did knowledge of complex operations such as the egg take described above become embodied in these fish culturists?"

Forms of engagement

My dissertation research was performed under the auspices of an on-going interdisciplinary project that examined the interactions between local and scientific knowledge exchanges in Canadian coastal communities. Prior to the commencement of my graduate studies, Michael, Stuart Lee (Michael's doctoral student), and Leanna Boyer (Michael's research assistant) had already conducted extensive fieldwork at Shallow River Hatchery beginning in 2000 (see footnote 20). Initially, I accompanied Michael and Leanna as they went about their interviews with various people associated with salmon enhancement. Their introductions to SEP staff were especially useful as I was a newcomer to this field; indeed, this was the first time I had set eyes on, or known about Pacific salmon. A few months later in the spring of 2003, the conduct of the research was solely in my hands as Michael and Leanna took on other research projects. Despite having previously transcribed interviews, photographs, and scientific reports—which amounted to nearly 600 pages of text—these were geared towards answering specific questions pertaining to the pre-existing project on knowledge flows. By way of example, I found that a large part of the recorded talk revolved around asking who knew what and how did that information journey (or not) from the hatchery to headquarters and vice versa. There was little by way in those areas of interest that emerged for me: identity, past and present learning experiences in the workplace, organizational routines, past scientific experiments, the history of making salmon in SEP or Shallow River facility itself. As such, I urgently needed to supplement the body of data that the research team had already collected and more importantly, experience first-hand everyday work practices in Shallow River.

In the course of my research in Shallow River, I adopted participant observation and forms of apprenticeship as research methods (LeCompte & Preissle, 1993). One of the hallmarks of anthropology, the former entailed long-term involvement in observing and trying to make sense of social practices and structures from participants' perspectives (Davies, 1999). This was insufficient for gaining an insider's understanding of work practices and hence I sought various forms of participation in everyday work life. Known otherwise as apprenticeship, I assisted the hatchery staff in work activities such as the taking of eggs, tagging, feeding fish, seeding lakes with chemical nutrients, taking measurements on fish and in the environment, sampling returning salmon, and releasing smolts (Coy, 1989). At other times, I followed the fish culturists to nearby elementary schools as they conducted egg takes as part of the classroom incubation program. These experiences permitted what I felt was a clearer, embodied sense of the technical and craft skills in fish culture that mere observation or verbal enquiry would never have been able to achieve. I have only recently come to appreciate that participation and observation as preferred methods for the field exists in a dialectical relationship, which is akin to the dialectic of explaining and understanding described in Chapter 3. I was engaged in this very process without a conscious understanding that I was doing so.

> In the dialectic between the poles of observation and participation, participation changes the anthropologist and leads him to new observation, whereupon new observation changes how he participates. But this dialectical spiral is governed in its motion by the starting point, which is observation. (Rabinow, 1977, p. 80)

Nearly all these events in or outside the hatchery were written up in fieldnotes, audiotaped or, more commonly, videotaped. The transcriptions of these events where dialog was present as well as my own notes formed the basis of my analysis of the work of fish culturists. In addition, I interacted with other members of SEP (e.g. veterinarians,

population statisticians, laboratory staff, technicians, administrators) about various aspects of the work and workplace, collected and photographed artifacts (forms, minutes, notes on scratch pads), and copied fish culture manuals, experiments, and newspaper clippings relating to the hatchery. Though laborious, transcribing the data myself was an avenue to an intimate familiarity with what the participants had articulated. Over a two-year period, I thus examined present and past work practices of three fish culturists in detail—Jack, Erin, and Gerri.

Because activity systems such as Shallow River do not exist in isolation but overlap with other related systems, I felt compelled to extend my fieldwork to other aspects of salmon enhancement other than the work in the hatchery. Attending both formal (e.g. scientific conferences on salmon, public meetings on wild salmon conservation) and informal events (e.g. the Ocean's Day Festival) allowed me to network with biologists, teachers, fishers, fishing guides, and conservation activists. In particular, I followed groups of DFO Education Coordinators and Community Advisors who were simultaneously trainers and dedicated campaigners in salmon conservation. I was fortunate to have attended their intensive training sessions for the classroom incubation program that took me to other towns across the province. In this, I helped take charge of aquarium equipment to distribute to schools for the incubation program. Acknowledging my presence at many of the meetings and training sessions, the teacher in charge of the classroom incubation program in my son's elementary school invited me to talk to the students there as well as to perform a salmon dissection. Immersing myself in this way for about one year, I have come to the conclusion that the classroom incubation program

is a remarkable partnership of government, grass-root conservation groups, and schools that deserves a separate study of its own.

Gathering relevant data was not solely restricted to a physical presence in the hatchery, in meeting rooms or classrooms. As I describe in Chapter 8, data collection for a cultural-historical account of salmon enhancement was a different but valuable experience involving archival research in government offices and museums. And, compared to graduate students working a generation ago, computer technology allowed for participation in a number of salmon-related mailing lists. This helped me keep abreast of developments across British Columbia such as the sea-lice controversy affecting local wild salmon or the recent uproar over chemical contaminants found in salmon.

Data analyses

The data analyses that were used in this dissertation were faithful to the principles of grounded theory because of its general application to qualitative research studies. After repeated reviewing of the artifacts, notes, and transcripts, codes that emerged were further classified into categories that formed the basis for my tentative hypotheses (Silverman, 2001; Yamagata-Lynch, 2003). Because most of the transcripts were available in electronic documents, it allowed for easy color-coding of texts that I then could link together into another computer file for further comparison and checking. Often, higher-order categories were discarded and revised in the light of repeated reading of the original transcripts. Other influences that helped me to engage the data came when I attended academic conferences such as ones for the *Society for the Social Studies of Science* and the *American Society for Environmental History*. Tentative ideas of mine were put to the test; but more importantly, it was through the interactions with fellow

students and meeting up with some of the known "celebrities" at the conferences that perhaps had the greatest impact on me. The many conversations that I had with Michael were invaluable too; sometimes, it was a mere remark or a reference to an article that opened up a new and fruitful avenue.

A major concern among qualitative researchers is the credibility of the findings that roughly corresponds to the concept of internal validity in positivistic kinds of research. What is of common interest is the degree of isomorphism between research findings versus an objective reality/world-out-there in positivistic research and a correspondence between the constructed realities of participants versus analysts' reconstructions of the phenomenon within qualitative research (Guba & Lincoln, 1989). In order to raise the quality of conclusions in what they call "fourth generation evaluation," these authors have suggested some criteria, which have been implemented in this dissertation. These include:

- *prolonged participation*, *engagement,* and *persistent observation in the field*: My research in Shallow River has taken the better part of two years with fieldtrips conducted over the seasons and with the intention of sampling varied work practices. Besides mitigating the interactional processes that are implicit in data collection methods such as research interviewing (see Chapter 6), longitudinal research builds rapport with the participants and increases the chances of encountering infrequently occurring phenomena. In Chapter 5, for instance, a fish culturist from another hatchery had sought Jack's assistance in combating a certain fish disease plaguing his hatchery. The captured (natural) dialogue discussing an enormous range of work practices and notions of expertise between

both men was truly a rare opportunity for most fish culturists normally work in isolation.

- *negative case analyses*: I revised my evolving hypotheses until these accounted for all known situations in the data. When negative cases were compared with other competing explanations/hypotheses in the data, it forced me to re-evaluate and determine the merits of the proposed hypothesis. For example, negative case analysis was employed in developing what constituted the learning organization in Chapter 4. I looked through all situations in my data that involved the creation of socio-material resources and analyzed what effect it had on the hatchery and SEP in terms of learning and new action possibilities. Conversely, I analyzed cases of absence or withdrawal of socio-material resources to ascertain the effects on learning in the organization.
- *progressive subjectivity*: A long process of checking evolving constructs, I kept short notes of my initial and ongoing hunches, concepts, and even anticipated results that I revisited at intervals during the research. More often than not, I made modifications which according to Guba and Lincoln (1989) indicated that I had not persisted in privileging a certain line of thinking.
- *peer debriefing with disinterested parties*: I presented my developing hypotheses to others for critique and comments. None in Michael's research group at the university were involved in my study of Shallow River and SEP and they served as critical colleagues without any vested interest during our sharing sessions.
- *member checking*: Member checking refers to the verification of facts and constructs by the participants themselves. Being a longitudinal study, it allowed

me to return to Shallow River repeatedly (or via means of a telephone call) for member checks that would not have been possible had the research been of a "flying visit" variety. Now, correcting errors of a factual nature was unproblematic but I was extremely wary of putting words or introducing *my* constructs into the participants' lifeworlds that Anthony Giddens called the "double hermeneutic" (Giddens, 1990). This was perhaps minimized when I consciously rephrased all my queries to participants using *their* wordings as far as possible and thus avoided leading participants in any particular direction (Edwards & Stokoe, 2004). This criterion of quality differs from what people normally associate with the process of triangulation as the strengths of the latter are in the verification of *factual* items rather than the *social constructions* offered by respondents themselves.

The above-mentioned criteria for quality in the analyses hold true across the various chapters in the dissertation but a point of clarification is needed. For Chapters 5 and 6 that extensively used DP, I have additionally tried to adopt what is known as the "discursive mentality" (Potter, 2004). Without being prescriptive—for DP is as much craft as science—researchers would be extra alert for a few other points concerning validity, including:

- *variation*: Variation in talk provides clues as to the purpose(s) of the nature of the work that the discourse is performing. I therefore attended to differences within the discourse of an individual (or over several occasions) and between individuals who spoke on the topic of interest. Of note, I considered what *was* said, as well as what *might* have been said. In this regard, the discourse of the fish culturists at

Shallow River offered a rich database in that certain topics were repeated but in different contexts and for different rhetorical purposes such as in the case of Paul the former fish culturist turned lecturer in Chapter 5.

- *detail*: Detail refers to the need for close attention to the subtleties that are inherent even in the most mundane fragments of discourse. Besides demanding that I spend an enormous amount of time with the collected data, I needed to be alert to participants' orientations, which is reminiscent of a DP version of the member-checking criterion for quality. At its simplest level, assuming that I found an explanation being proffered by a participant, it is expected that some form of an inquiry type of discourse would precede this fragment of talk. This was another salient point in Chapter 6 when I discussed how two seemingly innocuous words uttered by the interviewer ("None? Wow") had necessitated further accounting talk by the interviewee. Failure to consider these turn-by-turn moves would have cast the soundness of my interpretation into doubt (Antaki, Billig, Edwards, & Potter, 2002).
- *building on prior research*: A successful piece of analysis will build on any prior research conducted. Chapter 6 benefited from the huge corpus of studies that looked at identity from discursive approaches in general rather than specifically from interview research as was Chapter 5 guided by the established literature on discursive devices (Antaki & Wetherall, 1999; Roth & Alexander, 1997).
- *readers' evaluations*: In reproducing excerpts of talk within the restrictions of word length in journals, I have allowed for the independent checking and verification of my interpretations by the reader. I make this point in Chapter 5

when I argue that readers are far closer to the interpretive position of the analyst in discourse and conversation analytic research compared to most other studies of workplace learning and expertise that are based on ethnographic research.

Chapter 3

Background to Chapter 3

The first of three chapters on the theme of *Learning*, Chapter 3 combines two journal articles with a shared concern about the possibility of learning in seemingly mundane and routine work environments such as the hatchery at Shallow River. An earlier paper was completed in the fall of 2003 for an anthropologically inclined audience (Lee & Roth, 2004b) whereas the other was aimed at practioners, trainers, and academics within business and management circles (Lee & Roth, in press). If asked, I would attribute the origin of both of these manuscripts to an earlier departmental conference presentation (*Connections'03*) where I shared some preliminary research findings from the Shallow River project. On looking back, the three essential sociocultural themes of learning, identity, and history in this present dissertation were already identifiable in rudimentary form there. My immediate follow-up action from that seminal *Connections'03* paper was to develop the theme of workplace learning for two different audiences as I had already sent the editors of both journals a short abstract of my findings, which they then expressed tentative approval. This became an object lesson for me and reinforced Michael's (Roth) rule for successful publishing: "know and cater to your audience."

For the manuscript submitted to the *Anthropology of Work Review*, I located my study within a celebration and exploration of the remarkable craft knowledge exhibited by the fish culturists. In other words, readers appreciated thick descriptions of everyday life in the hatchery, which was reconstructed from a particularly detailed set of fieldnotes that I penned during a visit to the hatchery one summer's day (see Chapter 2). I

positioned the fish culturists as accomplished *bricoleurs* alongside other well-known exemplars in anthropology such as rural Mexican midwives, Brazilian fishers, and mechanics in upstate New York who together possessed embodied forms of workplace expertise. These studies would have been unfamiliar to readers of the second paper in the *Journal of Workplace Learning*. Had I persisted in developing these descriptions, it was likely that the manuscript would have been rejected and thus I substituted a more in-depth look at the theoretical arguments made instead. I was also fortunate in finding materials that spoke of the ubiquity of mundane work environments experienced by workers in Canada that assisted in supporting the practical importance of the study. It is this version of the *Connections'03* paper that forms the bulk of the chapter here.

Both manuscripts had asked a similar question, "How do seemingly repetitive actions that characterize mundane workplaces lead to expert behavior?" I wanted to convey a vigorously dialectical basis for learning (without unnecessarily burdening with concepts such as CHAT) that could result in some assertions regarding a mechanism for learning in the workplace. Assertions are brief statements that summarize a body of data and I have personally found them useful as building blocks to organize my thoughts and the evolving argument in the manuscript. My tentative assertions/hypotheses were then subjected cycles of revision and testing following the principles for quality or validity that were mentioned in Chapter 2. Using the exemplar of fish feeding in both articles, I demonstrated how a superficially mundane and routine practice could generate aspects of practical, embodied understandings of fish rearing. Sociocultural learning theories, usually premised on participation in some community, explain workplace learning well

up to a certain extent. I extended beyond these heuristics and tried to account for learning in repetitive and mundane work environments from a strongly dialectical perspective.

Supported by understandings I developed in discussions with Michael, I proposed that two dialectical processes drove the development of expertise in the Shallow River data. First, the *dialectic of doing* inevitably transformed individuals as they participated in activity over historic time. Traditional learning theories however require the injection of novelty and challenge to preclude habituation and stifle learning. Through this dialectic of doing, I realized that change always emerged in activity even if workers seemed to be doing the same thing over and over again. This was to be expected from a CHAT perspective that pointed to the mutual transformation of subject|object during activity.

Second, deeper experiential (practical) and conceptual (scientific) knowledge emerged when fish culturists initiated and conducted scientific experiments leading to the *dialectic of practical understanding and explaining.* On the one hand, the design and execution of scientific experiments required practical understanding of fish culture; on the other hand, practical understanding developed by means of experimentation. A leap-frog metaphor is apposite here: prior, embodied understandings exist, that when subjected to questioning and analysis, new forms of practical understandings surface and the cycle resumes. These two dialectical processes can account for learning in places that at first sight do not seem conducive for learning, change, and transformation. Besides extending the notion of learning beyond participation in some community, the findings suggests a need to rethink the nature and possibilities of learning in repetitive and mundane work environments that are believed to be so widespread.

The (Unlikely) Trajectory of Learning in Shallow River Hatchery

Programs of lifelong learning recognize that the development of competencies does not terminate with formal education but continues in various forms throughout the lifespan. One corollary is an increased focus on the nature and process of workplace learning that dominates so much of adult life (Billett, 2001). As my interests lie in the domain of adult education, I was concerned about reports stating that a fair number of Canadian workers had expressed dissatisfaction regarding the mundane and routine quality of their work (Livingstone & Sawchuk, 2004). A representative survey of a thousand workers conducted in 1997 indicated that one fifth believed that they held jobs requiring skills significantly below their level of expertise or experience. An earlier 1994 survey of more than four thousand employees also revealed that nearly 40 percent felt that their jobs did not require a high degree of skill (Lowe, 2000).

While it is understood that these surveys reflect the sentiments of participants, it is also believed that they conceal the true extent of workplace learning and expertise or what has been called *invisible work* (Nardi & Engeström, 1999; Suchman, 1995). Ethnographic studies in the workplace have brought to light high levels of complexity for seemingly routine and mundane occupations such as assembly-line workers, dairy workers, warehouse packers, waitresses, repair technicians, and phone operators (Scribner, 1986; Smith, V., 2001). In addition, the high levels of competency demonstrated by these workers usually surpassed any codified training manual or courses provided for by management (Kusterer, 1978; Orr, 1998). Yet, these so-called lesser-skilled personnel are thought to underestimate the cognitive demands of their workplaces

(Berryman, 1993). Workplace learning is often unrecognized for what it is because people

> do not think of their job as learning . . . what they learn *is* their practice. Learning is not reified as an extraneous goal or as a specified category of activity or membership. Their practice is not merely a context for learning something else. Engagement in practice . . . is both the stage and the object, the road and the destination. (Wenger, 1998, p. 95)

While there have been studies documenting the extent of expertise and skilful behaviors in workplaces, the research community lags far behind conceptually in explaining the nature and process of that learning in all its multiple dimensions (Berryman, 1993). Countervailing the dominant paradigm, whereby expertise is seen as independent of setting and located in the "heads" of individuals, workplace knowledge is better considered as stretched over people, objects, events, and cognitive practices (Hutchins, 1995). Assumptions that knowledge is an intellectual activity originating and residing in the mind are therefore at odds and in fact incompatible with the notion of skilful behavior arising from persons-in-situations (Il'enkov, 1991).

Work-related knowledge and learning are understood here to be not so much "a way of coming to know the world, but as a way of taking part in the social world" (Gherardi & Nicolini, 2002, p. 194). Two useful metaphors from the sociocultural tradition have gained wide currency in the literature—*communities of learners* (Rogoff, Matusov, & White, 1996) and *communities of practice* (Lave & Wenger, 1991). These metaphors generally eschew precise definitions of learning trajectories, though they are suggestive that learning occurs through some form of apprenticeship or participation within social groups. Knowing, learning, and transformation are thus seen as coextensive

with changing participation in continuously changing social relations that comprises everyday living (Lave, 1993).

In this chapter, the nature and possibilities of learning in the seemingly mundane and routine work environment of Shallow River salmon hatchery are described. As useful as the metaphors for learning described in the previous paragraph (and in Chapter 1 "Learning as a social process") may be, they are unable to clarify fully how people learn while engaged in supposedly repetitive work activities. It will be demonstrated here that learning, change, and transformation are all but inevitable in everyday work practices contrary to what it is often believed about such environments. When such work is further explicated or articulated such as during problem solving activities or by doing scientific investigations in this case, these actions can contribute significantly to extending one's practical knowledge in the workplace. These findings suggest a need for rethinking the nature and possibilities of learning in repetitive and mundane work environments that are believed to be so widespread.

Dialectics of learning

This chapter shows that expert practical knowledge of fish culturists in Shallow River emerged through their engagement in concrete work activity. Feeding fish for example, seems like a mundane or repetitive task for it is almost like a trademark, an index of fish culture—when visiting the hatchery one is almost sure of observing somebody engaged in this type of work. Yet, this will be used as an extended example to show how activity inevitably leads to change and learning, no matter how infinitesimal. Mundane work is not so repetitive, for the expertise that insiders clearly recognize against non-expertise shows that minute and invisible changes in actions eventually add up to be

visible as expert performance. There is a dialectical process at work, as every action is not merely reproduction but is also productive in nature leading to growing fish *and* to continuously developing expertise—a slightly newer, smoother or more economical way of doing things. If feeding fish was a merely repetitive act that is devoid of any learning then one is unable to account for the visible contrast in expertise between old-timers in the hatchery and that of recently hired workers.

It was found that a second dialectical process is at work. Practical understanding develops through a process that further interacts with conceptual understanding of fish culture. The origins of the latter arose when the fish culturists initiated and conducted various scientific experiments to resolve problems in the hatchery. By doing so, the lived, practical experience of fish culture was extended and deepened when fish culturists articulated their praxis of fish culture that concurrently depended on their vast prior understanding of fish culture in the first instance. But, this articulation of praxis was only possible because the workers already had a practical understanding. That is, practical understanding preceded, enveloped, and concluded theoretical analysis, but theoretical analysis led to deeper practical understanding. Thinking in these dialectical terms thus constitutes a theoretical advance over attributions of expertise to mere participation in some community.

In the next two sections, Jack will be used as the main protagonist to exemplify an aspect of the learning trajectory of an expert fish culturist employed in the seemingly mundane and routine work environment of the hatchery. The first *dialectic of doing* will be articulated with some ethnographic observations and then summarized in this section

by means of an assertion. Following that, the second *dialectic of understanding and explaining* will be described in a similar manner.

Dialectic of doing

Ethnographic observations

The task of feeding first begins in the small wooden shack next to the fish ponds where bags filled with commercially produced fish feed are stored. Jack fills a container with feed that is then weighed, and the figure recorded on a form tacked onto the wall. Walking to one pond and positioning himself at the perimeter, the task of feeding now begins. Collecting a handful of pellet feed in a scoop, Jack swiftly flicks it in a wide arc, allowing it to spread out as thinly as possible on the surface of the pond. This action is important for it affords as many fish as possible a chance to feed rather than those confined only to a small area where the feed lands if one merely performs a throwing/dumping motion. He pauses momentarily and observes how the fish break the surface of the water as they rush for the food. This is a critical juncture for now the fish on their part are "communicating with the feeder," which is how the fish culturists repeatedly described these moments. In Jack's words:

> If I was going to hire somebody I give them a bucket of food and watch him and if he can't feed fish, "Go! Next!" Plain and simple because that, I know, is the most tedious job for people, and if I can get somebody to do a tedious job well, then he should be able to do the non-tedious job really well! And feeding fish is important, and you'll hear people say well they don't want to stand there doing this but you gotta spend the time there, you have to do it! And you'll see your results, you'll see the results of different feeding techniques and it'll show in your fish.

Deep in concentration, Jack engages in assessing how hungry the fish are based on a variety of factors without, however, being able to specify objective criteria for this

assessment (Dreyfus & Dreyfus, 2005): how the fish break the water surface; depth at which the feed is taken; time of year; size of feed particles; and environmental factors such as water temperature and even air pressure. And being in charge of one or two species of salmonids per year enables Jack to know intimately the idiosyncrasies of each fish pond—to the workers, the salmon become like children. Jack resumes the feeding process and will continue so until he sees that the fish are satiated; again, when the fish "tell" him that they have had enough by some of the aforementioned signs. Whatever uneaten food is recorded and these numbers are later entered into a database that calculates the physical condition of the fish. Repeating the same feeding process another four to five times throughout the day for each pond makes fish feeding a somewhat wearisome job. Those who gain temporary employment in the hatchery are but little concerned with the fish ("It's just another job"). However, it actually affords an opportunity to "learn from the fish" for every act of feeding is a particular, unique event every time it is enacted. Thus, the task of fish feeding takes on a different dimension for old-timers.

> I like feeding fish I don't find it boring or tedious at all because I'm too busy trying to clue in to what they're doing. And that's what makes the job interesting.

> We look at visual things and we're with the fish everyday and if somebody's with something everyday they've gotta learn something unless they're just out to lunch... it's mostly visual how the fish react at times and it's just a gut feeling over time. (Jack)

Sometimes, the fish can fool inexperienced feeders, especially during cold weather when fish behave more sluggishly. These people usually give up after a few attempts of throwing feed into the ponds and watching this costly resource being ignored

by fish. However, doing this has long-term repercussions with regard to fish survival for being underweight not only lowers disease resistance but also increases the likelihood of starvation when the fry are later released into the rivers. Experienced staff know that the fish can be coaxed into eating by patiently offering a little food, stopping for a little while, offering again, and so on until all of a sudden, a feeding frenzy begins. This process is a skill to be learned by watching the fish over long periods of time and being acutely sensitive to environmental variables. New staff or part-timers are often unable to observe what experienced fish culturists can see during feeding time even when witnessing the same phenomenon.

Large hatcheries have increasingly resorted to feeding by mechanical feeders, a contraption that Jack detests for "machines feed ponds but people feed fish" as he often complained . His two major criticisms against machine feeding is that they are unable to adjust their output according to the level of hunger in fish or environmental contexts nor give a reasonable spread of pellets compared to the expert hand of fish culturists. The first is a reasonable claim for uneaten food on the bottom of a pond is a rich substrate for pathogens and a source of ammonia toxicity. The latter is perhaps a personal bias for Erin's new fish feeding contraption—a converted leaf-blower—assists without tiring, while leaving her with the freedom to decide where, when, and how long to feed (Figure 3.1 below).

Jack, however, remains unconvinced, and he does not look kindly upon any person who feeds fish with headphones plugged in their ears. According to Jack it is a fish feeder's duty to be alert to what the salmon are communicating during feeding, or at

Figure 3.1. The mechanical fish feeder that was converted from a commercial leaf-blower. It is seen here being towed into position next to a pond by a fish culturist. The machine, built by a fish culturist from a nearby hatchery, was exchanged for some excess feed in Shallow River. Photograph used with permission from Wolff-Michael Roth.

any other time—"I can put an automatic feeder on there and get the same result. I want somebody to tell me something, what they learned today about those fish so maybe I might learn something." His suspicions that fish feeders are inattentive or careless are further confirmed when they record something like *x* kilograms of feed repeatedly being consumed four or five times in a row that is a sure indication of either dumping food or fudging the results. Jack understands that fish are living organisms that exhibit variability in many aspects of physiology and as such are very unlikely to have a consistent appetite throughout the day. For these important reasons, mechanical feeders that were meant to relieve boredom are taboo to Jack for every action that they perform is always repetitive and uncharacteristic of sentient organisms that can learn and adapt or are sensitive to contextual cues.

Section summary

This study allows the formulation of the first assertion summarizing the results of these observations:

> Assertion 1: Actions might seem repetitive but are in fact always different and productive in nature leading to learning.

Fish feeding is not a simple or mundane task after all but one that is embodied and highly dependent on a whole host of environmental, biological, and contextual factors. The mastery of this activity, which is so vital to the success of fish rearing, comes about from engagement in actual work practices over extended periods. Contrary to the perception that Jack was feeding fish the same way 25 years ago, every instance of feeding fish is in fact not the same as the previous occasion when it was undertaken for the contexts are necessarily different. If this activity were merely repetitious, one would be unable to account for the evolution of skilful fish feeding. The Greek philosopher Heraclites already intuited that one cannot step into the same river twice, for fresh waters are ever flowing and altering the river. Calling it microgenetic development, representatives from the sociocultural tradition have implied that this process of learning occurs on a moment-by-moment basis throughout the course of everyday living (Billett, 2003; Rogoff, 1990). In the same way, the throwing movements of the fish culturists, though relatively similar and thereby reproducing the action, are never quite the same, opening themselves up for the production of change in the course of a career. This is what activity theorists understand by the mutual transformation of subject|object while engaged in activity.

Hence being different, but not completely so, makes change and learning in every occurrence of the task unavoidable. Even during the memorization of nonsense syllables,

making a bed, shaking hands with another person or something as mundane as opening a can, some meaning or comprehension always germinates in the subject and interpretation thus follows (Gallagher, 1992; Valsiner, 2000). Here, I differ from others (e.g., Jarvis, 1992) who believe that one has a degree of control in determining those experiences that would lead to learning or transformation. It is suggested that change is not only inherent in praxis but also coextensive with it. In the *dialectic of doing*, the familiar interpenetrates the unfamiliar and becomes the engine for interpretation and understanding.

For the fish culturists, then, all previous occasions of feeding fish existed as a resource for subsequent occasions of feeding fish. In other words, every act was intertwined with the past and the unknown future of possibilities. Certainly, Jack knows from and through his experience how to feed salmon in cold weather. But should fish still behave differently if they are also diseased for example, he would modify his feeding regime. From all these specific actions of feeding fish under various contexts, the fish culturists have gained a deeper holistic understanding of fish culture. Generalizing from the normal routine of feeding, fish culturists are able to adjust their feeding techniques during high air pressure conditions as I explain later when the fish will feed voraciously. At the same time, they know that every particular instance of fish feeding is different from all other occasions—its nature is *the same but not quite*. What works on this particular occasion under certain circumstances might not work in another as is commonly known. Fish culturists appreciate that all their fish are different by species, age, pond, and cohort and they can explain their peculiar feeding habits to anyone who cares to listen. It shows the deep embodied understanding that fish culturists have of their own fish, frustrating as this may be to DFO biologists, who sometimes recommend new

"scientific" feeding schedules and targets only to find them modified (at best) or ignored (at worst).

The dialectical nature of praxis thus can be described as a "blend of rule-following (reading the patterns) and confident extrapolation (into the new situation), and in this, both the routine and the contingent are present" (Beckett, 2000, p. 49). This tension or interplay of the routine and the contingent, the particular and the general, thus generated new understandings and contributed to the learning trajectory of practical expertise in the fish culturists. The results suggest that seemingly repetitive and mundane work practices can engender transformation and change that overturns the common notion that little learning occurs in such work environments. In the next section, I describe a second dialectical process occurring whereby this embodied understanding of fish culture was expanded by means of initiating and performing scientific experiments in the workplace.

Dialectic of understanding and explaining

Ethnographic observations

There is an upper limit to the types of questions that the fish culturists' practical knowledge can answer. Some pressing issues encountered in the hatchery involved, for instance, the questions about the best chemical for disease eradication, minimal levels of oxygen tolerated in the egg trays, or optimal stocking densities in the ponds. Mere observation could not resolve these issues. Furthermore when the fish culturists had to convince hatchery management about certain changes in practice, more convincing evidence was required than their own gut feelings. Hence, these workers initiated and conducted scientific experiments periodically to find explanations to phenomena that had

puzzled them in the workplace. I am unable to ascertain the role these experiments had on breaking any experienced monotony of daily work practices but time, sophisticated equipment, money, and lack of manpower had often limited the conduct of such doings. For instance, Jack in his 27 years of employment had conducted about five major experiments and innumerable smaller ones. During the period of our research, Erin kept careful observation records and conducted experiments pertaining to the effect of food type and food size on feeding rates. Geri conducted two experiments; one on the effect of hydrogen peroxide concentration on mortality rates during incubation and another on the survival of "super smolts" which are fish nurtured for an additional 12 months over normal rearing periods.

These experiments were central aspects of the dialectic of practical understanding and concept-based explaining. Practical knowledge, the "knowing how" of the workplace had arisen through participation in hatchery activities and long-term observation of the fish. Conceptual knowledge grew when fish culturists subjected these prior, embodied, and un-reflected understandings of fish culture to scrutiny and challenge in performing these science experiments. This mutual interpenetration of understanding and explaining thus contributed to the widely acknowledged expertise in these fish culturists. In what follows, two examples of hatchery experimentation involving Jack are provided; one on fish anesthetics and the other on air pressure.

Before fish anesthetics were commonplace, handling salmon during egg takes was always a stressful affair for both animal and fish culturist. Each struggling fish had to be restrained as best as possible in nets until they utterly exhausted themselves prior to being hand checked for ripeness (readiness for reproduction). With up to 2000 salmon to be

individually checked this way per day for up to a month, some fish culturists had complained that this toil had literally wrecked their bodies besides harming countless animals. It is thus noteworthy that Jack had pioneered the use of carbon dioxide as a cheap and rapid anesthetic to be used to calm down fish with little side effects to animals or humans.

Previously, a fisheries scientist had written a paper claiming that a chemical known as MS-222 was better than 2-phenoxyethanol as a fish anesthetic. A self-described "Joe Blow" with hardly any formal scientific training, Jack read through that report and spotted a serious experimental error for the two independent variables were not delivered at identical concentrations. Jack later repeated the experiment himself and found that there was actually no difference in efficacy for both anesthetics. In spite of this, he was still unsatisfied for both of these chemicals created side effects in fish. When it was later suspected that carbon dioxide was a potential anesthetic, Jack began modifying it for hatchery practices. Results from these experiments with different temperature regimes, water types, and size of fish were so encouraging that the use of carbon dioxide as an anesthetic is now widespread. A fish culturist from another hatchery, whom Jack described as "smart as a whip and able to write papers in his sleep," performed similar trials around the same time but utterly failed in his attempts for he lacked "practical knowledge" and thus "couldn't see anything" according to Jack.[21]

On another occasion, Jack suspected that environmental variables like air pressure and lunar cycles were influencing feeding responses. Through repeated visual

[21] I describe this incident with Paul in greater detail in Chapter 5. Chapters 4 and 7 also mention these experiments with fish anesthetics in the contexts of creating new socio-material resources and organizational identification respectively.

observations, Jack made the association that high pressure was correlated with increased feeding activity. Being more than a hunch and eager to prove it to himself satisfactorily, he requested his helpers to record barometric pressure against a simple feeding response scale. Earlier, Jack had sought the assistance of a government biologist (Brad) whose job was to assist the hatcheries on scientific or technical matters for this investigation. Brad had worked closely with Jack before on other scientific experiments that the latter had initiated including those on water quality, disease management, and egg hatching. Although Jack and his peers usually initiated these projects, the support biologists helped fish culturists in designing them as scientifically rigorous control studies. This had to be "good, tight experiments so nobody could shoot them down," for "the tighter you can make it, the better it's going to be and the faster you're going to get results" (Jack).

To Jack's disappointment, there was no statistically significant correlation of feeding response with air pressure after collecting data over 12 months. Yet, to this day he insists that they are important variables, "as obvious as your nose on your face" for he believes that living organisms are attuned and affected by weather changes to a far greater degree than human beings. Although Jack had continued watching the barometer for a period of time, he now just observes his pet cat's behavior for similar to the hatchery fish, it responds behaviorally to weather fluctuations. Though this investigation was conducted 15 years ago, when he observed recently that the fish were unexpectedly jumping in the water and had poor appetites, he quickly associated this phenomenon with pressure changes after having ruled out all other possibilities.

Section summary

It is now possible to formulate the second assertion summarizing the results from these observations:

> Assertion 2: Practical understanding develops dialectically with conceptual understanding when the latter is subjected to scrutiny.

How is Jack able to behave in important respects like a scientist for one that has just college education and 14 years of prior working experience as a plumber? If one further realizes that hatchery management and DFO had provided scant training in terms of formal courses or fish culture manuals then Jack's achievements as a competent hatchery worker are even starker. Indeed, if the argument that fish culturists become experts by participation in the hatchery community that would still be unable to explain how their rather mature knowledge of science had developed. One saw for instance, how objective Jack was in relation to new scientific claims, his ability to spot bias in scientific papers and desire to replicate the anesthetic experiments. His wanting to make "good, tight experiments" and long term collection of data are likewise hallmarks of scientific practice as is his knowledge of dependant (fish responses to anesthetics or air pressure) and independent variables (types of anesthetics, air pressure) in experimental design. Even a form of scientific skepticism was observed in Jack for he explained that even if

> DFO comes with a new procedure, we'll look at it and if it looks like it's not gonna fly well, we'll do an experiment and that's what I tell students or anybody that I, even you guys have I talked, if I tell you something you don't believe me, prove me wrong and if you do we both learn somethin'. But if you go away, goin' like this, well, we haven't really learned a whole lot, you know.

This is explained, in part, by means of another dialectic, the *dialectic of understanding and explaining* that extended but also necessitated their practical embodied knowledge in the first place. Understanding is a characteristic of our way of

being in the world, and one that is based on practical experience (Ricœur, 1991). Called also an initial understanding, it is an overall but unexamined grasp of meaning. Likewise, the fish culturists had built up an enormous store of embodied knowledge, their practical experience of fish culture, which is practical understanding that has not (yet) been articulated or may forever resist expression. When problems occurred while the fish culturists undertook scientific experiments, they relied on this foundation of practical understanding as a guide. Performing these experiments that developed the fish culturists' conceptual understandings involved the kind of structural analysis of fish husbandry that "bring[s] out the logic of it, the operations that relate the 'bundle of relations' among themselves" (Ricœur, 1991, p. 163). But understanding requires explaining (generalized knowing) to avoid dogmatism in which case the initial understanding was transformed thus contributing to Jack's trajectory of workplace expertise. Activity theorists describe this learning by the reciprocal interplay of "experiencing or knowing the immediate circumstances... and processes of thinking beyond and about the immediate situation in more general terms" (Lave, 1993, p. 13).

To elaborate, Jack would not have been able to appreciate the significance of the experiments without his deep embodied prior understandings of fish culture required in articulating any experimental and control variable; he would not have been able to initiate thinking about solving these problems in the first place. Taking the air pressure experiment, for instance, it seems unlikely that anybody other than a fish culturist spending huge amounts of time observing the fish would have devised a hypothesis to test the effect of air pressure with feeding responses. Being involved in the experiments altered his understanding of fish culture as well—he appreciated the critical role of

environmental variables in a deeper sense compared to others who had not participated in such activities as we saw when Jack feeds fish in cold weather. For all these kinds of behaviors in their work practices, the fish culturists in the hatchery became widely regarded as experts even by fisheries scientists in DFO.

Conclusions

Other studies—for instance, among rural Mexican midwives (Jordan, 1989), Brazilian fishers (Robben, 1989), or mechanic *bricoleurs* in upstate New York (Harper, 1987)—have described aspects of the natural, inevitable learning arising from bodily performance in everyday work practice. Sociocultural metaphors of learning have, however, not fully explicated the trajectory of expertise that constitutes the focus of this chapter. In the case study here, I show the nature and process of learning to be an expert fish culturist in Shallow River Hatchery, a seemingly mundane and routine workplace. On the basis of these findings, the findings extend beyond models that explain the growth of expertise through participating in relevant work practices. Instead, practical and conceptual understanding can be described as developing in a dialectical manner. This transformation into experts is portrayed against a backdrop of seemingly low skilled and repetitious daily activity in the workplace said to be common in Canadian society. Indeed, this chapter was prompted by an initial observation that there was an apparent incongruity with the high level of practical knowledge demonstrated by the fish culturists and the relatively low level of formal training in aquaculture that the fish culturists had received. Coupled with the apparent monotony of the daily routine in the hatchery that is dominated by the task of feeding fish about five to six times a day, it seemed difficult to explain how expert workplace knowledge had developed. Certainly, the repetitive and

mundane nature of work practices, such as those found in the hatchery, were believed by some learning theorists to stifle innovation or experimentation by being conformist in both the process and outcome of the action. The critical role of novelty in enhancing workplace learning was additionally something that was assumed as lacking in hatchery work practices.

For these reasons, understanding the trajectory of expertise in fish culturists was thought to be especially insightful. If there has been a perception by a segment of Canadian workers that their jobs are predictable or unchallenging, then examining how learning and transformation had developed under comparable situations in the hatchery might help alter beliefs that these kinds of work lack significance. At no time do I wish to defend these work practices, much less condone any exploitative, alienating or destructive (physical and psychic) forms of work. Instead, these results demonstrate how learning and expert workplace knowledge as a way of being in the world had emerged from, and despite situations of, routine and mundane work practices.

One should be less concerned with the perception that some jobs are mundane or routine (which might reflect genuine sentiment) but that the possibility of learning in these work environments is downplayed. I want to affirm that learning is all but inevitable in seemingly repetitive chores. This is because every enactment of the task is non-identical from other occasions of its doing—hence being different but not completely so—it leads to change and learning. For these fish culturists, engagement in the same activity over time led to a deep embodied understanding of workplace practices that extended beyond fish feeding. This work activity transcended its basic chore of delivering food to be a means of intimately knowing the fish and a reflection of one's

identity as an expert. Through the agency of individuals who are undergoing changes in their own forms of practice, there are concurrent changes in the very structures that frame these activities. Jack was not only becoming an expert through feeding fish but also was transforming the character of everyday work in the hatchery, which activity theorists define as the change in the dialectic of agency|structure. Even if his colleagues were unaffected by this change in Jack, anthropologists would still understand this as a (re)making of workplace culture. In short, individual change and learning is constitutive of change at the collective level, and equivalently, cultural change always implies individual change that I describe more completely in Chapters 4 and 7.

When the practical understandings of fish culture were articulated and explicated in the conduct of scientific experimentation, these initial understandings were deepened and contributed to the trajectory of learning in the workers. The value of these two kinds of knowing is alluded to from a memorable sentence from Jack himself: "[to be a good fish culturist] you gotta have some bookwork but you gotta have some practical work." It is thought that he beautifully summarized, albeit inadvertently, the trajectories of workplace learning and expertise that he and other fish culturists had taken. Certainly, salmon hatcheries are unique environments but these findings indicate that opportunities for learning and transformation are always present in seemingly routine and mundane workplaces.

Chapter 4

Background to Chapter 4

In the process of completing the text for Chapter 7 on collective identity, I had obtained a reasonable grasp of the closely allied field of organizational learning. Because none of the articles I surveyed had considered the latter in terms of the individual|collective dialectic, I decided to write a new piece on learning (this chapter, which is the second of three on this theme) that explicitly addressed these concerns. The existing literature, in fact, relied upon static and dualistic conceptions of learning in collectives. Now, I tried to answer two related problems: "Who learns and how in the learning organization?"

Other than the few papers informed by structuration theory (e.g. Berends, Boersma, & Weggeman, 2003; Sarason, 1995), this was an original attempt using CHAT to understand the learning organization in an alternative way. The framework was fundamentally dialectical: in their actions individuals concretely reproduced the organization and, when actions varied, realized it in novel forms—organizations therefore presupposed individuals that concretely produced it; but individuals presuppose the organization for acting in the patterned organizationally-appropriate ways in which they do. Without an organization, therefore, there would be no aim or orientation for individual actions to speak of in the first instance. The upshot of my argument here was that learning organizations presupposed learning individuals just as individuals who learnt presupposed learning organizations. Additionally, it was individuals who learnt, not some abstract notion of organizations, through the production of socio-material resources that transformed the configurations of participation (learning) for others in the

activity system. Expansive learning in individuals was thus co-constitutive of expansive learning in organizations whereas decreasing interest in individual learning constituted lowered levels of action possibilities for the collective.

I drew on four mini-case studies from the Shallow River data that exemplified learning in the organization (i.e. SEP and DFO), which occurred during the production of new socio-material resources. Whenever a new way of doing things was established, or a new piece of equipment made available, or a different way of approaching a problem was shared with other colleagues, this was equivalent to organizational learning. On the one hand, the individual benefited. On the other hand, the collective benefited as well and organizational culture (the activity system) consisting of shared tools, routines, and artifacts underwent transformation and change, as these elements were configured and available in new, contingent ways. These socio-material resources increased action possibilities for the collective whether realized concretely or not. Because culture changed, the modes of participation were no longer the same and learning therefore transpired.

Regarding the practical applications of the study, I raised the issue of opening access to participation in the collective by all members within the organization. This was a line of reasoning that is being made by increasing numbers of experts in organizational theory; everybody, regardless of hierarchy in the firm, has something valuable to contribute to the functioning of the collectivity. For some time, the question whether a trivial behavior like making a cup of coffee for a colleague could be legitimately considered as learning troubled me. Michael (Roth) clarified by stating that as long as the object of the activity within the system was ultimately served, any particular action could

be seen as meaningfully contributing to organizational learning. It is my intention to submit this chapter to *The Learning Organization*, which is a publication devoted to discussions on how organizations learn and innovate. Targeted mainly at practioners, the style is less academic in tone and the word length shorter than most other journals.

The Individual|Collective Dialectic in the Learning Organization

> We had these workshops and everybody [went], well, not everybody—one or two people from the hatchery. Well to me, that's not trying to solve the problem. Well, you're not getting everybody involved because there's people out there that are just feeding [fish] that don't know anything really about fish that might see something. So, let's say one of these people wasn't there and all of these people [at the workshops] are banging their heads and not getting anywhere when this person wasn't invited. But if he was there and say, "Well, I saw this." And then all of a sudden the light comes on and everybody starts, "Oh, wow! We'd better look at that!" So, the more people looking, doesn't matter what your education is or who you are, you never know. (Part of interview transcript with Jack)

As a researcher who is situated in the broad discipline of adult learning, I have become intrigued with the notion of learning organizations. My ongoing fieldwork in a rather unique workplace—Shallow River salmon hatchery—has however reinforced my growing suspicion that scholars have tended to neglect how organizations and their members presuppose each other. By this, I mean that individual and collective development is mutually constituted during periods of stasis when little learning is apparent, and also during times of expansion, amplified choices, and possibilities that are said to characterize learning organizations. One of the main informants from the hatchery, Jack, had articulated what I feel is the essence of a learning organization in the opening interview excerpt by advocating that everyone in the organization be given a chance to participate in the collective life of the organization. The presence or absence of individuals mediates what the organization can learn collectively: "all of a sudden the light comes on and *everybody* starts..." And everybody also means *every body*: collective learning inherently means learning of the individual. In his own way, Jack had recognized the importance of micro-macro linkages in the learning organization that I

find highly agreeable within a framework that forges individual and collective into one irreducible, dialectical unit. As I shall elaborate, learning individuals make learning organizations what they are, while the latter provide affordances[22] for its members to develop.

Much has already been achieved in recent years regarding the understanding and theorization of learning organizations. Pertaining to the elemental but problematic definitions of *organizational learning* and *learning organization*, for example, these are generally believed to be distinct though interrelated constructs associated with different communities of practice (Sun & Scott, 2003; Wang & Ahmed, 2003). A phenomenon such as identity, previously believed to be pertinent only at the level of individual members, is now considered to be coextensive with learning in groups[23] (Wenger, 1998). While the track record of translating most of these research findings into new work practices has been mediocre (Huber, 1991), this has not deterred many private and public-sector corporations in attempting to become learning organizations (Beauchesne, 2001; Stoyko, 2001). In fact, there appears to be an evolutionary (societal and market-related) context that puts pressures on organizations to convert themselves into learning organizations for corporate failures and breakdowns have often been attributed to deficiencies in organizational learning.

Although theoretical knowledge about organizational phenomena has increased tremendously during the 1990s, some scholars have stated that many of the change

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[22] An engineering term that refers to the set of opportunities that are allowable in that particular situation or context. With these sets of opportunities comes certain limits to action as well (Erickson, 2004).

[23] I further develop this claim in Chapter 7.

initiatives to become learning organizations are premised on a mistaken dichotomy between the polar opposites of individual and collective (Child & Heavens, 2001; Huysman, 1999; Stacey, 2003). These explanations begin from either pole and reduce the other dimensions to a causal consequence: either individual learning is said to constitute the basis for organization learning—the fallacy of reductionism—or organizations are believed to analogously learn like persons—the fallacy of reification and anthropomorphization (Berends, Boersma, & Weggeman, 2003; Virkkunen & Kuutti, 2000). To elaborate, grounded in technical or behavioral theories of the firm that has dominated thinking in the past, many scholars have focused organizational learning research on how knowledge is acquired, interpreted, processed, and stored thereby inherently objectifying it. With striking congruence to classical psychological theories of learning, disciples in this field concluded that

> [a]ll learning takes place inside individual human heads; an organization learns in only two ways: (a) by the learning of its members, or (b) by ingesting new members who have knowledge the organization didn't previously have. (Simon, 1991, p. 125)

Models of organizational learning based on individual learning processes have also been appraised negatively by critical psychologists, for a "psychology that deals with averages in the hopes of achieving generality through abstraction can never become relevant to the particular individual" (Tolman, 1991, p. 5). Similarly, a formal and top-down approach that ignores local contingencies was said to be implicit in recent knowledge-creation paradigms of organizational learning (Engeström, 2001). It can be argued that all these might be conceptual viewpoints that are located at the extreme ends of the spectrum but at the same time, these ideas are not uncommon in the management literature.

In this chapter, I therefore bring insights from CHAT to propose an alternative explanation to the related questions of "Who learns, and, how in the learning organization?" A dialectical approach distinguishes this analyses whereby the individual and collective presuppose each other. By so doing, I avoid theorizing learning in organizations beginning with the individual or the collective that has been a persistent shortcoming in other studies. To exemplify my arguments, I draw on various episodes from a study of a public-sector organization, the Salmonid Enhancement Program, in British Columbia. I show how actions performed by individuals can be seen as simultaneously constituting individual *and* collective learning.

The Salmonid Enhancement Program—A non-learning organization?

Begun in 1977, the Salmonid Enhancement Program (SEP) initially was a joint federal-provincial venture that was entirely managed by the Department of Fisheries and Oceans Canada (DFO) two years later. Following a century of equivocal progress in the artificial rearing of Pacific salmon, SEP was heralded as the culmination of best practices in fish rearing and biological science. Using a variety of strategies ranging from habitat restoration, spawning channels, fish ladders to strongly interventionist (though efficient) approaches like fish hatcheries, the original mandate was to double the catch of salmon, which would have translated into desirable socio-economic, environmental, and recreational objectives that I elaborate in Chapter 8. Organizationally, the program now consists of more than twenty staffed hatcheries and several research laboratories at different locations in British Columbia. Although the organization has been plagued with severe fiscal cuts from the time of its inception, SEP still consumes most of DFO's annual budget for its Pacific region, which gives an indication of the importance attached

to this fish by the federal government. As described below, these issues about spending were implicated in the learning trajectory of SEP. Besides the rank and file workers in the hatcheries—the fish culturists—there is also a veterinarian on staff and several support biologists to bridge the gap between big science research and the hatcheries. Fish culturists and government scientists work largely independently though there are occasions when the hatcheries serve as important project sites in scientific experiments.

The report card for salmon enhancement seems to be mixed after a quarter of a century for fish numbers have not reached targeted figures while the program has been plagued at various times with deep controversy especially with regard to the hatcheries that it operates. In the ongoing public debate about salmon enhancement, SEP has been blamed more than once for being an organization that does not learn from experience (Hilborn & Winton, 1993; Hume, 1997), and for having censored or revised information that was damaging to its corporate image (Glavin, 2000; Thorne, 1997). Whether SEP was truly a learning organization remains an empirical question (Brown, 1981; Winton, 1991) for the purpose here is to document a *mechanism* of organizational learning by describing four mini case-studies from Shallow River Hatchery. These explanations are based on the dialectical relation between individual|collective: in their actions individuals concretely reproduce the organization and, when actions vary, produce it in novel forms; the idea of an organization therefore presupposes individuals that concretely realize it. However, without an organization, there would be no aim or motive to individual actions. Individuals orient toward the organization (however ephemeral it might exist for them as a collective body), which therefore provides a framework within which each individual action makes sense. That is, the actions of each individual, constitutive member

presuppose the organization. In the first two case studies, I show how individual learning constitutes collective learning while the subsequent two demonstrate how the lessening of interest in individual learning constitutes decreased learning opportunities for the collective.

Performing experiments in Shallow River Hatchery

One aspect of the workplace in Shallow River was the freedom and encouragement management gave in the early days to the fish culturists to seek scientific solutions in improving their fish husbandry practices. In this context, each action therefore also produced outcomes that constituted new resources for future actions at the individual *and* collective levels. For example, a specific experiment that showed that easily obtainable carbon dioxide gas was equivalent in efficacy to the ubiquitous MS-222 anesthetic used at the time now provided new options for the individual fish culturist who ran the investigation and for all those who found out about the experimental results. In common with other activity theorists, I understand such increases in action possibilities or room to maneuver as learning (Holzkamp, 1983; Tolman, 1991). Here then, the controlled experiment in which carbon dioxide and MS-222 were compared led to an increase in action possibilities for the individual fish culturist and to the hatchery as a whole: they could now choose, according to personal preferences and accounting for other constraints such as toxicity to humans, purchasing costs, and other costs among alternatives. Therefore, although based on and starting with the interests of one particular fish culturist, the outcome led not only to the individual's learning but also to learning of the hatchery collective: individual and collective learning occurred simultaneously and—because of the previously articulated, dialectical relation between individual|collective—

presuppose one another. In fact, the different action possibilities always exist even though at any one moment none of the fish culturists chooses either carbon dioxide or MS-222. If an extreme situation is reached whereby there exist no choices to make, learning becomes something that is merely reproductive and determined in nature. The organization can thus rightfully be said to have ceased being termed a learning organization.

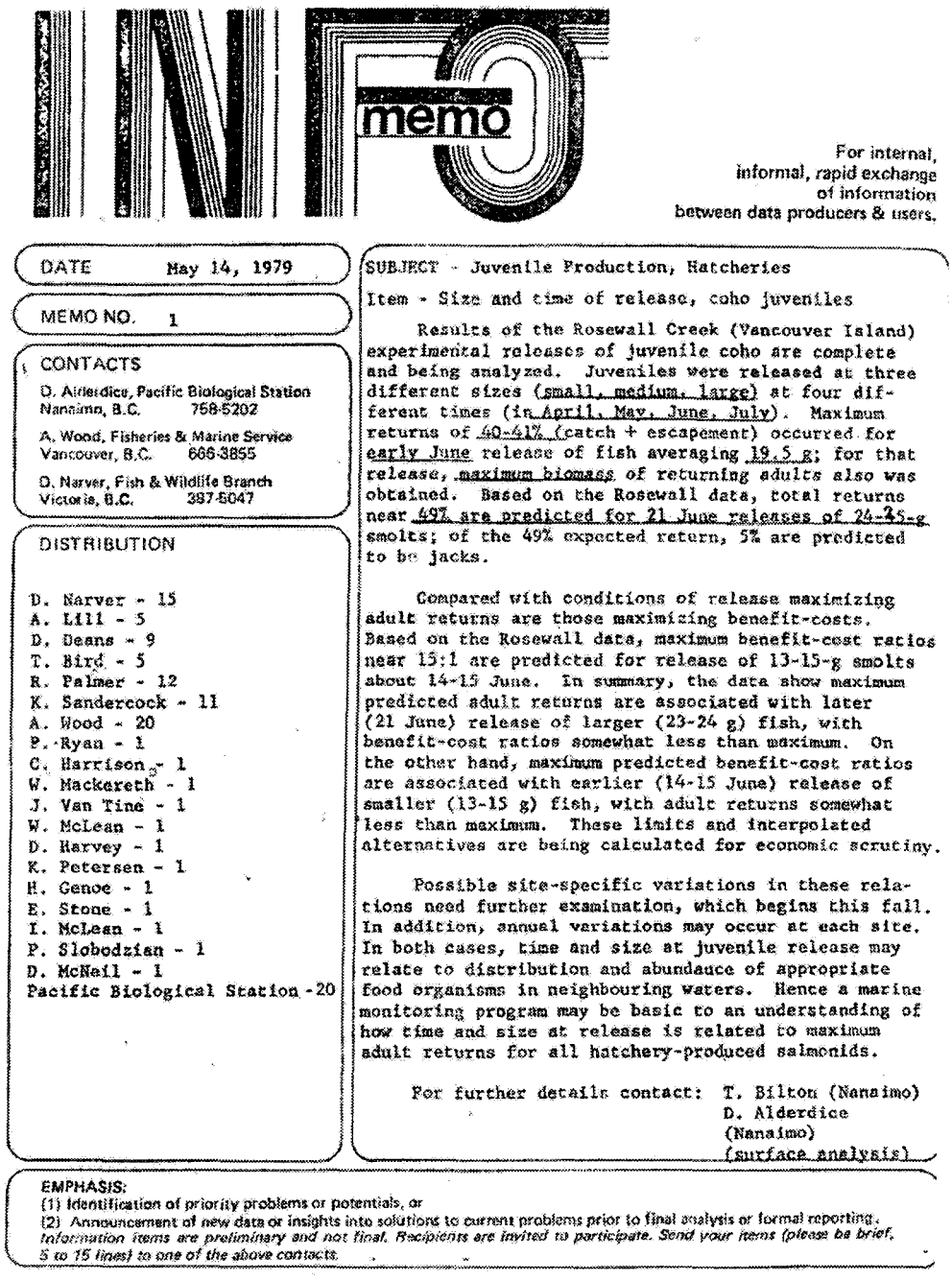
Devoting a large part of the day to feeding fish had contributed towards an embodied and tacit knowledge of salmon in these workers. Some fish culturists could even tell the temperature of pond water without using thermometers while others could estimate the flow rates there merely by observing the behavior of the fish. Possessing these prior understandings and a curiosity for what made their fish "tick," the fish culturists formulated various hypotheses that could be tested scientifically whenever time and funding permitted. Basically concerned with optimizing production, the experiments had centered on issues of fish nutrition, health, growth, and behavior. Some were of short-term duration over a few months or weeks while a few stretched over many seasons. The fish culturists initiated and performed the scientific experiments largely on their own (with some planning assistance from DFO biologists), constructing knowledge that were unknown to the SEP scientists in particular and the scientific community more generally. At the same time, the fish culturists' knowledgeability of fish husbandry deepened because the experiments forced them to articulate and make explicit previously tacit know-how of fish husbandry. It certainly comes as no surprise to hear that the practitioners at Shallow River are widely acknowledged as one of the most skillful in the province as I described in the previous chapter.

This expertise nonetheless, did not remain confined to certain fish culturists but diffused in various forms to the rest of Shallow River and throughout SEP. During weekly staff meetings in the hatchery for example, experimenters often shared details about progress in their projects and thus kept other colleagues updated. Although sometimes the outcomes enjoyed a wider audience during DFO organized meetings, usually news that someone was working on, or, had solved a particularly tricky problem got around to other SEP facilities via word of mouth. Occurring whenever somebody dropped by in Shallow River or through the support biologists who moved around the many SEP facilities under their charge, this became an informal though efficient communication network. Hence, relying on the telephone or occasionally coming down in person for some hands-on experience, other SEP staff who faced similar fish husbandry problems as that encountered in Shallow River could readily benefit from the latter's experience. This network was more than a localized phenomenon for all the support biologists in the province once shared a common office in SEP headquarters, which led to a spread of action-supporting resources and therefore to the expansion of action possibilities at the collective level. Coupled with other facilities performing their own experiments in seeking local solutions, it constituted an overall increase in the action possibilities within SEP. Yet, there was another tool whose very existence directly contributed towards making SEP a learning organization—the *InfoMemos*.

Mass-circulation of resources for action: SEP InfoMemos

In what follows, I describe how an artifact, the *InfoMemo*, produced by individuals or groups of individuals assisted in making SEP a learning organization with greater action possibilities for the collective (see Lee, 2004). Not only did these

InfoMemos furnish material resources in that every facility had access to this rapidly expanding database of fish husbandry but also it catalyzed changes in work practices. Consisting of brief reports (usually a single page of text or diagrams), they were aimed at offering a "rapid, informal means of communicating new or useful information at a preliminary or pre-publication stage" (Alderdice, Wood, & Narver, 1984, p. vii). This practice of producing and sending around InfoMemos began when a SEP biologist recognized that some forms of knowledge about fish husbandry derived from the fish culturists' experiments were very beneficial although these studies might never pass the gatekeepers of "proper" scientific journals. Therefore, rather than risk the chance of tentative and potentially useful knowledge claims being lost, InfoMemos were created as a means to articulate the knowledge and thereby make it available at the collective level. Submission criteria were kept intentionally simple; results were written up briefly in a technical language accessible to all fish culturists and sent to the part-time editors (three DFO scientists) before redistribution throughout the SEP organization. Participation rather than exclusion seemed to be the rule as whoever had potentially useful information to share did so in the hope that somebody else could find a vital clue to solving their own problems. InfoMemo topics from the years 1979 to 1984 for example, spanned a huge spectrum from water quality issues, feed quality, growth rates, incubation techniques to fish diseases among many others (Figure 4.1 below). Some contributions were less than a hundred words in length (InfoMemo # 11) while others even shared what staff had observed when visiting an overseas aquaculture facility (#27). Still others advertised useful books (#12) or just gave tips on what had worked in their particular workplaces (#53).



INFO memo

For internal, informal, rapid exchange of information between data producers & users.

DATE May 14, 1979

MEMO NO. 1

CONTACTS

D. Alderdice, Pacific Biological Station
Nanaimo, B.C. 758-5202

A. Wood, Fisheries & Marine Service
Vancouver, B.C. 666-3855

D. Narver, Fish & Wildlife Branch
Victoria, B.C. 387-5047

DISTRIBUTION

D. Narver - 15
A. Lill - 5
D. Deans - 9
T. Bird - 5
R. Palmer - 12
K. Sandercock - 11
A. Wood - 20
P. Ryan - 1
C. Harrison - 1
W. Mackereth - 1
J. Van Tine - 1
W. McLean - 1
D. Harvey - 1
K. Petersen - 1
H. Genoe - 1
E. Stone - 1
I. McLean - 1
P. Slobodzian - 1
D. McNail - 1
Pacific Biological Station - 20

SUBJECT - Juvenile Production, Hatcheries

Item - Size and time of release, coho juveniles

Results of the Rosewall Creek (Vancouver Island) experimental releases of juvenile coho are complete and being analyzed. Juveniles were released at three different sizes (small, medium, large) at four different times (in April, May, June, July). Maximum returns of 40-41% (catch + escapement) occurred for early June release of fish averaging 19.5 g; for that release, maximum biomass of returning adults also was obtained. Based on the Rosewall data, total returns near 49% are predicted for 21 June releases of 24-25-g smolts; of the 49% expected return, 5% are predicted to be jacks.

Compared with conditions of release maximizing adult returns are those maximizing benefit-costs. Based on the Rosewall data, maximum benefit-cost ratios near 15:1 are predicted for release of 13-15-g smolts about 14-15 June. In summary, the data show maximum predicted adult returns are associated with later (21 June) release of larger (23-24 g) fish, with benefit-cost ratios somewhat less than maximum. On the other hand, maximum predicted benefit-cost ratios are associated with earlier (14-15 June) release of smaller (13-15 g) fish, with adult returns somewhat less than maximum. These limits and interpolated alternatives are being calculated for economic scrutiny.

Possible site-specific variations in these relations need further examination, which begins this fall. In addition, annual variations may occur at each site. In both cases, time and size at juvenile release may relate to distribution and abundance of appropriate food organisms in neighbouring waters. Hence a marine monitoring program may be basic to an understanding of how time and size at release is related to maximum adult returns for all hatchery-produced salmonids.

For further details contact: T. Bilton (Nanaimo)
D. Alderdice (Nanaimo) (surface analysis)

EMPHASIS:
(1) Identification of priority problems or potentials, or
(2) Announcement of new data or insights into solutions to current problems prior to final analysis or formal reporting.
Information items are preliminary and not final. Recipients are invited to participate. Send your items (please be brief, 5 to 15 lines) to one of the above contacts.

Figure 4.1. The first SEP InfoMemo released on 14th May 1979, which reported on the relationship between size and time of release of coho juveniles.

Similar to the previous situation with scientific experimentation at Shallow River hatchery, members contributed to their own and collective learning through the InfoMemos (a socio-material resource) while the structure of SEP (management, scientists, funding) enabled and sustained its inception and flourishing. The actions within the organization were thus twofold in nature; they reproduced the existing organization and produced new structures at the same time. This increased the action possibilities within the organization and therefore constituted organizational learning. One should not forget that individuals rather than the organizations performed the actions, which therefore constituted their own learning, but the actions were possible and made sense at the collective level of the organization. Here, the collective level actually exceeds the sum of actions concretely realized—in the organization, there are always action possibilities that are not concretely realized by any one individual, though the possibility always exists (Il'enkov, 1977). These action possibilities exist in, arise from, and constitute organizational culture. What we know as the phenomenon of learning organizations are thus constituted by possible actions that are enacted and expanded with both social (e.g., new personnel at various levels of competency, routines, rules-of-thumb) and material resources (e.g., new machinery, funding). Innovations such as the InfoMemos were thus important elements to extend new action possibilities from an individual to his or her local organization (hatchery) and to the entire organization.

In opposition to traditional conceptions of learning, it seems best to consider learning as a form of changing participation in a changing world that the InfoMemos and hatchery experiments seemed to exemplify. By freely sharing solutions on an organization-wide basis without putting barriers on who was qualified to do so, it was

partly responsible in allowing SEP to overcome many fundamental problems in fish rearing in the early years. Through their participation, variously placed individuals in the organizational hierarchy from professional biologists to technicians to fish culturists all facilitated in making SEP continually responsive to ongoing challenges that characterizes what is termed a learning organization. Participation, it must be added, is not a matter of "being present" or "doing something" but of joint ownership and joint responsibility to that activity system that has been united by a common object (Garratt, 2000). By engagement in collective life, individual learning leads to an expansion of general (collective) possibilities because individuals always co-constitute the very organizations to which they belong. While such positive transformations are always welcomed, individuals may in all likelihood produce and reproduce an organization in stasis, which is how the next two episodes now unfold.

Withdrawing from hatchery experiments

In the following accounts, I trace part of Jack's learning trajectory as he limited the action possibilities for himself and SEP by neither participating in major experiments in the hatchery nor in locally organized conferences for fish culturists.[24] One underlying paradigm in the literature on learning organizations emphasizes the role that key personnel and management play as the primary agents of change (Elkjaer, 2003). From the analyses, however, this position has to be reassessed for I show how the agency of "ordinary" workers like Jack can deprive themselves and their organization of new socio-material resources. Indeed, this argument finds no conflict with a small but growing

[24] I enlarge on this withdrawal from experimentation and the fish culture conferences by Jack in the context of organizational deidentification in Chapter 7.

recognition that all individuals have the potential to facilitate or to impede learning organizations (Dierkes, Antal, Child, & Nonaka, 2001).

The Jack of old can hardly be more different from the present person that one encounters during a visit to Shallow River Hatchery. His current behavior and attitude can perhaps be summed up when he told us that giving "300%" to the organization was unfortunately a thing of the past. Now, he merely works to rule for he declares that "I just don't have the drive anymore to do it, I don't have the fire to get down there and really get it going." What circumstances had led to this transformation? From the interviews, I discovered that in the mid-eighties he had initiated an extensive series of investigations on a mysterious disease known as crib death. Especially lethal, it killed huge numbers of juvenile fish without warning and as such was dreaded throughout all SEP hatcheries. After planning the investigations, doing the fieldwork and collecting data for five years, the results were handed over to a hired biologist to write for publication. When asked the reason for this, Jack replied that writing, especially scientific texts, was a task totally beyond him. After some time, the biologist resigned and the findings never saw the light of day. Jack said, "I was kind'a let down with that, I was really disappointed" and from that point onwards, he devoted less and less energy to doing experiments.

Due to the absence of mediation by other members in the organization, Jack experienced a severe limiting of agency and room to maneuver. Jack earnestly wanted to pinpoint the cause of crib death even though the findings from his experiments were merely suggestive and inconclusive. Hence, not getting a piece of the puzzle disseminated to the wider community was a major setback, which he responded by withdrawing gradually from participation in research. Such setbacks led to a negative

emotional valence with respect to the collective in general and management in particular. His attribution of incongruities to the culture and structure of the corporate unit led to his withdrawal. According to sociologists of emotion (e.g. Turner, 2002), the lowering of both individual commitment to the collective and willingness to play roles in the corporation is a typical response to such setbacks.

In Jack's withdrawal, mediated by the hatchery management and SEP, learning was therefore diminished both at the individual and collective level. First, Jack no longer actively expanded his own action possibilities by conducting experiments and articulating his own practices. Prior to this incident, he had even constructed Plexiglas equipment by hand so that he could study the behavior of the fish in his makeshift laboratory in Shallow River such was the enthusiasm that he possessed. Jack certainly continued to be a competent fish culturist and therefore a valuable (constitutive) member of the hatchery organization, but he no longer engaged in active learning. Second, at a collective level, there were fewer new resources that expanded the action possibilities in the hatchery. This decreased the learning potential of the hatchery and the SEP organization as a whole. That is, the organization did not collapse due to the actions of the other colleagues who sustained it but it experienced stagnation when Jack consciously diminished his possibilities for action and chose instead to reproduce the status quo. If this type of phenomenon were thoroughly pervasive, all learning would cease both at the individual and collective levels.

Two further points are germane: First, Jack's withdrawal was influenced by his negative emotional valence; but all future actions that made the withdrawal visible further (re)produced the negative emotional valence. Second, because Jack is a constitutive

member of the hatchery collective, the overall emotional valence also decreased. But collective emotions presuppose individual emotions (e.g. Collins, 2004), so that the workplace as a whole lost in its drive to become a learning organization.

Boycotting the conferences

Becoming a learning organization is like a fast moving, two-lane highway; individual agency and organizational structures dialectically determine its flow with mishaps sometimes occurring. In the final mini-case study, I focus on an episode whereby events at the collective level mediated the learning of individuals and ultimately learning at the general level. Again involving Jack, we see how severe cost-cutting measures in SEP decreased opportunities for participation and constituted obstacles for individual and collective learning.

About 20 years ago, SEP organized conferences for the fish culturists whereby these workers could come together and, as insiders described it, "talk fish." These conferences were motivated by a vision similar to that behind the InfoMemos: to facilitate knowledge exchange within SEP, within and between hatcheries and between hatcheries and the scientists. Presentations were kept informal; fish culturists briefly shared their successful practices or the interim results of their experiments in language that was free of scientific jargon. In common with other conferences, most of the truly useful knowledge exchanges about fish culture were made over refreshments instead of within the official program. Attendance was initially open to all fish culturists in the early years but due to supposed budgetary cutbacks, participation soon dwindled down to a single person from each hatchery afterwards. At this stage, Jack, for example, registered his extreme annoyance about the lack of representation by boycotting the conferences

entirely for he believed that everybody had something to contribute whatever their level of education as we read in the opening interview excerpt of this chapter.

The corporate history of SEP revealed that cost-cutting drives have plagued hatcheries almost from the time that they were built thirty years ago. These macro-level contradictions have had repercussions in that it was increasingly difficult for planners to maintain normal operations with shrinking budgets. Thus, the loss of a single attendee at a conference (which was personally salient in Jack's explanations that opened the chapter) might not seem remarkable from the perspective of management. However, this reasoning is indefensible when one recalls the individual|collective dialectic that links micro-macro levels in the learning organization. Whereas previously fish culturists like Jack were active contributors in the conference, SEP and DFO now forfeited his experiences in fish rearing that could have made a difference to somebody just as Jack also lost the chance to extend his personal understanding of fish culture from interacting with other colleagues. Here again, the mutually constitutive nature of individual and collective learning comes to the fore.

Conclusions

The purpose of this chapter was to articulate the relationship between individual and organizational learning in a dynamic way that eschews the dichotomies and reductions inherent in other approaches. Drawing on case-study material, I illustrated a way of framing individual|collective learning as coinciding as soon as individual and collective are theorized as mutually constitutive (presupposing) entities. Hatchery experiments, InfoMemos, and fish culture conferences constituted tools for individual and collective learning, for they expanded the action possibilities of all individuals in the

collective. Because these resources were freely circulating in the organization, the practice of fish rearing was continuously changed as new action possibilities evolved throughout SEP. The distinction between individual and the collective learning is erased, as both levels exist dialectically—individuals constitute the organization while the latter enables or constrains the former. On the other hand, stasis in organizations also involves occasions of non-learning in individuals and the collective. I exemplified this situation in the accounts of the withdrawal of one fish culturist both from experimenting and attending conferences. Both Jack and the organization as a whole contributed to and mediated this withdrawal and the reduction in individual and organizational learning.

I began with two interrelated questions, "Who learns, and, how in the learning organization?" Previous theories about learning organizations that analytically started at the individual or organization pole ignored the fact that both are different but inter-dependant expressions of each other. Learning always begins from concrete individuals but by the mere fact of engagement in practical activity, the collective is co-constituted which is another way of framing the individual|collective dialectic argued here. I summarize the conclusions in one sentence: dynamic and expansively learning organizations presuppose dynamic and expansive individuals; dynamic and expansive individuals presuppose dynamic and expansively learning organizations.

Chapter 5

Background to Chapter 5

The contents of this chapter were first presented at the 2005 annual meeting of the American Educational Research Association (AERA) for a CHAT Special Interest Group session. An earlier version of the writing, however, took a very different stance in that it was a polemic against school systems claiming that failure in schools was largely the consequence of failing schools. In this portrayal, educational structures were oppressive and exclusionary institutions that maintained an ideology of deficit thinking to explain underperformance. This line of argument was loosely modeled on Michael's (Roth) previous tale of Davie, a boy labeled as learning disabled and a trouble-maker in school but, oddly enough, an accomplished environmentalist and mentor outside the classroom (Roth & Barton, 2004). Accounting for failure or success in these situations were thus attributed to changing forms of participation in different activity systems rather than taken as durable characteristics of persons. As I claimed on page 100, learning and knowledgeability are better understood as outcomes of "person-in-context transactions rather than in terms of knowledge or skill housed within human minds."

In common with the Davie story, I had some Shallow River data that showed how Jack experienced school failure in the past despite being acknowledged as an expert worker now. What was perhaps the Achilles heel in my argument was that the effects of time could not be discounted, that is, Jack was not only crossing activity systems from school to the workplace, it was also a temporal displacement. Forty years of maturation and development in his life and career were not easily dismissed. In any case, I was later compelled to drastically revise this proposal for an AERA reviewer brought to my

attention that my claims "lacked originality." Importantly, this person had indicated that my presentation would probably *not* interest him or her in attending nor was the contribution to the field significant, which immediately set off alarm bells. The reviewer asked:

> I'm receptive to the argument, but it sounds very familiar. Back into the 1960s, and increasingly with the socioculturalists/activity theorists, we've had arguments that the culture/practices of the home don't always match those of the school, and that school evaluation systems don't accurately capture all competencies. What is your research adding to this long tradition? (Comments from Reviewer #1, taken from AERA website)

Michael then suggested that it might be valuable to examine how Jack had accounted for his own learning in the workplace from a standpoint informed by discursive psychology (DP). This seemed reasonable and so I re-analyzed the data using the concepts in DP, which I had some familiarity. Now, I encountered a new problem. What was the chapter's relationship to CHAT and to the dissertation in general? In order to make the writing relevant for an AERA audience interested in CHAT, I located the study within the wider sociocultural movement to explain workplace learning. I explained that these frameworks had attracted much attention over the last two decades and that they were united in affirming how expertise or knowledgeability was a contingent, situated achievement that was co-constitutive of workers' identities. Given that many of these studies of the workplace were based on ethnographic and interview methods, I then gained a potential foothold for critique. The thrust of the chapter became an explanation of some shortcomings in ethnography (which have already been extensively critiqued and discussed elsewhere) and research interviewing in workplace research (which I had written about in the paper that forms the basis of Chapter 6). To me, a failing of most sociocultural approaches to generate theory for workplace learning were the forms of

reporting that did not relate to participants' everyday lives because many were overly theoretical in nature (e.g. Wenger, 1998). I proposed examining participants' accounts of workplace learning and expertise from a DP framework as a possible corrective to some of the aforementioned problems.

I tried to demonstrate the use of analysts' concepts—*school-* and *workplace-based learning*—as discursive devices to reconcile these seemingly opposing ways of knowing by Jack. Almost approaching the level of dogma, CHAT theorists and scholars from various disciplines demarcate schools and workplaces as opposing systems with different motives and objects of activity. That these notions, which also featured in Jack's accounting, might not seem extraordinary being culturally available resources in society. There is, nonetheless, one important point of departure—these were participants' concerns rather than concepts originating from the researcher. I felt that this was the message that would interest CHAT researchers: participants could, and do, utilize analysts' concepts in their accounts without being conscious of doing so. Without stating it explicitly in the text, this phenomenon was the agency|structure dialectic at play for these discursive categories were available at the general level of society but were concretely realized by particular individuals. In concluding this final chapter on the theme of learning in the dissertation, I affirmed the value of understanding the phenomenon of workplace learning directly from member's accounts and interpretations, which has been neglected in the sociocultural literature on workplaces.

After writing the paper, it occurred to me that Jack might had consciously oriented to the aims of our research for I had found occasions whereby he discussed our motives for research in Shallow River to help bridge the gap between local and scientific

knowledge. In one example of an exchange that aroused my suspicions, one can see Jack declaring that:

> Jack: You see this is where I like Mike [Roth], this is where I like the wolf man. Because he, he wants scientists to treat us the same way like we're not under the scientists, like we, you and I have valuable information, the scientists have valuable information, we should share our information and we both go away the wiser! We can't put a wall up and say, "Well I've got a degree, I'm not going to talk to those guys" and we can't say, "Well we don't have a degree and we're not going to talk to you."
>
> Eric: Who said, the scientists, do they like us?
>
> Jack: Well, Mike's trying to get them so that they like us. You know what I mean, is that is that, am I wrong or, or share information, not basically to like us but share...
>
> (Excerpt of interview transcript with Jack and Eric [another fish culturist] on 31 Jan 2003)

I could dismiss any fears of generating leading questions on my part (c.f. page 49–50) but this orienting behavior by the participant was something beyond my control. If my hunch was accurate, it would have severely damaged the credibility of the findings for then most of what Jack said would had been what he thought we *wanted* to hear. A distressing situation, it was an identical dilemma that an anthropologist working among the *Lue* tribes in Northern Thailand had once experienced (Moerman, 1974). I then consulted Michael who had interacted with Jack for much longer periods than I had, including over many informal and social occasions away from the hatchery. With some relief, I learned that the same discursive devices that Jack employed were not only present in my data set but were observable over many other un-recorded occasions of natural talk. In other words, the phenomenon that I reported seemed a stable feature in Jack's accounting, at least for the past five years. Again, this highlighted to me the importance of having a sufficiently large data set from which to detect any disconfirming cases, if any (Silverman, 2004).

The chapter has since been submitted for review in the *Journal of Workplace Learning*. As such, the citations used, locus of interest, style of what is acceptable, and allowable manuscript length have made the text here assume the form that it did for that particular audience.

Learning about Workplace Learning and Expertise from Jack

Sociocultural approaches to explain the learning that occurs in workplaces have attracted much attention over the last two decades. Learning is defined here as changing participation (for the individual) in a changing world, that is, in terms of person-in-context transactions rather than in terms of knowledge or skill housed within human minds. Eschewing any dichotomy that threatens to separate people from social situations, new vocabularies have therefore been coined to unravel the phenomenon of workplace learning. Descriptive and theoretical concepts including "situated cognition," "distributed learning," "communities of practice," and "cognitive apprenticeships," among others, are now traded freely. Making participation in some culture or community the focus of attention, scholars also promote exploring the shared routines, artifacts, languages, and stories that distinguish newcomers and old-timers (Lave & Wenger, 1991). Scholars in these traditions share the conviction that knowing lies in acting; sets of patterned actions constitute a *practice* that embraces the idea that workplace knowing and learning are verbs and not static entities to be acquired, possessed, or transferred between individuals. By the same token, some researchers have begun downplaying terms such as "organizational learning" in favor of "learning-in-organizing" because of the inability of the former to capture the situated, dynamic, and relational nature of knowing (Gherardi, 1999).

Despite their increasing popularity, researchers still ask if sociocultural approaches have been adequate in explaining the intricacies of workplace learning and expertise. Already, there are critiques of the popular "communities of practice" notion from a variety of angles (e.g. Bradley, 2004; Edwards, A., 2005; Huzzard, 2004; Sfard,

1998). Apart from these epistemological questions, I wish to raise in this chapter some methodological shortcomings in the sociocultural learning literature about workplace learning and expertise. Most have relied upon thick ethnographic descriptions that have been invaluable in uncovering how routine jobs are complex and how complex jobs are made routine (Smith, V., 2001). Granted that these methods embody many nuances, the conduct and reporting of these forms of studies together with the ubiquitous research interviews that accompanied them are not without problems. These issues are the focus of this chapter to which a possible corrective is offered that can enrich future inquiry into the phenomenon of workplace learning.

The "silent" employee

Ethnographic studies of work and workplace learning have, as a whole, suffered from findings that are either too specific to local contexts (the problem of generalization) or are too broad (the problem of relevance) to furnish any useful information for intervention purposes (Berryman, 1993). Problems of access to employees up and down the organizational hierarchy as well as stopping the analyses at the level of description rather than proceeding onto explication has also prevented many researchers from realizing the full potential of their efforts (Smith, V., 2001). At other times, these forms of inquiry have made it difficult for any independent verification of data (e.g. checking of fieldnotes) by readers—"we are either in his [the ethnographer's] camp or not: possibly converted, but never convinced" (Moerman, 1988, p. 93). This, I believe, is indicative of a wider loss of participants' voices about their learning trajectories. For example, a major review of workplace competencies reported that

> many conceptions of competence are not those of the agent or employee but of some other party, i.e. the researcher. Limited emphasis has to date focused on employees' conceptions of competence and how such conceptions may influence notions of workplace learning and in particular the learning process. (Garavan & McGuire, 2001, p. 150)

Given that researchers are locked tightly within circuits of production, consumption and exchange in academia, this situation is perhaps unremarkable. Known also as the analysts' paradox, it refers to the "need [to] access . . . participants' insights in order to be able to understand the participants' practices and tacit knowledge structures but at the same time . . . report them explicitly in the language of research" (Sarangi & Candlin, 2003, p. 274). I argue that this situation is problematic on two interrelated counts: the first raises the possibility of a direct access to social reality from participants' talk (interviewing in the broad sense), which I critique in the next section while the second concerns what is called "decontextualized generalizations" (Francis &Hester, 2004). By this, I refer to the tendency to view specific actions and talk by research participants as expressions of some larger, abstract phenomenon rather than situated accomplishments that are worthy of empirical investigation in themselves. Privileging the analyst's authorial voice and interpretive commentary, the object of interest lies *behind* talk/action rather than seen as co-constituted during the process of enactment. Even when ethnographers have sought to adopt categories or concepts that have been derived from participants' choice of terms, these do not usually fit conveniently into researchers' inferences and conceptions. Because of these prior theoretical commitments, one often finds that the high-level abstractions and post-hoc reconstructions do not easily gain acceptance with participants nor bear close resemblance to their everyday lived experiences (Potter, 1997b). Accordingly, sociocultural studies based on ethnographies

can sometimes fail to uncover the intricate ways in which workplace learning and expertise are actually accomplished on a moment-by-moment basis through talk.

Pitfalls of research interviewing

If investigations into workplace learning and expertise have been generally negligent of participants' voices, attempting to make meaning of those voices is equally problematic. Interviewing is one of the most recognizable and widespread data collection tools available for workplace researchers. Yet, getting participants to characterize their learning via interviews has been acknowledged to be difficult and subject to multiple interpretations, for workers do not generally view their learning as distinct from other aspects of everyday life. When asked explicitly to articulate their learning, the nature of these responses tends to utilize conventional, culturally available terminologies in society about learning and education (Boud & Solomon, 2003). These terminologies that privilege abstract, theoretical knowledge (Brown & Duguid, 1991) are sometimes intended for the researcher rather than highlighting the meaningful and concrete particulars of a person's workplace (Smith, D. E., 1999).

Above all, research interviewing as a method to examine workplace learning and expertise has usually ignored the interactional effects of talk (Hammersley, 2003). Until recently, analysts have glossed over the fact that *how* one talked about learning was as critical as *what* one said concerning the phenomenon. Whether acknowledged or not, researchers are indeed co-participants in this process of reifying social order and reality. This, I believe, has implications that have not been fully appreciated by many researchers in the field. For instance, the use of narratives as assessment tools for workplace learning has recently been promoted (Inman & Vernon, 1997). Insofar as employees describe

situations about what the organization is, where it is heading, and what it was in the past, they make sense of the collective (and themselves) as characters in a developing and coherent story (Ricœur, 1992). Seemingly offering a transparent window into workplace learning, what is forgotten is that talk is a fluid rhetorical construction that emplots characters in contingent ways depending on the contexts. Some scholars even view the interview event purely as a social encounter between researcher and participant that takes precedence over any disclosure of content matter that arises. Few workplace learning researchers who have used this method seem to have been aware of or have made explicit its co-constructive nature (contra Boud & Solomon, 2003; Majors, 2003). As a result, many continue to make strong assumptions about obtaining a direct access to events, structures, and other phenomena through this method.

A discursive analytic approach to workplace learning and expertise

In contrast to those who are optimistic that the combined merits of ethnographic studies (observing what participants do) and research interviewing (hearing what participants say they do) will remove any discrepancies between thought and deed by participants and make for better research, I claim that this is unwarranted. The first assumes fidelity in data collection, which already acknowledged as improbable, does not necessarily translate into reporting and new conceptual understandings that do justice to human agents as mentioned. The second claim assumes that any information can be mined, at face value, depending the skill of the researcher, the willingness to divulge information and so forth. This ignores the interactional nature of the event that requires enormous rhetorical effort to co-accomplish successfully.

I therefore suggest an approach to understanding workplace learning and expertise—discursive psychology (DP)—that attempts to do justice to participants in the research process while attending to the interactional nature of interviewing broadly defined (see Chapter 1). To the best of my knowledge, this has never been undertaken before by workplace researchers and it offers a distinctive strategy towards overcoming some of the aforementioned problems. Compared with much of the current literature on workplace learning, understanding this phenomenon as *part of lived practices* rather than contemplations or interpretations on them promises to return human agency to where it rightfully belongs.[25]

In what follows, I analyze transcribed excerpts of fish culturists accounting for their trajectory of workplace learning and expertise in Shallow River salmon hatchery. By no means are these extracts exhaustive in characterizing what is workplace learning; my intent is to provide a demonstration of the larger possibilities that can arise from taking a discursive perspective. I have identified two analysts' concepts—school- and workplace-based learning—used by fish culturists as discursive repertoires/resources (c.f. page 21) to account for their expertise, knowing, and learning in fish husbandry. Workplace-based knowing in their accounts encompassed notions such as interest and practical experience whereas school-based knowing was treated as abstract and theoretical with minimal practical relevance. Although there was a weak correlation between these two categories according to the fish culturists, the importance of both kinds of knowing were ultimately reconciled by means of a discursive device. I conclude this chapter by emphasizing understanding the phenomenon of workplace learning

[25] Even in work that explicitly draws on DP, vigilance is still needed to prevent imposing analysts' categories onto participants' talk (Edwards & Stokoe, 2004).

directly from member's accounts and interpretations that has thus far been neglected in sociocultural learning research of workplaces.

Members' accounts of learning and expertise in the workplace

Job interest and the low correlation between school and workplace knowing

Drawing first from an excerpt involving Jack, Eric (another fish culturist) and the research team, I show how interest in one's job discursively built up the phenomenon of workplace learning and excellence. Keen interest resulted in securing practical experience and getting the "best product" although neither were closely related to the amount of education that a fish culturist previously obtained. By making themselves allied with the farming community and in opposition to students, Eric and Jack positioned themselves as able workers with craft knowledge but with modest levels of school-based knowledge.

Episode 1: 31 Jan 2003

1. Researcher 1: So, most of the things you guys just learned on the job, the hard way?
2. Jack: Yeah
3. Researcher 1: Like you said...taking the fish with no anesthetic.
4. Eric: Well, I can I can only I can tell you what I've seen. What I've seen is that there are guys like us who have wanted to do it, have come in and try to grab what we can. And I've even seen students come in, with the, the theory and, and not the experience and kinda get disillusioned because it's not sitting in an office.
5. Jack: Yeah, I . . .
6. Eric: It's no different than going to a farm, there's no difference. I mean you're not, it's not just (?), you can put anything on paper, but I mean if you have heart in it, I mean, and it, what I, what I have on paper is immaterial. It's the product that I'm putting out. If I feel that is good then I'm happy. That's what I want.
7. Jack: That's what we're at. And we can go from there, if we wanna go more advanced in a different area then we can eh? But like Eric said we're fish farmers, that's all that we are, basically. And try to get the best product to go out and the healthiest state to come back.

> And like I was saying, some of the best farmers on the prairies have Grade three education. We're just farmers.

Episode 1 began with the researcher posing a question to Jack and Eric, which both fish culturists then oriented to this opening. After a brief "yeah" by Jack, the researcher elaborated this response by bringing up an earlier story about handling fish without sedatives that is not reflected here. Eric then stated that his account was based on experiential authority, which discursively rendered his statements more trustworthy. Eric now categorized Jack and himself as belonging to the "guys," who had expressed interest in their jobs, and, by implication, benefited/learnt during the course of their work. Against these were the "students" that Eric positioned as the alternative member of a standardized relational pair (e.g. master-student, husband-wife, right-wrong) (Lepper, 2000). This particular choice of terms carried connotations of youth with incomplete mastery of the domain, perhaps even training under compulsion. For listeners, this contrasted two types of people: newcomers possessing abstract school-based knowledge versus old-timers like Jack and Eric who gained practical experience on the job. Continuing to elaborate his workplace repertoire (Edwards & Potter, 1992) in turn 6, Eric now realigned the fish culturists with another membership category[26]—the farming community. As long as one had the "heart" or interest, paper qualifications did not really matter in these two occupations for the proof of the pudding was in the eating. Having interest in one's work was the key to a "good" product and personal satisfaction. Eric is doing more than describing the different types of employees that he has observed; he is in fact constructing the identity and learning trajectory of expert workers with us and for us.

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[26] Membership categories, a concept derived from Conversation Analysis, define an identity for a certain group of people (Lepper, 2000).

In turn 7 Jack accepted Eric's preceding assertion and now incorporated elements of the previous story into his own. There was a twist, however. By stating "that's what we're at" rendered this an *extreme case formulation* that made Jack's talk discursively vulnerable. In other words, Jack affirmed the correlation of interest in one's job and generating the best product and ensuing satisfaction that was possible however minimal one's educational attainment was. In the following sentence however, Jack conceded that further learning was possible after all rather than being rigidly predetermined (by past educational qualifications). This mitigating sentence was the second of three parts in a conversational structure known as *showing concessions* (Antaki & Wetherall, 1999). Not qualifying or mitigating the first sentence—a discursively vulnerable position—would have allowed the claim in the extreme case formulation to be easily undermined or dismissed. However, the third part of the device embedded with the contrast markers "but," "that's all," "basically," and "just" returned listeners back to earth and served to overturn the preceding concession. What rhetorical work the third section did was to reprise and strengthen the initial claims that a limited school education was in fact no obstacle to workplace knowing and expertise because interest in one's work carried far more weight. This was what excellence in farming and fish culture shared at their most fundamental level—skilled craft workers who generally possessed modest amounts of school-based knowing. Jack then summed up by reminding everyone that some of the best farmers on the prairies had but an incomplete elementary education—school and workplace knowing were indeed weakly correlated. That this kind of talk came from the research participants is interesting for they had utilized, as discursive resources, one of the canonical distinctions or polarizations used by sociocultural theorists (i.e. schools and

work as separate activity systems) to account for their own trajectories of learning (Le Maistre & Paré, 2002).

Practical experience is vital for workplace knowing

I was fortunate to have three parallel accounts by Jack of a failed scientific experiment conducted by a colleague named Paul. After unpacking two of these episodes and a different one involving engineers in Episode 4, one gains a better appreciation of how much Jack valued what he called practical experience in his workplace (see Harris, Simons, & Carden, 2004).

Episode 2: 27 February 2002

8. Jack: ...same with carbon dioxide years ago . . . one of my fellow workers screwed up on on carbon dioxide for an anesthetic and ah and it went it did it he said it didn't work. Okay so and I got back into it, it worked for me and what happened he made a mistake somewhere but didn't catch his mistake, I wasn't helpin' him so I didn't know, not that I'm tryin' to sabotage his, his experiment and stuff I just wasn't involved in that situation. So when I got it, it worked, I thought well there's nothing wrong here, how simple can we get. It's just put it in and it works. And then I tried it in different water temperatures, all sizes of fish, saltwater, freshwater and it worked fi-, it worked fine.

This episode began with a discussion (not reflected here) about whether Jack took heed of what the other hatcheries were doing in terms of scientific experimentation. It was in this context that Jack first revealed to the researchers the circumstances surrounding an experiment involving carbon dioxide as a possible fish anesthetic. Jack succeeded in getting results rather easily ("when I got it, it worked") whereas his colleague was continuously disappointed. Apparently, Paul had made a mistake but was unable to pinpoint the source of the error. The experimental set-up was said to be simplicity itself ("nothing wrong here, how simple can we get. It's just put it in and it

works") under various experimental conditions, which acted to throw the failure ("screwed up, "mistake") into stark relief. At the same time, Jack tried to dilute his agency and maintain his neutrality in the affair by stating that he did not assist in the experiment (hence unaware of the full extent of complexity) nor did he attempt to sabotage his colleague's project.

Episode 3: 11 March 2003

9. Jack: There is a guy here at (?) and he had knowledge that you wouldn't be- but no practic-, nothing practical eh? Smart as a whip, could write papers inside out and backwards, probably could do it in his sleep, he tried carbon dioxide and it was a big disaster. So, something wasn't working right for him but he didn't have that insight to try to figure out this isn't going to work so...Yeah, he's [a] fish culturist and uh that was on carbon dioxide. Well, he, now he's one of the head honchos at...one of the colleges anyway at College River they do adult programs whatever. So he left here and went up there. So that's more suited for him, that's great but he wasn't really a fish culturist because he was too smart to be a fish culturist. He didn't have enough practical, and he couldn't see anything, you know? Like he couldn't see or observe? . . . the lights didn't turn on. So, and then he tried it and I tried it and it worked great!

Episode 3 represents the most elaborate explanation of Paul's failure that showed Jack's artful use of school- and workplace-based knowing as discursive resources. One hears that Paul had great knowledge and was able to write scientific papers without any problems. However, Paul was "too smart," which disqualified him from being a genuine fish culturist according to Jack. One is reminded here of the first episode in this chapter that spoke of the modest levels of education obtained by most fish culturists. Reasoning in deficit terms, the lack of practical knowledge and insight in this workplace was said to have prevented Paul from making critical observations ("the lights didn't turn on"). Now that Paul was a senior teacher in College River, this was felt to be more appropriate for he was finally in his element. In other words, college teaching was the correct category-

bound activity and location for Paul, a person said to be "too smart to be a fish culturist." Revealing important identity work in the process, Jack had articulated one obligatory trademark of fish culturists: sufficient practical knowledge, which manifested itself in knowing precisely what to see in the workplace.

Besides explaining the importance of the practical in the workplace by means of an anecdote about some engineers that he once met, Jack now suggested a means of rapprochement between school and workplace knowing in this next excerpt.

Episode 4: 11 March 2003

10. Researcher 1: Um Jack, what jobs do newcomers begin with when they come to the hatchery?

11. Jack: Basically they're doing stuff that we don't want to do you know? . . . I was there, I've done it all and uh my philosophy is you start at the bottom and work your way up and I think that just makes you a better fish culturist and a better person instead of coming out of school like some of them do, figure they're going to start at the top, oh man, forget it man, you know? Like I was with engineers at (?) that didn't know one end of the pipe from another and was trying to tell me what to do and I, it doesn't work! You get out and work with the tools for a while and then go back to school, then come out hey it's just going to make you a better engineer, way better than if you're just going to sit on your &^%$ in the university.

It comes as no surprise to discover that Jack promoted starting at the bottom (assuming nothing about fish culture) and working one's way up in the workplace. This was according to him the recipe towards developing into a better fish culturist and person. Claiming that he "was there" and had "done it all" coupled with "my philosophy" increased his stake here and made the claim difficult to be disputed (c.f. page 22). This granted invaluable practical workplace experience, which Jack exemplified by some engineers that he once met. Possibly coming fresh out of school with a wealth of theoretical knowledge but with nothing practical, they unsuccessfully tried to teach this

ex-plumber with 14 years work experience what to do. The contrasts were rhetorically exploited to their maximum: professional, university-educated engineer versus high-school educated fish culturist; little practical experience versus abundant real-world experience. This excerpt parallels what was earlier described about the weak correlation between school and workplace knowing. Yet, Jack also suggested a form of boundary crossing between schools/universities and the real world as the ideal arrangement for genuine workplace competency. Using a discursive device, Jack thus discursively reconciled the two apparently opposing systems.

The ultimate importance of school- and workplace-based learning

Two common analytic concepts—schools (theoretical, bookwork) and workplaces (hands-on, practical work)—were used as interpretive resources to work up Jack's account of learning and expertise in the hatchery. When there were potential conflicts in mediating these seemingly opposing repertoires, a discursive device was then introduced which affirmed the ultimate necessity of both kinds of knowing.

Episode 5: 31 Jan 2003

12. Jack: It's like I was fortunate one time I taught for a week at Carnation College at (?) for fish farmers. So they asked me to do it. David the manager was supposed to do it and he put it off on me, and I thought holy shit. You know, I got no experience to teach and I was making big bucks, three hundred bucks a day for five days, wow! So I went through all my stuff and I had...And I already had about ten or more years of experience and I thought, well that's what I'm going to do. And I went into the library and I saw books were written, bullshit (?). I put them on the table and I said to the students the first thing you do you get rid of this shit! Put it onto the floor, I says whatever I teach you in five days you take with a grain of salt, ok, if you don't believe me, you prove me wrong, and if I'm wrong we both learn something, that was my approach. Uh I said the best thing to do is to look at scientific papers, make your own books, this was at this time eight years ago. I think I had one university student in there and he gave me the worst critique of the,

> of the whole thing. And basically what I, what I did was I taught with my experience, and that's what I did. And showed them things that we did and what to look for, and, and be cautious of books be cautious of even papers because the biologists. So that's what I said to them, "Just take everything with a grain of salt and if you wanna know then you, try to prove that to yourself the best way you can with what, any information that was there." That guy that had the most education, he said, "I didn't want to come here to shoot the breeze." But then you see, he didn't realize that shooting the breeze, there was a lot of things hehheh which would have saved him a lot of trouble!

Without claiming any final authority on the topic ("take with a grain of salt"), he challenged the class to test all knowledge claims about the fish culture, his included, so that if proven wrong, both teacher and student would learn something. This extreme (and easily threatened) claim was positioned using direct reported speech that served to reinforce an air of objectivity to the account. This interpretation seems plausible when we examine the two extreme case formulations in turn 12 ("the first thing", "the best thing") that were not mitigated in any way by concession statements or markers. Again, speakers use this form of talk for showing investment (e.g., commitment, certainty, determination) in their accounts. It was not that he was against any form of school/book learning for he suggested researching scientific texts first (Jack consulted his "stuff" and library material), critically assessing these claims against experience, and then deciding what was worth adopting or discarding. In this way, one could then "make your own books"—an ideal situation ("the best thing") comprising a dialectic of the practical and the theoretical that generates true workplace knowledgeability (see Chapter 3).

One now hears that the student who found the course most wanting was a university graduate—"the guy that had the most education"—who felt that it amounted to mere chitchatting. In Jack's version of the event, this person represented school learning,

that was abstract, authority-bound, and resistant to the practical, problem-solving nature of workplace knowing. Our longitudinal fieldwork in the hatchery has shown that fish culturists like Jack are better viewed as *bricoleurs* who used whatever tools, resources, and methods available on hand to provide immediate, concrete solutions to everyday problems. Few have educational qualifications but most are masters in their domain that again suggests the lack of correlation between school and workplace knowing in fish culture. Advising students to make one's own books was thus a discursive device that reconciled the two apparently conflicting ways of knowing lest a hearer had the impression that either one was inherently superior to the other. This was noteworthy without ascribing any conscious intentionality to Jack (Potter, 1997b); totally downplaying book learning would had been unwise for Jack was teaching college students whereas relying on practical experience completely would have required blind acceptance on the part of the students.

The final example of Jack's use of a discursive device occurred during a discussion (not reflected here) with the research team about some of the past scientific experiments that he had pursued in his workplace.

Episode 6: 27 February 2002

13. Researcher 2: See this is what we were interested in because often people assume that knowledge just goes this way like scientist to the people or management to the people and yet people like you, they know a lot of stuff that other people ought to know.
14. Jack: Yeah exactly. See this is nice where you guys come in because you gotta have some bookwork but you gotta have some practical work you and I discussed this before like I, as far as schooling to me goes is a waste of time, a lot of it and um common sense. What ever happened to common sense? Some of the best farmers in the world if they got three, Grade three education they're lucky you know? Now it's different we got computer mod, everything, we got cows hooked up to a goddam computer. But fifty years ago the cows weren't hooked up to nothin' and they're doin' just quite

> nicely, you know? And maybe even better because they're not takin' the antibiotics they have to have and stuff like that...

Researcher 2 framed the opening remark in Episode 6 about the unidirectional nature of knowledge flow in the workplace by incorporating four category identities: people (unspecified user-groups and the fish culturists), scientists (principal generators of knowledge), and management (who often dictate knowledge use). Apparently, what was unappreciated was that the fish culturists knew "a lot of stuff that other people ought to know" to which Jack replied in the affirmative. Adding that he was pleased with what the researchers were doing, he invoked a discursive device—"you gotta have some bookwork but you gotta have some practical work"—that made it evident that both types of knowing were vital in his opinion. This requires explanation for the previous sentence was concerned with the network of knowledge flow whereas Jack now spoke about having inclusive forms of knowing. Presumably, it rhetorically implied that whether one was a generator or consumer of knowledge in the wider organization, having both forms of knowing was important and could transform or erase the existing one-way exchanges of information. Understood this way, the message was that the scientists could be better practioners by incorporating more practical work experiences just as they should be receptive to the information generated by workers like Jack. This interpretation seems plausible in the light of Jack's previous talk concerning the engineers in Episode 4 as well as in other accounts.

> [Y]ou and I have valuable information, the scientists have valuable information, we should share our information and we both go away the wiser! We can't put a wall up and say, "Well I've got a degree, I'm not going to talk to those guys" and we can't say, "Well we don't have a degree and we're not going to talk to you." (Excerpt from interview with Jack, 31 Jan 2003)

However, Jack was now compelled to account for himself here; what was his personal situation? Did he heed his own counsel? This was a difficulty that needed repair for although Jack was a widely acknowledged expert worker, he was simultaneously a school failure in his many self-ascriptions (e.g. "I didn't want to be there[school]," "I was a failure in school up to a certain point," "I wasn't academic/scholastic"). Jack then defended his stake in the account by declaring that school was largely a waste of time since education was basically common sense. In principle, common sense was widely distributed but it seemed in Jack's accounting to be displaced by the effects of too much schooling and bookwork—"[w]hat ever happened to common sense?" Jack assembled this argument by (a) invoking the familiar exemplar of otherwise excellent farmers who had minimal bookwork and (b) criticizing how modern technology (derived from bookwork) had undermined traditional reliance on common sense (and practical work) in farming. By doing so, he aligned himself with a particular identity while affirming the weak relationship between bookwork and practical work similar to what happened in Episode 1. Was Jack being contradictory here? Most ethnographic accounts that rely on interviewing would find difficulty in explaining Jack's position. Adopting a discursive approach however enables us to appreciate that discursive devices are not used consistently and statements and claims in different domains are not seen as contradictory by some individuals. Thus, for the generalized Other, having bookwork and practical work was the ideal but for himself, already an established employee nearing retirement age, school-based knowing had low saliency for his work practices.

Conclusions

The prime concern of a discursive framework is not to establish some immutable truths about the phenomenon of workplace learning and expertise but rather it seeks to understand how these are made accountable through talk, how the phenomenon is "done" by participants.[27] Furthermore, it uncovers what issues participants are seeking to manage when they talk about their learning for talk is not just about something, it also *does* something, it is performative. From this particular study that largely drew on the accounts from one expert fish culturist, we have seen how the discourses drew on two interpretive repertoires to account for workplace learning and expertise. Jack affirmed the primacy of interest and practical experience just as he presupposed a weak correlation between school-based (theoretical) and workplace (practical) knowing. However, both kinds of learning were also deemed important though articulating this sentiment depended on the particular contexts of its production. A moment's reflection would reveal that these notions do not seem very different from what scholars have advocated about integrating school and workplace learning (e.g. Schuetze & Sweet, 2003). However, there is one important point of departure—these were participant concerns (using culturally available resources in society) rather than theorizations originating from the researcher. Instead of being external, taken-for-granted determinants that guided what the analyst should have found, these issues were some of the interpretive repertoires that were made available, accountable, and salient during specific social contexts. What this discursive approach calls for is therefore a sensitization of the shortcomings of ethnographic accounts and interview strategies that has often taken participants' talk at face value, ignored or

[27] The next chapter in fact considers how a research participant performed the identity of a scientist during an interview session.

subsumed them under some predetermined schema. Only when we give due attention to participants' accounts, then can we realize a form of inquiry that repositions situated practices at the center of our research and treats research participants as the experts that they are.

Chapter 6

Background to Chapter 6

Both dealing with issues of identity, Chapters 6 and 7 complement and yet contrast with each other. The former explicates identity from a discursive framing between two people in the joint activity of an interview whereas the latter brings in the notions of socio-material resources and learning in the organization that is Shallow River Hatchery. Together, the unique contribution of these chapters to the scholarly literature is that they offer new ways of looking at and understanding identity, which has been described as one of foundations in not just psychological research but also in sociology, anthropology, education, and cultural studies.

Chapter 6 first began taking shape in late winter 2002 and had originated from an earlier desire to conduct research *about* work practices in science laboratories. At that time, I was unsure about the nature of my study focus although I knew collecting as much data as possible about the work practices in those settings was imperative. By coincidence, I was also attending a graduate course on interpretive inquiry taught by Michael (Roth). Because he drew on environmental and watershed-related concerns as exemplars during the course, I decided to complement Michael's growing corpus of data by interviewing a top scientist in the domain besides serving my own interests in examining environmental scientists who crossed boundaries from one activity system to another.

I anticipated the research interview to proceed smoothly[28], which it did, and then planned to analyze the transcript by means of a grounded-theory approach (Glaser & Strauss, 1967)—the method Michael was teaching in that course. Because of my uneasiness that one or even a few interviews were sufficient for generating any worthwhile and publishable conclusions, I opted instead to analyze *how* this scientist had articulated his concerns and the concomitant issues of identity that arose more than *what* he had told me during the interview session. What had normally would have been regarded as superfluous or impediments in the real business of "getting information" from the interviewee took on significance as the new focus of inquiry now. I felt that one of the best means to achieve my aims was by using discursive psychology (DP). Here, taken-for-granted internal constructs such as motivation, attribution, emotions, and identity are treated as outcomes of context-dependent talk (cf. Chapter 1).

Again, this after-the-fact accounting for my choice of methods might not have been the complete story, for in 2000 I had written to Michael inquiring about the possibility of a joint research project with him and with a colleague of mine. As a newly appointed teacher-educator, I had wanted to conduct action research on what schoolteachers in Singapore believed about teaching the topic of biological evolution (cf. "Autobiographical aspects" in Chapter 1). I prepared what I believed was a fairly complete research proposal involving a rigorous interview schedule and sent it off to Michael. When Michael replied that he did not think it was possible to discover what was in peoples' minds by asking them, this caused no small conceptual disequilibrium in me.

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[28] Nevertheless, interviews that are seen as failures or those that go badly can be equally informative and offer what is called "uncomfortable reflexivities"—a critical interrogation (and discovery) of researchers' selves and practices (Nairn, Munro, & Smith, 2005).

Reading some suggested books on DP that I mulled over for weeks, I found Michael's notions so strange and counter-intuitive that I abandoned the idea for research in this area.

Readers may therefore find it ironic that I chose to utilize DP as part of my theoretical tools again. Yet, on revisiting the literature, and more importantly writing about it for not one but eventually two chapters, it causes one to regard DP afresh, and with some respect. Being my first paper as a student that was accepted for an online publication in *FQS: Forum Qualitative Social Research* also afforded me some confidence and satisfaction that the long hours of work thus far were not in vain (Lee & Roth, 2004a). In the course of writing this chapter, there were extensive revisions by Michael that centered not so much around my use of language but on the distinctive style of expressions that was necessary when one viewed identity as both process and product of *talk-in-interaction*. It was extremely demanding then, though only less so now, to write about identity as a *joint* achievement of participant and interviewer as subject in the activity system (Cassell, 2005; Rapley, 2001). Said differently, interviewer and interviewee are both at the subject end of the activity triangle while the object of the joint activity is to enact the interview. These indexical aspects of identity are not something that are innate nor do people carry them over to other situations like they wear a badge from one conference meeting room to another. Instead, these aspects were co-constituted in *this* way on *this* particular occasion. These ideas are aligned with activity theorists who insist that identity is dialectically related to action, in this case, engaged in enacting a particular research interview (the object of this activity). Whether or not these aspects of a person's identity would be manifested somewhere else in another activity system is always an empirical matter.

The arguments that I made in this chapter may appear familiar and unremarkable to most qualitative researchers although it is a message that usually fails to find its target audience. That is, most publications discussing the inherent problems with interview methods are "preaching to the choir." Nevertheless, the value here is that it reminds readers of the errors of taking interviews at face value (see also Chapter 5) while attempting to bring in a novel activity theoretic turn to the analysis of identity as well.

I opened the chapter by stating that participating in an interview was taking part in an activity system that was often very different from the daily lives of most individuals. Grounded in CHAT and DP, I then argued that the interview event and whom these agents became during that process was an outcome of the activity of "doing interviews." In contrast to the modern (as distinct from postmodern) concept of identity, a stable and characteristic feature of an individual, I approached the phenomenon of identity as arising from social interactions—identity and activity exist in a dialectical relationship, a notion first introduced by Karl Marx. Interviews were thus occasions whereby agents manage identity and self-presentation primarily through discursive processes. By further regarding interviews as "topic" I made salient their co-constructive nature qua social interaction rather than as a neutral data-gathering devices. This case study of an interview with a renowned environmental scientist demonstrated how identity was rhetorically played out using the concepts of *stake* and *footing* from DP. It was found that the participant came to be a full-fledged member of the scientific community with traits typically ascribed to scientists such as expertise, objectivity, passion, and disinterestedness. This discursive "doing" of identity during research interviews was a

pervasive effect and cautions practioners against treating interviews as an unproblematic method—the participant's identity was as much the result of his as it was of my doing.

Making a Scientist: The Discursive "Doing" of Identity During Research Interviews

Interviewer: Well, you know, so, what does the research mean to you personally?

MacArthur: Satisfaction of achievements. That I want, satisfaction of contribution to the society? I think that's the, that's the major fulfillment, that I don't do science, just for the sake of science. I want to have my science make a difference, make an impact. If it doesn't, I'm not interested in doing that science; it has to have some impact on the society, on the economy, on health, you know, somewhere beyond my area of research. Yes, there is always a, a satisfaction of producing a top-notch paper in the world's top journal, that's a different kind of satisfaction, among my peers. But my greatest satisfaction is beyond my peers, to the society, to the general public actually, so that I can take my science to general public, actually make them understand exactly what I do.

Interviewer: Wow that's great. If you could have one word to describe what drives you in your work, what word would that be?

MacArthur: Fun?

Interviewer: Fun?

MacArthur: Yes. It's fun.

MacArthur is an internationally renowned environmental scientist who participated in this larger study on knowing, learning and identity in different communities. There is in fact, more to MacArthur than meets the eye, or more accurately the ear of the researcher. In that short time that he graciously granted to us for the interview, he communicated more than just important details about his life and research. MacArthur constructed with and for us the identity of an excellent scientist in the community. For example, we (are made to) realize that he is not just any scientist who publishes papers but one who desires to publish top-notch papers.

He is a professional who does not just do any science—which those interested in the history of science might associate with "normal science"—but in science that makes a difference in and to society, a science at the cutting edge that makes an impact, a Kuhnian

"revolutionary science." MacArthur, however, considers communicating his research to wider society an even more satisfying challenge. His is the identity of a communicator, someone who does not only talk to and write for his peers but also to the general public. In the interaction with the interviewer, he becomes a modern day Janus with one face speaking to his scientific peers and the other to the general public. These intimidating challenges that would deter most people are, according to MacArthur, fun!

In this chapter, I demonstrate that during the rather distinctive activity that we call the research interview, both participants and researchers are active agents whose identities are constituted in that process. The standpoint derived from cultural-historical activity theory and discursive psychology is that who a person is cannot be divorced from taking into account the social contexts of the environment. Furthermore, the means by which these concerns are primarily negotiated and accomplished is through the medium of discourse during interviews. The perspectives that are adopted here stands in contrast to traditional psychology, which, similar to folk psychology, has tended to view identity as an innate construct deterministically controlled by other innate variables.

By further treating interviews as "topic," I strengthen the view that they are not straightforward elicitations of information from participants to researchers but are sites whereby identity is accomplished. This study is significant in that (a) it contributes detailed empirical data to the small group of studies whereby identity is shown to be discursively constructed in activity like interviews (Abell & Stokoe, 2001), and (b) it cautions workplace researchers against an unproblematic use of the interview which is a corollary from the previous point.

The interview as resource and topic

As a preferred data collection strategy, interviews are unrivalled within the social sciences—about 90% of all research conducted here had used it in one form or another (Briggs, 1986). This is perhaps not surprising for we live in an *interview society* (Atkinson & Silverman, 1997) whereby interviews are a central part of meaning making in social life. Since interviews are utilized so regularly and oftentimes uncritically, it is therefore vitally important for its epistemological foundations to be appreciated by all researchers. There are four general ways in which interviews are used, namely as (a) "a source of witness accounts of the social world," (b) "a source of self-analysis," (c) "an indirect source of evidence about informants' attitudes or perspectives," and (d) "a source of evidence about the constructional work on the part of the informant (and perhaps also the interviewer) by means of which interview data are produced" (Hammersley, 2003, p.120).

In this taxonomy of interview functions, the first two pertain to interviews as *resources* while the latter two pertain to interviews as *topics*. Beginning with the studies by Cicourel (1964; 1974) and Garfinkel (1967), advocates of the latter two approaches have questioned the role of interviews as a neutral data-gathering instrument that affords an in-depth window into the mind no matter how rigorously conducted. These positions, which depart from the traditional and commonsensical views in (a) and (b), have instead understood the interview as a joint or co-construction process that concerns itself with issues of accounting, self-presentation and identity management by participants in a socially situated context.

In other words, the researcher now analyzes how people present themselves in the process of talking, make sense of each other, and the rhetorical devices that they use to successfully accomplish these tasks. Focus is now on examining "doing" the interview as a social encounter between researchers and participants and this takes significance over disclosure of content matter that arises. Understood this way, interviews are lively interactions between people acting in particular social contexts rather than merely an exchange of information or an authentic reflection of an out-there-ness that has to be excavated by the researcher.

Which position is to be preferred? Practitioners adopting interviews as a resource understand and utilize interviews as data that help them discover something about the world and social reality. However, researchers using interviews as a topic despair in extreme cases of even obtaining any useful information from participants themselves because whatever is said can never be something solely attributable to the participant. What is perhaps more meaningful and interesting to these analysts is the manner in which both research participants and researcher *manage* the interview as a social process (Suchman & Jordan, 1990).

The "radical critique of interviewing should not be adopted uncritically. At the same time, to ignore it would amount to complacency, since it points to some serious dangers in using interviews and especially in relying exclusively on data from that source" (Hammersley, 2003, p.124). I thus advocate treating the interview as both resource and topic in a stance that can be described being faithful to and yet critical of research data and the circumstances in which it was collected (Silverman, 2001). By doing so, one realizes that as much as there is little reason normally to doubt the veracity

of participants' accounts, one is constantly mindful that interviewing is a social interaction that takes rhetorical effort to accomplish successfully. Thus, both researchers and participants take on their normative roles, which usually means that the former initiate the interview, ask questions, and steer the conversations while the latter are the actual subjects of interest and respond to requests of researchers. Issues of identity and self-presentation are at stake and have to be managed actively but are usually ignored or glossed over when taking interviews solely as a resource.

Activity theory and identity

What I have articulated so far about how identity develops in social situations like interviews has been similarly been arrived at from a different perspective—cultural-historical activity theory. Activity theory normally describes the trajectory of ever-changing participation in collective activity while interviewing as topic speaks about the hidden complexities of the co-constructional work that arises from social interactions. Some moment's reflection would reveal that there are indeed similarities in both of these positions that inform how we should treat research interviewing as social activity/interaction. Western psychology has traditionally perceived identity as an innate construct in a person who needs to expend effort to locate and cultivate it for proper psychosocial functioning. Activity theorists in contrast understand identity as being both process and product of human activity (Engeström, 1987). By engaging in praxis, people constitute and (re-) produce the very structures that gave rise to the practices themselves.

For example, "being a teacher in firm control of a class" or "being an A student" are not aspects of a stable identity, although research participants may treat them as such. Rather, identity is continuously produced and reproduced in activity, which inherently

allows people to be different across situations. Rather than being astonished that someone is a good teacher in one class and a poor teacher in another, and rather than describing them as having a good day or a bad day, one simply accepts that identity is the outcome of activity instead of its precondition. All identities are constantly evolving over historic time in the constantly changing social interactions or communities that one participates. Yet, framed in the contexts of an urban inner-city school, both structural and cultural inequalities can severely constrain agency in students (Roth et al., 2004). Without drastic changes in broader society, the identities of most of these "youth-at-risk" would be unable to transcend that of a school dropout or failure in life. More precisely, one finds that identity does not develop in solo contexts but requires the mediation of other people (and division of labor, tools, rules) in the salient activity system. In my study of expert fish culturists in Chapter 3, it was found that their identities as experts could not have developed without the assistance of support biologists who helped deepen their practical understanding of fish culture. When these forms of mediation were lacking, there was not only a withdrawal by these fish culturists from the activity system of the hatchery but also numerous instances of deidentification with the organization.

It follows that the identities of both researcher and participant as subject are thus enacted during research interviewing qua interactional event. To exemplify my case, I drew on data collected as part of a larger project on the interaction of scientific, local (aboriginal) and everyday knowledge about the environment. In particular, I selected one interview with a scientist who holds a chair at one Canadian university. Rather than thinking about him or the researcher independently of their context, I view the interview, what is being said, and who the participants are becoming (MacArthur the scientist and

researcher as earnest inquirer) as an outcome of the activity "doing interviews." Both MacArthur and the researcher therefore partook during the interview session in a common activity system with a shared object/motive of producing a fairly complete and mutually satisfactory recorded interview that subsequently was to be transcribed. In the progression towards achieving the object of the activity system, the subject (individual or groups of individuals) is changed; identities are reinforced, modified, resisted or discarded.

The division of labor in CHAT required certain behavioral norms expected of such encounters as mentioned earlier while being governed by rules of courtesy and respect in the company of a distinguished scientist. By all these aforementioned criteria, the interview became not just a straightforward elicitation of information as assumed unproblematically by most researchers but an interactional process by active agents whose identities had to be managed. Research interviewing is not part of mundane life for most individuals, which means that participating in this activity system demands a specific re-orientation and concomitant management of identity. Activity theory therefore provides an alternative and robust way of thinking into why interview data have to be considered as topic as much as a resource.

Analytic framework

Data analysis in CHAT research has generally relied on long term, fine-grained descriptions of individuals or groups of individuals in collective activity. For this current study, I have chosen to concentrate instead on the chief meaning making process in the interview that enabled it to be accomplished successfully as joint social activity—discourse. By taking interviews as topic, one further finds support for considering

interview data as a means for achieving intersubjectivity, a co-construction of social worlds during talk. It seems befitting therefore to use a large and heterogeneous group of analytic procedures for spoken and written texts known as discourse analysis. Discourse analysis of the kind inspired by the Loughborough school (known otherwise as discursive psychology [DP]) is especially concerned with how talk is used to perform social actions; how certain phenomena are created, reified, and taken for granted. As such, it was a suitable frame although I focus more on using the concepts of stake and footing in DP (see Chapter 1). Taken together stake and footing allowed language to perform identity functions while MacArthur spoke about his life and work during the research interview. What MacArthur said and his deployment of stake/interest and footing, however, should not be understood independent of the interview context, the particular questions asked, the trajectory of the interview event that evolved unforeseeably from the transactions between its participants.

On being a world-class scientist: "Doing" identity in an interview setting

In this study, I exemplify my argument with data from one interview with one scientist (MacArthur). The interview schedule adopted a semi-structured format where the questions ranged from eliciting past personal experiences and information about water conservation to learning issues and knowledge flow. The session lasted for nearly an hour and was subsequently transcribed by myself. At a superficial level, the interview with MacArthur proceeded rather typically with general discussions about his life, research, and work experiences. Many details were presented that would be of broad interest to historians, educators, social scientists, environmentalists, and even journalists, for MacArthur's life was indeed eventful and showed his dynamism, and commitment to

his work. It is however, at this level of analysis that taking interviews as a resource terminates—unable to break its theoretical straightjacket to see that more was occurring than mere conveyance of information.

In the following sections, I present data to show how MacArthur came to be effectively and unassailably constructed as an expert scientist who was able to see what others similarly trained in science could not see. Passion for science drove him onwards and excellence was both the goal and by-product of his endeavors. Indeed, the statements he made implied that the watershed research program was the most unique in the world. Science seems complex to most lay people but MacArthur besides being the professional scientist was also going to be a fearless communicator and interpreter of science. (It should be kept in mind that it is always the audience that makes such implications [Derrida, 1988], always the ear of the other that hears statements in particular ways [Derrida, 1985].) To summarize, this participant came out of the interview as a full-fledged member of the scientific community with traits typically ascribed to scientists such as expertise, objectivity, passion, and disinterestedness. Through the concepts of stake and footing among others, these often hidden but pervasive dimensions of identity formation are shown to be present in research interviewing such as in the study here. MacArthur was not just telling a story about his life that someone else asked him for; he was *making* himself for the researchers (both his audience and fellow-actors). But he was making himself in the context of *this* interview and in response of *these* questions.

As a result of the discursive transactions between interviewer and MacArthur, the latter came out to be a scientist with a particular identity. The particular aspects of his identity included here made MacArthur a scientist (a) with a trained eye, (b) who runs an

excellent program, (c) who has a life-long passion for science, (d) who proclaims objective truth, and (e) who is able to communicate scientific matters despite its complexity. In contrast to other research that would ascribe these aspects of identity to MacArthur independent of the situation, I suggest that the particular form of identity produced here is an outcome of the interactions and therefore highly specific to this setting. I assume that any claims to more enduring features of his identity that exist across situation would have to be empirical matters rather than presupposed.

Doing science needs a trained eye...

In the following three excerpts from the interview transcript, we see how MacArthur's stake as a visionary and knowledgeable scientist came to be co-constructed. By means of footing, we become aware that MacArthur alone saw what even scientifically competent people were unable to see. His was the trained eye, the persistent evangelist who dared to voice his opinions to disbelieving higher authorities that eventually (had to) come around to the truth that MacArthur brought.

Excerpt 1[29]

1. Interviewer:	Dr MacArthur, one of the main research priorities in your team is in the ecosystem and watershed understanding of water resources. Why did you choose such a high level of complexity to look at? Why didn't you choose a lower level?
2. MacArthur:	Um since I, since I started working on water quality about x[30] years ago, I, I realized that the kind of science we produce with basic research on water quality linking nutrient loading and how it affects water quality, the major help it can provide is to water utilities that supply drinking water. And um I realized that most of the processes drinking water utilities use, is uh treatment and disinfection while quality of water is actually a

[29] Numbers within the excerpts refer to turns during the conversation.

[30] For anonymity, some dates and places take the form of Xxxxx or x.

function of the source water you start with. And, that's where I started thinking, I said, "If we could actually develop some models and understanding of how ecosystems function at the source water, would be able to help the water utilities better manage the quality of water at the tap and improve human health."

Excerpt 2

108. Interviewer: Well, to me Canada is a very developed country, if you bring it to some parts of Asia or Africa, you might have the science but solutions are affected by many other things.

109. MacArthur: Oh yeah. Here it's, in Canada as well. You can call Canada as a developed country, but when it comes to environmental regulations and policy development we are not much different than any other developing or undeveloped nations!

110. Interviewer: Oh is it?

111. MacArthur: Absolutely! Uh there are places where water quality is so poor, it's amazing that it is still allowed to be used as a source water, okay?

112. Interviewer: That's surprising.

113. MacArthur: Yeah, it is, it is! So, on superficially we are a G-seven country but when it comes to environmental degradation um we are not any better than any other countries actually.

114. Interviewer: Was it a surprise when you found that out?

115. MacArthur: Oh absolutely! Uh I, and that's how most people actually have the myth that Canada is the pristine North? We don't have environmental problems? And we are one of the developed nations in the world, we don't have those kind of problems. But the moment I started working relating science and policy and regulations, linking these three, I realized that wow! We're not any more evolved than any other countries in the world!

In response to the question about research priority in the first excerpt, MacArthur talks about the salience of water quality from his perspective. The interviewer asked him, "Why did *you* choose…?" and he responded to give a historical narrative in which he is the main protagonist. Through the person-centered narrative, his biography comes to be that of an expert scientist with a trained eye (Ricœur, 1992). He is not inherently the expert scientist, but in the turn-by-turn unfolding of questions and responses, focusing on him as a protagonist, the narrative comes to construct his identity in this way (Bamberg,

2004). Because of the questioner's focus on how he had come to choose a high level of complexity, MacArthur is the person who comes, in the response, to see what a group of scientifically competent people working in the water utilities (turn 2) fail to do—that scientific models and understanding the watershed are the ways forward for better water quality. He comes to initiate this idea of looking at the source water, which is something that is new and hitherto unheard of but he is unable to do the science alone, he needs his team for he uses the subjective personal pronoun of "we" rather than "I" as he did earlier on. He may not have chosen the person-centered perspective in other circumstances, but in the present situation, the question itself sets MacArthur up to provide a particular response and thereby construct his identity in a particular way (Bamberg, 2004).

By using the footing of self-reports (i.e. claiming experiential authority) in turn 2 and 115, he makes his personal claim of basic research and scientific discovery even stronger and more vivid as he describes his own eureka experiences. One sees in Excerpt 2 (turn 115) that he changes to the footing of the common person three times to build his claim that most people are unaware of the serious problems in the environment in Canada. This comes perhaps as no revelation; if the people working in water utilities are unaware of the environmental situation in Canada (turn 2, and also in 37 below), how can laypeople ever hope to understand? At the same time, this response needs to be seen in the context of Excerpt 2, which explicitly asked MacArthur whether the situation was a surprise to *him* when he found out. Even a scientist can be fooled as MacArthur admitted to being astonished initially about the extent of the environmental problems here in turn 115. This footing device somewhat mitigated the ignorance of the lay public and signified his alignment and sympathy for their lack of scientific training. MacArthur however, was

not just any narrowly focused scientist, he was one performing in multidisciplinary modes, one who did not remain in the dark for long for he saw the truth of the matter "the moment" he started relating science and policy (turn 115). In these accounts, MacArthur's personal stake in scientific discovery was maximized and thus made his construction of himself as a scientist difficult to be challenged by anybody.

Excerpt 3 below foregrounds MacArthur's stake as the scientist par excellence; he lives for his work and science is his life. An unassuming servant of science, he managed to gain the ear of government and industries for he was armed with the "truth" of science.

Excerpt 3

35. Interviewer:	When um, how did this evolve? Did you decide at the beginning I want to work with so and so and so, or when you, or is it evolving like when you meet with one you realize that, I, I need to link up with this, something like that. How did all these partnerships come about?
36. MacArthur:	Um, in 19xx I was taking my sabbatical. I was a professor at University of Mxxxx before coming here, and I was thinking of a sabbatical, I had a fellowship from Sxxxx, to go and work on Lxxxx. Then I had a fellowship from Fxxxx um in 19xx, I served as an advisory committee on Cxxxx water department's panel, and they heard that I was taking a sabbatical, and they wrote to me say we would provide you a sabbatical fellowship if you came and help us, work with us, understand some of our issues. I said, "That sounds pretty exciting, this might be an opportunity for me to apply my basic science." Came without actually thinking how much I could do…
37. MacArthur:	started talking to utilities, talking to provincial government, federal government, and first response from some of the water utilities was, "Why do we care about source water?" That, that was the first response. Then I started giving talks, I said, "Well, this is why you need to care about it". It took me about a year and a half for me to convince government and industries that this is something worthwhile for them to do. So that's, and then it became, now, it is, it is a very very well recognized, well respected program not only in Xxxxx, in all of Xxxxx actually!

Job security or an attractive salary did not feature in his account about being hired for a job in the Cxxxx water department (turn 36) when MacArthur was asked about the

origins of all his research partnerships. On the contrary, it was the lure of doing and applying his basic science that brought him there even though there was no specific problem to solve in the first instance. Here we hear a man who was truly passionate about his job, one who pursued science for its own sake. Basic science is unbiased, disinterested and objective from MacArthur's point of view for he wanted to see where his research would lead him rather than being dictated by his employers' agendas. Being the expert with a trained eye, he brought along his novel ideas of tackling the water problem at the watershed that he had already developed by then. This of course brought him into conflict against a disbelieving audience very quickly. Again, MacArthur employed a footing of self-report that made it clear that he was in the thick of the action in watershed evangelism (turn 37). He was the prime mover in the eventual change of mindsets though it took about 30 months to do so. He employed rhetorical features artfully in these segments of discourse. One sees an ignorant but willing water utility that become among the best in the land after MacArthur's efforts. He came, he saw (with his trained eye), and he converted. With similarity to the empiricist repertoire of scientists, MacArthur presented a view that science ultimately triumphs, that the truth would prevail no matter what (Roth & Alexander, 1997). Again, MacArthur's use of stake and footing in this excerpt made his claims difficult to be discounted and strengthened his identity as an expert scientist and passionate crusader for the truth.

Running an excellent program

Besides being a capable and committed scientist, MacArthur co-constructed the fact that he was also the leader of a top interdisciplinary team that he had managed to bring together. From the following two excerpts, one realizes that he is running an

excellent program that is more than ready to tackle challenging problems in the field. Indeed, through stake management and footing, MacArthur has us understand that his research program is the "most unique in the world." But his program becomes most unique in the context of a question that asked him whether there are "any" comparable programs, and the geographical scope is set by the interviewer's mention of "Asia." That is, MacArthur responds to questions that he cannot predict, and which themselves are grounded in the interviewer's preconceptions that he cannot know. One can therefore say that a particular identity emerges from *this* interview from the transactions between the co-present interviewer and respondent. An informative example of the highly interactional nature of research interviewing arising from seemingly mundane elements in discourse is also presented below.

Excerpt 4

7. Interviewer:	I see. Ok um interesting... are there any such programs in let's say in Asia for example? Or Europe?
8. MacArthur:	Nope.
9. Interviewer:	None? Wow.
10. MacArthur:	There is one program in Australia, in Canberra, where they are looking at source water, watershed processes, not at the scale that we are looking at, I think our program linking watershed through treatment and disinfection to human health, I think it is the most unique in the whole world.
11. Interviewer:	Oh wow.
12. MacArthur:	Yeah, it is very complex and it's going to take time and a lot of effort to do that but I think, I think we can do it!

When questioned if there was a similar watershed program elsewhere that was comparable to MacArthur's, he initially denied it in turn 8. However, he conceded that there was indeed one in Canberra after the interviewer expressed genuine surprise by exclaiming, "None? Wow." These seemingly innocuous words had in fact threatened MacArthur's stake in his accounts about the exceptional nature of his program. Is there a

possibility that such statements could be contested? MacArthur's repair strategy was then to concede that there was one that bore some resemblance but concurrently discounted it by saying that it was on a smaller scale. This management of stake served to restore his credibility as an objective informant—what he said must be true for he gave the "fine print"—MacArthur's program was perhaps the most unique in the whole world after all. In turn 11 whereby the interviewer subsequently expressed an amazed "Oh wow," this was interpreted as an acceptance of MacArthur's account. I say this with some confidence for turn 12 did not contain any elements further serving to protect MacArthur's stake but instead began with a "yeah"—MacArthur had earned "permission" from the interviewer so to speak to continue with his version of the story. And so he asserted that while problems in watershed processes were complex, with time and effort he believed that they could conquer them as MacArthur's team was after all the best.

Through this short fragment that has many similarities with the "showing concessions" device mentioned in Chapter 5, I demonstrated the highly interactional nature of research interviewing; the choice of words as in "none, wow" or "oh, wow" that are so unconsciously uttered can affect the trajectories that interviews take. Unfortunately, these important features that enable meaning making in daily life to occur as ethnomethodology has long alerted us are the very elements that are neglected when one fails to consider either interviewing as topic or as joint participation in an activity system.

Excerpt 5

33. Interviewer:	So, Dr MacArthur, in what way do you think your team has found a niche in its area of science? Is it ahead or is it so specialized that few can match up to it? Speaking about your lab...
34. MacArthur:	Uhm, it is, it is not so specialized that people can't catch up with it, uhm, people will have tough time catching up with our, uh

> approach is because it takes a large group of interdisciplinary, people. Like I've been working with economists, I've been working with psyc-, environmental psychologists, I'm working with public health office people, I've been working with terrestrial people who do geo(?) and remote sensing type of modeling so that we can quantify land use on a watershed from an image and then link it to the water quality at the source. And we need partnership with water utilities and industries to do this. So very few group can actually put all this together to address the issue.

A top-notch program demands an equally talented team of people to manage which MacArthur describes here in this excerpt. The interviewer started off Excerpt 5 by inquiring about the distinctive features of MacArthur's research team, an issue that was close to his heart; in fact, the interviewer's statement is akin to a trap that put the lab ahead of similar labs so that MacArthur might be said to blow his own horn if he did not moderate that statement. Either blowing one's own horn or belittling the team on the other end of the spectrum is highly undesirable so a middle course seemed to have been chosen by MacArthur. By stating "it is not so specialized" in turn 34, he initially made a modest claim. What followed next however became a counter claim; his inter-disciplinary team was in fact a tough act to imitate! This happened because the phrase "it is not so specialized" acted in retrospect like a stake inoculation device. Combined with his personal footing in turn 34 where he listed the many different types of professionals that he routinely consulted with, we are now left with little doubt about the uniqueness of MacArthur's research team under his able leadership. It is no wonder that MacArthur's science is so cutting-edge, for an inter-disciplinary team of professionals supported him. Again, I state that this interaction that revealed his stake in his research team only came about in response to a query about it in the first instance.

A life-long passion for science

Already we are acquainted with MacArthur as the quintessential scientist with many allies running a top-notch program in water resource management. During questioning about the factors that led to being what he was today, we find that it was a personal and natural decision for MacArthur from his youth to pursue science. Again, the request to account for his interests beginning with his youth constituted a horizon for MacArthur's response. This gave MacArthur the best job in the world for he was doing what he simply enjoyed.

Excerpt 6

65. MacArthur:	Yes, yes. Well, I think when you try to understand you can use your curiosity driven research, innovation, in more you know, in depth than we're trying to fix things. It, it you know?
66. Interviewer:	So, um you had this um natural curiosity, from a– from a young age?
67. MacArthur:	Ahuh ahuh, yeah, I love, I love fishing, I love being outdoors, I love being in the water, it's a, it's a, natural actually.
68. Interviewer:	Natural.
69. MacArthur:	I'm doing what I love doing. And I think everybody should do what they love doing.
70. Interviewer:	I'm sure.
71. MacArthur:	And I'm fortunate that I, been able to develop a career in something that I cherished from my childhood. So..
72. Interviewer:	Um, that's great. Your parents were supportive of you doing science rather than medicine?
73. MacArthur:	Um there were a few arguments here and there. But I said I, this is what I will enjoy doing. Becoming a doctor and you know, it's not something that I will enjoy doing...it it, you know...
74. Interviewer:	Were you the oldest son?
75. MacArthur:	Nope, nope.
76. Interviewer:	Sometimes there are pressures on the oldest ...
77. MacArthur:	Yes, yes. I think all of my brothers actually, we all had, we all had the grades, and excellence in school to go into medicine or engineering. All of us chose actually to be in fundamental science.
78. Interviewer:	Oh?
79. MacArthur:	Yes.
80. Interviewer:	Then do you think your siblings had some influence on you?
81. MacArthur:	Umm no I think we're, we grew up as very independent children, all of us, brothers and sisters. We decided to do, we did what we

decided, we thought would be best for us, not like, what others thought we should be doing as an individual. And I think it's an upbringing that our parents gave us, that freedom actually, to think about ourselves. And while they suggested that you maybe you want to go into medicine, or engineering but do what you enjoy doing.

82. Interviewer: I think in Sxxxx, many parents, forcing their children to take up medicine, for the prestige.
83. MacArthur: Oh yes, I understand, yeah yeah.
84. Interviewer: Asian parents sometimes.
85. MacArthur: Like my brother, he, they wanted him to go into engineering because he was excellent in mathematics. He said, "No, I'm going into mathematics!" Now, he has a Ph.D. from Oxxxx and he's a Xxxxx physicist and he's a professor at University of Cxxxx, in Xxxxx. So, he's extremely happy with what he does, so.

The interviewer's questions about parental support opens opportunities to use other family relations in accounting for the special interests that ultimately led to his career as a leading scientist, and to the interviewer who had recruited him because of the perceived status as a leading scientist. Using the footing of his brother in turn 85 and of himself in turn 69 and 73, he oriented to the interview's question and then illustrated the importance of doing what one enjoyed, in this case science, specifically water resource management for MacArthur. As worthy and noble as medicine or engineering might be as a profession, true love for the subject is a requisite. Research involving water issues was a natural thing for MacArthur which explained the recurrence of this theme during the interview. Indeed, once he claimed that it was "natural" in turn 67, it was difficult to discount his stake in his accounting. The interviewer in these excerpts seemed to be rather accepting of MacArthur's accounts and thus expressed assent or clarification type of responses that did not seem to lead to any interactional difficulties (e.g. threats to stake) for MacArthur here.

Proclaiming objective truth

The power of a scientific fact should not only be seen in its elegance of theory but perhaps more crucially in its usefulness to society. Scientists no matter how brilliant like MacArthur need to expend initial effort to convince people about the value of some their ideas outside of their monastic communities. Resistance to the implications of his science by sheer ignorance, bureaucracy or politicking fortunately did not deter or prove to be much of an obstacle for MacArthur. To use the metaphor of a maverick scientist or lone prophet to describe him in Excerpt 7 would not be out of place here. MacArthur's identity from this excerpt is that of a voice that insisted on proclaiming objective scientific truth, which would eventually prevail over doubters.

Excerpt 7

116. Interviewer: Ok, having said that, do you think that there are some difficult issues outside of science, like politics that you have to tackle, or will have a great impact on your research?
117. MacArthur: The politics that will have great impact on my research?
118. Interviewer: Ahum.
119. MacArthur: Well, because I work on water, and drinking water, it is always very closely tied with provincial and federal politics. I try to be as independent as possible and provide my independent views...
120. Interviewer: As a scientist?
121. MacArthur: As a scientist and I think I, almost all the time have the integrity of giving my views regardless of whether my funding depends on government, my funding depends on industries or not. Like Cxxxx water department is one of my major sponsor, I still criticize them, publicly. Not criticize them, but provide suggestions that this is where you could improve, you could do, you could have done this better. So while they are my sponsor, so
122. Interviewer: Are they appreciative?
123. MacArthur: Absolutely! Sometimes we have arguments about it but most of the time, they accept my suggestion. While it goes against their current view, they appreciate it.
124. Interviewer: Ok. so.
125. MacArthur: You couldn't find similar situation in many places actually. That water utilities trying to take suggestions, and be criticized and actually accept that criticism.
126. Interviewer: Maybe in that sense Canada is developed!

127. MacArthur: And very unique watershed, water utility, you wouldn't see that in most cases.
128. Interviewer: You mean our Sxxxx?
129. MacArthur: Cxxxx water department is a very progressive, very progressive water department. Ok, you wouldn't see that kind of situation [in] many many places.
130. Interviewer: Was that perhaps one of the reasons why you were keen to work with them?
131. MacArthur: Absolutely! And it, the reason when they invited me to come and develop the program is an indication that they're willing to learn, do their job better.
132. Interviewer: Ah, ok. Quite nicely ties in.
133. MacArthur: Exactly, yeah!

The interviewer began by querying MacArthur about some outside pressures like politics that might have influenced the conduct of his research. After clarifying the trend of thought, MacArthur picked up the prompt suggested by the interviewer and instantly adopted the label of the independent and objective scientist in turn 121. As such, when this fearless scientist spoke, he spoke for objectivity and truth which all (rational) others had to listen to. It was a universal truth, not just MacArthur's truth. The water department knew that MacArthur's views were out of the ordinary yet they asked him to come and develop it, to change it for the better (turn 131). And because the water department was willing to accept suggestions and learn (turn 123 and 131) from the invited authority that they sponsored, MacArthur considered them as very progressive and praiseworthy. Indeed, in turn 121 the word "criticize" was perhaps too strong a word to use and MacArthur corrected himself to say instead that he "provided suggestions." This was felt to be a move that indicated his stake in the good name of his employer, the Cxxxx water department despite the occasional differences of opinions between them. The relationship with the water department was symbiotic—the scientist with the new scientific principles and a water department that was willing to take chances and improve. The water

department was progressive as MacArthur was; indeed, he identified very closely with them (turn 130 to 133). I reiterate that aspects of MacArthur's identity that presented themselves here were in response to these questions, in the context of the activity system of that particular interview event.

Science seems complex but it's a matter of communication

Doing excellent science with a fantastic team was an undeniable source of pride for MacArthur the top environmental scientist. Yet, he aspired to extend and share these otherwise esoteric facts beyond academia or government to wider society. Framed by the interviewer statement about scientists who talk above the heads of normal people, MacArthur described himself as the expert communicator of science as the opening vignette in this article demonstrated—he wanted to bring sparks to peoples' eyes when he explained his science. Though he was not always successful in this regard at the beginning of his career, this was a job that he clearly enjoyed and excelled in now.

Excerpt 8

150. Interviewer: A comment by some of the hatchery people, the people that work on the field is that sometimes, not always, but sometimes scientists just speak over their heads.

151. MacArthur: Ahuh, oh yeah, oh yeah! Like I did too. When I started this chair program, and started giving talks, um I did not create, as much, as much spark in peoples' eyes who were listening to me when I started, now I do. Now I create sparks, doesn't matter what level of people they are.

152. Interviewer: Ok, can you give me an example? What do you mean by create sparks?

153. MacArthur: They say, "Wow! Why didn't somebody do it, before? You know, you're telling us that we don't understand that? You're showing us that, this is so simple to understand, why don't we do it?" I say, "That's the problem!" That, making you understand this complex science in a simple manner is not an easy job." But I'm, I'm really grateful that people actually understand what science I do. Now, I can put it in their language, that's why you see the sparks in

people's eyes! "Wow, is that what he mean? Yeah, I didn't know that!" You know? So...

154. Interviewer: Do you consciously try to relate it to issues affecting the people in that community?

155. MacArthur: Absolutely! That's my first and foremost job as an Xxxxx Chair, that's my first job. To convey my science in a manner that people actually can use them, understand them? Where it matters? Not among my peers?

Excerpt 8 shows a mix of footings by researcher and participant that together built up an argument on the desirability of communicating complex science to the people. The interviewer in turn 150 reported a comment by some salmon hatchery workers about how scientists sometimes spoke over their heads. This footing device served to distance himself from possible blame and to minimize his stake in case he was incorrect in his assertion. However, this change in footing was unnecessary as MacArthur aligned with the same position that sometimes "scientists speak over peoples' heads," himself included.

After this admission of guilt, MacArthur turned around and depicted himself as the scientific expert (turn 151 and 155) that brought light and sparks to peoples' eyes when he revealed the truth. Again, the stake inoculation devices in "like I did too. When I started..." (turn 151) and in "that's my first and foremost job...my first job" (turn 155) served to prevent potential threats from undermining his account. This truth of environmental science is a paradox; on one hand many (simple) things remain unanswered while explaining these issues in a simple manner is a complex task. Nonetheless, MacArthur the science communicator had persevered and succeeded which he articulated by using multiple footings of an imaginary and appreciative audience that began to see the light once he started giving talks (turn 153). I am unsure whether what he told the public was identical to what he had tried to convince local government about but it is ironic that the latter were so skeptical about MacArthur's research that he had to

expend more than a year to convince them. In contrast, MacArthur could persuade the public almost instantaneously.

Conclusions

The empirical data contributes to the small group of studies whereby identity is produced and reproduced in everyday activities. Here I focused on one such activity—interviews. I exemplified this approach by showing how in one interview setting, stake and footing performed and managed these concerns. In doing so, the scientist came to be identified as a full-fledged member of the scientific community with many characteristics expected of scientists by society including expertise, objectivity, passion, and disinterestedness. He came to be a typical scientist who had loved science from his youth, and who did science for the sake of discovering something new rather than for other motivations. And being the expert with a trained eye, he saw what others who were similarly educated in science in the water department failed to see. MacArthur came to shoulder the duty to communicate the voice of scientific "truth" to the local water authorities, government, and the lay public—a task which he clearly very much enjoyed. Above all, he came to be a person who wanted to make an impact, a meaningful contribution to all levels of society through his work.

At the same time, I recognize that in the study, the interviewer was not a naïve inquirer without preconceived notions of what to ask or behave as researcher. Neither was MacArthur a naïve expert who answered queries only in response to my prodding. Rather, he was embedded in and enacted the discourse practices becoming of a respected, influential scientist, and faculty member who the interviewer co-participated in as well. Indeed, without the participation of the researcher, MacArthur's identity in the interview

would not have arisen in that manner (Cassell, 2005; Rapley, 2001). MacArthur and the researcher together performed institutional talk and enacted identities in an intersubjectivity of how such events should normally proceed.

The research interview became not just an elicitation of information but a site of co-production, management, and presentation of identities which we understand as taking the interview as topic. In the language of activity theory, I describe this situation as researcher and informant participating within the same activity system without "objectifying" the informant. I describe the object as the completion of the interview to a mutually satisfactory level in which identity emerges from this process. I emphasize that these facets of MacArthur's identity arose within the context of that particular interview and the historical events that preceded and influenced the interview that the researcher had with him. Thus, one comes to the conclusion that identity is a situated accomplishment, an outcome of activity rather than its precedent that foregrounds the dialectic of subject|object, and that its formation depends on numerous unknown contingencies.

There are however much broader lessons from the analyses for researchers using interviews as data collection tools. Neglecting interviews as special types of situations—that the interviewer and interviewee co-construct and from which the interview content emerges as a contingent product—would in fact create a naïve and unproblematic acceptance of interview data at face value. Though unacceptable from my point of view, it is nonetheless a frequent and serious shortcoming in the social science literature. Research interviewing is always a special situation created by the researcher in all senses; a parallel from the field of quantum physics, which has alerted us about the effects of the

observer on the behavior of the system might be loosely applicable here. Unlike the non-living systems that physics deals with, research participants are always active agents embedded in unique cultural-historical environments and who necessarily co-opt researchers into their meaning-making processes.

Chapter 7

Background to Chapter 7

Together with Chapter 3, this chapter branched off from an earlier departmental conference presentation on learning and identity in the salmon hatchery. With one paper on identity already published in *Forum Qualitative Social Research* (Chapter 6), I now ventured into navigating uncharted territory in identity research: collective identity from a CHAT perspective. Despite a considerable number of studies in the field, and despite the increasing importance of *identity* in the scholarly literature, CHAT theorists had not yet incorporated this concept into their own domain—this is the unique contribution of this chapter. Completed in early summer 2004 after six months of writing, it was a struggle in trying to formulate a new conception of organizational or collective identity that posed a riddle even to full-time organizational theorists. I also experienced first-hand the hazards of crossing into new disciplinary domains when I erroneously conflated organizational identity with organizational identification until I was about halfway into the project. Without exaggerating too much, I rate this chapter as one of the most arduous and frustrating besides Chapter 8 in terms of trying to extend theory. At the same time, it was comforting to observe scholars from very different theoretical backgrounds grappling with similar issues; "What is identity?", "Where is identity located?", "What is collective identity?", "What is the relationship between individual and collective identity?" and so on (Albert, Ashforth, & Dutton, 2000; Pratt, 2003). Indeed, part of the motivation for attempting this project was to offer a dynamic, non-dualistic basis for understanding collective identity, which was virtually unknown in the extant literature be it in psychology, sociology, or management theory. Of course, I was not entirely bereft of

pointers in the way forward; the text of Chapter 6 and Michael's recently co-authored paper (Roth et al., 2004) furnished me with two toeholds by which to proceed. First, I worked on the claim in sociocultural theories, including CHAT, that identity was a product and byproduct of activity that emphasized its mutable, contingent nature in social interactions. Second, I searched the Shallow River data to see how issues of identity, identification, and learning were made salient during felt contradictions in the activity system. As I wrote on page 158, contradictions were especially important for they are "emotion-laden situations . . . [that] make visible the work that goes into producing and reproducing [identity] as part of ongoing work practices."

I then extended the argument in Chapter 7 to say that collective identity was always a structural feature of organizational life because the individual|collective constituted an inseparable dialectical unit. This made a CHAT perspective useful, as it averted a problematic explanation of identity beginning from the individual or organizational pole, which was how it had been approached in the extant literature. I then tried to show that identification arose whenever learning and the expansion of action possibilities occurred at both individual and collective levels. Conversely, deidentification with the organization was associated with non-learning and stasis experienced at these levels. If there was one important lesson that I learnt during the writing it was that Michael taught me how to blend the theoretical concepts with the empirical data into a seamless web in the text. Not only was this an easier read without lengthy (or boring) theoretical sections disjointed from the research findings but the text also offered a compelling interpretation of events for a wide social science audience. Whether or not I succeeded remains to be seen although I have regularly encountered this

mode of writing in the science studies literature as well. After some transformations, which include the perspectives of Michael, SungWon Hwang, and Maria Inês Mafra Goulart, this chapter forms the basis for a section in a book on learning, identity, and participation (Roth, Hwang, Lee, & Goulart, 2005).

Organizational Identity and Identification from the Perspective of CHAT

Organizational identity is such a complex and multi-faceted phenomenon that it has often led to confusion about what exactly the term denotes. Fundamental questions about whether a construct under scrutiny is related to identity, and collective identity in particular, has even been problematic for researchers in this domain (Pratt, 2003). The study of organizational identity—the "who are we" question—has nonetheless attracted much interest since its initial articulation two decades ago not in the least because of the intrinsic possibilities of manipulating it for corporate advantage. At the same time, this compelling means of understanding human action in organizations can also present a dilemma for management in that too strong an organizational identity has been implicated in obstructing openness and transformation when needed (Fiol, 2002).

Personal identity and organizational identity are, depending on the theoretical framework taken, connected in some form. It has been claimed that little linkage and overlap between these two levels can occur unless there exists some stability in the system, which may be associated either with the individual or the organization (Sveningsson & Alvesson, 2003). Consequently, many theorists describe organizational identity in terms of something uniquely identifiable, central, or enduring shared by the members of a group (Albert & Whetten, 1985). These conventional views have now come under increasing revision, as organizational identity has been reconceived as possessing a changeable, transient, and mutable character (Pratt & Foreman, 2000). For example, due to the indeterminacy of the trajectories conversations take within an organization, identity has a chameleon-like nature within a narrative or storytelling

approach (Czarniawska, 2000); from the perspective of symbolic interactionism, organizational identity has been viewed as a process (Hatch & Schultz, 2002); likewise, it is a fluid entity within a social constructivist methodology (Gioia, Schultz & Corley, 2000).

Another longstanding problem inherent in most approaches to organizational identity concerns the nature of the linkage between the individual and collective. Thus, individual and organization are usually treated as two discrete entities or poles that have deterministic effects on one another—individuals shape what the organization is or can be whereas organizations govern what individuals do, and who they are. Depending on the approach chosen, individual and collective are thereby reduced to the other (Child & Heavens, 2001; Virkkunen & Kuutti, 2000). In the allied domain of organizational learning, similar pitfalls of such dualistic and reductionistic thinking have been highlighted as arising from either the organizational end (entailing reification or anthropomorphization) or the individual end (Berends, Boersma, & Weggeman, 2003). Said differently, theorists have often either chosen to extrapolate issues of learning and identity from individuals to explain higher order phenomena, or, modeled organizations in terms of persons. Because of these conundrums, identity and learning at the organizational level have sometimes been described using metaphors and analogies though this practice has not escaped criticism itself.

The closely related phenomenon of organizational identification has similarly faced a history of fuzziness and lack of clarity in its articulation. Nevertheless, most researchers concur that organizational identification pertains to the overlap between characteristics individuals ascribe to themselves and those they attribute to the

organization they work for (Dutton, Dukerich & Harquail, 1994). This development of connections and links with the organization is important for a variety of reasons for workers. On the one hand, there are many positive outcomes believed to stem from organizational identification in the form of fulfillment of safety needs, security needs, and well being among others. On the other hand, disidentification and deidentification (Pratt, 2000) with the organization can sometimes be empowering or liberating in that they function as processes that make the workplace a more livable place (Bhattacharya & Elsbach, 2002). Acknowledged as one of the least understood aspects of organizational identification, the origins of this phenomenon have been suggested to arise by means of affinity or emulation (Pratt, 1998). Others have instead implied that organizational identification is a process of *becoming* rather than of mutual *fitting* of persons and their organizations (Ashforth, 1998; Linehan & McCarthy, 2001). This latter approach seems promising, for it does justice to the complexity and indeterminacy of the phenomenon while hinting at its dialectical properties.

The purpose of this chapter then is to contribute to a new conceptualization of organizational identity and identification that draws on cultural-historical activity theory, an approach that puts primacy on practice and practical action. As mentioned in earlier chapters, activity theorists understand identity as an ongoing, contingent achievement during social interaction. Yet, organizational identity can also be considered as a structural feature of activity that is co-constitutive of individuals and collectives simultaneously. In addition, changes in socio-material resources manifest themselves in the form of felt contradictions in the activity system of the organization. When these contradictions are successfully overcome, it affords increased action possibilities and

different modes of participation that are co-extensive with learning, identity, and identification. Conversely, episodes of stasis and non-learning in the organization are associated with organizational deidentification. Providing opportune windows for researchers to examine these issues of organizational learning and identification are thus the contradictions within any organization. These phenomena are exemplified with selected episodes from this study of fish culturists working in Shallow River Hatchery.

CHAT and identity

One significant concern in CHAT is the nature of the linkage between individual and collective. Activity theorists understand that individuals (re-) define and (re-) constitute the very nature of collectives while structures present at the collective level enable, sustain, and constrain individual actions and possibilities. The organization is thus realized in and by the agency of every member, but people act meaningfully only because they orient towards membership in their organizations in the first instance. All actions that members perform (e.g. feeding fish in the hatchery, sampling water temperature, plotting a graph) are necessarily social in nature, which recursively create the conditions for the continued existence or change of the organization. This dialectical approach privileges neither the individual nor the collective but considers them as mutually presupposing (i.e., dialectical).

I find CHAT useful because it adds to other sociocultural theories a conceptual language for theorizing the structural dimensions of activity—the molar unit of analysis. These six theoretical entities include the acting subject (individual, collective) and object, the tools subjects' use, the community, the rules describing interactions with other entities in the system, and the division of labor that exist within the unit. These entities

constitute the socio-material resources within the activity system that are brought into play by the community-specific practices. Through the incessant transformations of these resources during activity, the participation of agents in these fields likewise changes and issues of learning, identity, and identification become germane.

To sum up, organizational identity arises from the dialectical relation of individual subject and collective, which is asserted simultaneously with every action that concretely realizes the current activity. It is a structural feature of activity, for members *always* constitute the collective in either its material or psychic aspects. Who the individual and organization are cannot be understood without reference to the other; that is, individual and institutional identities presuppose one another. This seems to be responsible for the sense of permanence in identity while its dynamic aspects are accounted for in terms of the ongoing, mutable and contingent nature of social interactions. It is to be remembered that identity is a relational process, constituting the "pivot between the social and the individual, so that each can be talked about in terms of the other. It avoids a simplistic individual-social dichotomy without doing away with the distinction" (Wenger, 1998, p. 145).

Organizational identity and identification in/from contradictions

Activities are oriented toward collectively determined object/motives; thus, the activity of salmon fish hatching is oriented toward producing myriad juvenile salmon that maintain the stocks of these species. Individual actions concretely realize the activity. However, a specific fish culturist may act for reasons other than those of realizing the activity—for example, treating his or her work as just a job. In this case, the motive realized in the actions is earning a living and extending his action possibilities elsewhere

than in the hatchery; a contradiction therefore arises between the collective motive and that toward which the individual is oriented. If the two were perfectly aligned, one would have a case of identification; when the two are misaligned, the situation is one of deidentification. Unresolved issues of organizational identification—associated with the internalization of values and beliefs or the hazy separation between identity and commitment (Pratt, 1998)—largely disappear once the focus shifts to activity and changing forms of participation. As this case study shows, identification with the organization is associated with learning and expansion of action possibilities at the individual/collective level whereas deidentification is associated with stasis as these levels.

If aspects of identity and identification are situated and contingent achievements arising from activity, one ponders whether all forms of agency equally express these phenomena for analytic purposes. A possible resolution is supplied by CHAT: contradictions or "disturbance producing systems" (Blackler, Crump, & McDonald, 1999) are especially revealing of changes in identity. Described as emotion-laden situations where identities and identification are at stake, contradictions make visible the work that goes into producing and reproducing it as part of ongoing work practices. For this reason, and the fact that the individual and collective are treated as a dialectical unit, make CHAT an ideal, non-reductionist framework for understanding issues of identity. In what follows, I articulate this new conceptualization of organizational identity and identification based on case studies from Shallow River Hatchery.

Being and becoming in Shallow River Hatchery

I present in this section case studies of organizational identity and identification reconstructed during instances of perceived contradictions in Shallow River Hatchery. From a CHAT perspective, individuals and collectives constitute a dialectical unit: individual actions not only contribute to the production of fish, and therefore, to making the hatchery what it is, but simultaneously to the production of identity. Whenever a worker feeds fish, for example, his or her actions exhibit levels of knowledgeability that others can use to make attributions as to who the person is: a novice or an expert, a dedicated or not-so dedicated fish culturist. At the same time, due to the contingent nature of these actions, stability in (organizational) identity has to be explained rather than assumed. It is through this latter process that accounts for the dynamic nature of identity that recent work from many disciplines has found to be so compelling.

Whilst organizational identification is co-extensive with increasing agency and new modes of participation, deidentification is associated with its opposite effects and mutual detriment for both persons and organization. I view these manifestations of identification not as inherent properties of any persons per se, but as highly specific outcomes of interactions within that particular historical moment in the activity system. Identification with the organization (hatchery) became apparent, for example, in the case of Erin. Throughout the research, Erin went out of her way to keep the collective activity running smoothly even when, recently, she had received word of being laid off. She nonetheless continued to align herself with the organization and engaged in actions that would minimize the operating costs of the hatchery in terms of time and money—her actions being a contradiction in the activity system. In fact, right up to the final weeks of

her employment, Erin persisted in collecting scientific data and behaving like a model employee. Jack, who used to identify with the hatchery for many years in the beginning of his career, is now a vastly different person. In contrast to the enthusiasm, eagerness to learn, improve or mediate the learning of other hatchery staff, he now concedes to performing merely at a minimum level in the workplace.

Organizational identity and identification

In what follows, I relate two episodes that concern the recording and creating of information via previously absent channels in the organization. Seemingly a drain of energy and time on the part of the originators, the introduction of these resources led to a transformation of identity at the individual and collective levels—the organization assumed the identity of a learning organization as the fish culturists grew in a widely acknowledged expertise. Due to the successful overcoming of these contradictions in the activity system, it allowed for expansion of action possibilities and new modes of participation that were associated learning and identification with the organization.

> Erin kept meticulous records about feeding rates, water temperature, daily mortality and other details concerning the coho salmon under her care. On entering her office, we were greeted with shelves filled with thick binders containing these data. Although not officially required for her job description, this was a task that she willingly performed, for, as she told us, she wanted to carefully track the growth parameters of her fish for someone in the future—fish culturist or scientist—might just have a need for it. When she left her job, she handed them over to the manager for safekeeping.

> Two decades earlier, Jack planned to coordinate information about the various diseases afflicting hatchery fish. He wanted each hatchery report to scientists, in a brief manner, any occurrences of novel fish diseases that they encountered. He would then collate this information for re-distribution to all other hatcheries thus building up separate but identical epidemiological databases in each location. Despite encountering difficulties, Jack persisted in building up his own handbook resulting in a thick plastic folder with photographs of diseased fish, which he took himself, and supplemented with explanatory texts (Figure 7.1 below). The

manual is now used to teach fish biology to students in a nearby college. (Fieldnotes)

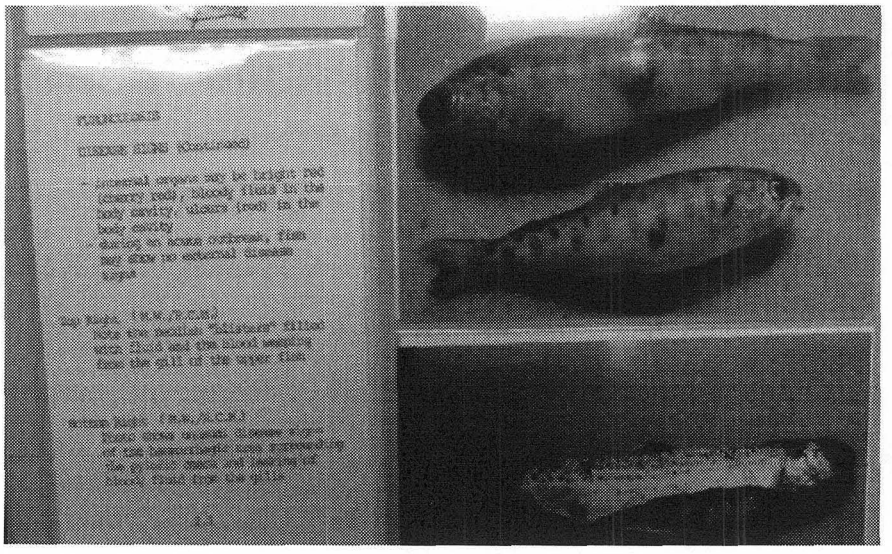

Figure 7.1. A page from the handbook of salmonid fish diseases that Jack compiled with the assistance of DFO support biologists.

Both episodes feature individuals committed to their organizations and going out of their way to document work practices. The actions of Erin and Jack did more: they not only collated information useful to this hatchery and scientists alike, but also afforded themselves opportunities to learn and develop, to recursively transform the practices of the community to which they belonged. For Erin, the data contained in the binders entailed sampling fish and other environmental variables almost on a daily basis. Although this was unnecessary for official purposes, she anticipated that at some future date somebody, including herself, might possibly be interested in the data and deem them useful. To this end, she collected data on the fish under her care, storing them on printouts and hard disk. Since her departure, these binders of coho life histories now sit in the manager's office for anyone that cares to use them. Similar to Erin's recordkeeping,

Jack's efforts in building up a handbook of fish diseases changed the possibilities of action in the activity system around him. Rather more visibly than Erin, his agency not only concretely provided a resource for his immediate workplace but also mediated the learning of future fish culturists in the nearby college. Because the fish culturists developed their knowledgeability and identities through the creation of new socio-material resources, so too did the hatchery manifest the identity of a learning organization. New knowledge resources created by an individual became available at the collective level (regardless whether it was actually realized) and therefore constituted new affordances for the actions of others. Through the overcoming of the introduced contradictions in the activity system, there was an increased room to maneuver and expanded action possibilities that I associate with organizational learning and identification.

Further examples of this linkage between organizational identity and identification occurred when the fish culturists at Shallow River conducted scientific experiments in order to boost fish production or solve workplace problems. Participation in and outcomes of these experiments led to learning in those directly involved and simultaneously changed practices and identity in the hatchery at large. Regardless of outcomes, conducting experiments had served to catalyze reflection about fish culture in deeper ways than what was possible by mere book learning and thus made Shallow River a center of excellence. The new socio-material resources produced also led to an expansion of action possibilities and identification with the organization.

> Jack investigated the use of carbon dioxide as a cheap, rapid, and effective anesthetic in fish culture. At one point, fish hatcheries had no means of sedating fish when handling them. Having read a paper describing several anesthetics for aquaculture, Jack decided to conduct an experiment specially to find out how

> carbon dioxide would compare to some of the chemicals, with which he was concerned because of their possible side effects on fish and humans. It turned out that carbon dioxide was not only as good as the chemicals in sedating fish, but also had no side effects. Carbon dioxide then became not only a choice but in fact the main strategy in this and other hatcheries. (Fieldnotes)

I had ample opportunities to witness fish culturists conducting experiments that they had designed to better understand aspects of their practices. Such experiments enabled workers like Jack to broaden their knowledge of fish husbandry in deeper, more reflective ways. The fish culturists already had an embodied knowledge of fish culture, built up over many years of experience. By conducting experiments and by creating the binders and handbook, there was an interplay between the practical understanding of everyday hatchery operations and the scientific explanations associated with the process. Here, understanding preceded, accompanied, and concluded explanatory forms of knowledge; these, in turn, allowed the workers to develop their understanding of fish culture in an analytic fashion. For Jack, achieving a breakthrough despite not having much of a scientific background was partly attributed to his vast though unarticulated experience of all the minute environmental changes that fish were sensitive to. Yet, by performing experiments, by scrutinizing these untested assumptions, Jack's knowledge about fish biology and behavior were broadened. Articulating and subjecting their prior understandings to theory-seeking explaining thus became the basis for development and expansive learning in Shallow River. No longer could the staff here be satisfied with previous levels of competence for Jack had pushed the envelope of what was possible.

And during the creation of these new socio-material resources for the collective, the status of identity became salient for both fish culturist and hatchery. Jack and Erin probably did not realize it but they were (re-) producing a community of expert fish

culturists, including themselves, in manufacturing their binders, handbook, and experimental results. These innovations changed the structure of what was possible or doable for the collective and by (re-) defining good practices in fish culture, both the identities of the fish culturists and organization evolved in a dialectical fashion (Stacey, 2003). The organization became more like the fish culturists and they became more like the organization. It comes as little surprise then that DFO scientists and staff singled this hatchery out among all those in the province and considered its fish culturists as highly competent. Again, identification with Shallow River is salient here for Jack as the changed practices from the new socio-material resources (contradictions) opened up different ways of acting in the entire activity system.

Organizational identity, identification, and learning need not be directly related to generating scientific knowledge as described in the previous paragraphs but as part of the flow of everyday workplace activity. In the following "boat incident," I highlight how Erin's actions dialectically reinforced her own identity and that of Shallow River while displaying her affiliation with the latter at the same time.

> One spring day, there were two teams of fish culturists working away from the hatchery using two trucks and one boat. Erin's team had the keys to the boat and was ready to return having completed their tasks. Her colleagues, already having arrived at the hatchery, needed the keys shortly. The teams could not meet halfway as their routes to-and-from Shallow River were different. Erin called to the hatchery, asking whether and when the other team would depart, and then waited by the side of the road to pass on the key. After half an hour, Erin left the keys in the truck for her colleagues while she drove back to Shallow River at breakneck speed to feed the hungry coho salmon. (Fieldnotes)

Taken at one level, these kinds of incidents are routine and are judged to be of mundane significance. The day when this happened was a busy one for Erin; her main duty was to feed some caged fish in a distant bay, which necessarily needed a boat for

transportation. Having completed the task, she and her team had the opportunity to return to the hatchery immediately though it was not to be. By attempting to make the boat available to her colleagues, who would not have to make a 50-kilometer round trip, she created a potential resource and possibility of action for the collective that would not have otherwise existed. The sacrificial actions seemed only to benefit the others and the organization as a whole, producing resources for saving time and (gas) money but this is not totally correct. Through this new resource, she introduced a felt contradiction into the current activity system that deviated from what one would normally expect. Instead of a bitter, cynical or nonchalant attitude often found in persons who anticipate that they are going to be laid off soon, I witnessed behavior that was more becoming of an "employee of the month." Because other staff could see in her a model of dedication and commitment, this changed the possibilities of action and collective memories for the others—herself included—in the activity system. Though these kinds of acts had a limited "audience," organizations are composed of these dynamic micro-interactions that an anthropologist would recognize as the making of culture and identity within the community.

Organizational identity and deidentification

If organizational identification is associated with learning and expansion of action possibilities, then its converse is also true. It seems unfortunate that while Shallow River in the past could undoubtedly be termed a learning organization, Jack, the most senior and experienced fish culturist there largely deidentifies with what the hatchery stands for nowadays. His interests are more often than not misaligned with the hatchery management and as such, Shallow River is no longer the same (learning) organization as

before. Granted that Jack still co-constitutes the organization by virtue of simply performing his duties as a fish culturist, his identification with Shallow River is nevertheless minimal. In contrast to the Jack of old, we witness a person who declares, "so that's where I am at, if I could quit tomorrow I would!" Performing experiments was once integral to Jack's identification with the organization; however, one particular experiment stood out as a turning point in the slow process of deidentification with Shallow River.

> In the mid eighties, Jack initiated an extensive series of investigations on a mysterious disease known as crib death that killed large numbers of juvenile fish. After planning the experiment and collecting data for five years, Jack handed the results to a biologist hired to write them up for publication. When asked the reason for this, Jack replied that writing and especially the writing of scientific texts was beyond his capabilities. Unfortunately from Jack's perspective, the biologist stopped working on the write-up for scientific publication about halfway into the project. Neither hatchery management nor the scientists in the provincial laboratories pursued publication thereafter, and the findings never were published. This was an experienced contradiction by Jack that ultimately was never overcome. Jack told us, "I was kind'a let down with that, I was really disappointed" and from that point onwards, he devoted less and less time to doing experiments. If he does do anything in this direction at all, his experiments will be "quick and dirty" ones to satisfy his own curiosity. He confesses, "I just don't have the drive anymore to do it, I don't have the fire to get down there and really get it going." (Fieldnotes)

This particular event became a milestone for Jack; all the while continuing to be an acknowledged expert, Jack began to withdraw from getting too deeply involved in his work. He no longer received the emotional uplifting that he had previously experienced, and he blamed others in the activity system for showing too little interest in making improvements. He resigned to do his job, to "put in the eight hours," and to seek fulfillment outside work. Rather than simply displaying a negative or non-cooperative attitude from this episode, Jack experienced a genuine emotional hurt that cropped up repeatedly from his retelling of this episode. This contradiction became a turning point in

that he lost the drive to further pursue any more large-scale experiments after that. Coupled with other acts of non-participation in workplace practices over an extended period of time, this was the genesis of his deidentification with Shallow River.

Undoubtedly, Jack was (and is) still a worker at the hatchery, and he and the hatchery (collective) continue to stand in a constitutive relation. But his affect and sense making were increasingly absent from the organization as he directed his interests to unrelated activities during work. In activity theoretic parlance, this is described as a change in the object of activity: the workplace became just a place to make a living rather than a place where Jack, the subject of activity, fully engaged with the (socially mediated) object. The hatchery thus experienced a double blow: (a) a loss of one worker who identified with the general object of activity and, in his actions, contributing to learning at the collective levels; and (b) an attenuation of learning on the part of an individual. Certainly, the organization persisted due to the efforts of colleagues who sustained it but it took on a different tenor: Jack and a number of his co-workers felt the working climate to have changed, an outcome of the changing personal engagement by others as well.

Together with the frustration experienced with the crib death experiment, pulling out of the fish culture conferences became another symbol for Jack that illustrated the lack of interest in the system, which mediated his own loss of interest. That is, the loss of interest and deidentification with the activity system entailed a changing working climate (experienced as lack of structural interest), but the changing working climate also entailed a loss of interest.

> About 20 years ago, DFO organized annual conferences for the fish culturists whereby they could come together and "talk fish" as how it was described by insiders. Because fish culturists were not formally trained in science, some of the

> novel fish rearing practices developed by these workers might have been lost because they were never officially reported. The annual conference was held as a way of creating a structure where others could learn, and thereby maintain the practices at the activity system level. Intentionally the meetings were kept informal; fish culturists briefly shared their successful practices or the interim results of their experiments in language that was free of scientific jargon. Attendance was initially open to all fish culturists in the early years but due to supposed budgetary cutbacks, this number soon dwindled in later years to a single representative from each hatchery. Jack disapproved with these developments and no longer attended the conferences. (Field notes)

From Jack's perspective, limiting the attendance at the conferences to one person per hatchery limited the learning opportunities available at the collective level. He saw these conferences as an important cornerstone not only for improving fish hatching practices but also for creating a community spirit and stimulating the morale of fish culturists. Decreasing attendance was a symbolic act that provided Jack with evidence that there was no longer an interest in the collectivity to enhance the system. Thus, perceived crimping of learning opportunities at the collective level entailed limited learning at the individual level. It is evident that both boycotting the conferences—Jack, recognized as one of the most knowledgeable fish culturists in the system, is the ideal participant because he also knows to ask critical questions as we could attest repeatedly during observed meetings and scientific presentations—and withdrawal became aspects of Jack's identity. These actions became alternative symbols for others—including management—that was Jack no longer a committed employee, did not exhibit loyalty, and so forth.

To some, the withdrawal of one person might not seem critical, but in fact each action by an individual member in a collective has repercussions for the collective. While individuals concretely realize the organization in all their actions, learning, and new action possibilities can remain stagnant for the collective when individuals withdraw and

hence no longer create resources that expand their own action potential and that of others. In this case when conference participation by old-timers was prevented or when people like Jack lost interest in self-learning by doing experiments, the organization lost valuable know-how of fish biology and rearing. The organization not only suffered as a learning organization but individuals lost the chance to extend their own trajectories and identities in fish culture. Ironically, Jack once articulated the essence of the phrase *one for all and all for one* in the dialectic of the individual|collective that was slowly loosing saliency for him (c.f. page 78 in Chapter 4).

Conclusions

Waiting in a truck for a colleague, feeding fish, recording water temperature or attending a conference can be denigrated as routine, mundane processes by organizational theorists. Looking at it from the dialectical perspective of the individual and collective presented here, these kinds of actions must be viewed as necessarily co-constitutive of organizational identity. Through the course of everyday life in Shallow River, Erin and Jack slowly became experts just as the identity of the hatchery evolved more like that of a learning organization. And when contradictions in the activity system were successfully negotiated, the range of possible actions (i.e. the room to maneuver) there was amplified. Through the transformation of these existing socio-material resources in the activity system, it led to learning at the individual and collective level that also contributed towards members' identification with the organization.

A combination of various factors probably contributed to Jack's eventual loss of interest and the beginning of a process of deidentification with the organization. In part because Jack continues to be a constitutive member of the organization, the collective lost

opportunities to learn and experienced a decrease in the workplace climate. Previously identifying closely with the hatchery, it was his source of deep pride. Now the hatchery was just a place with very limited possibilities of action and devoid of personal meaning and satisfaction. Loosing a paradigmatic trajectory in Jack, the organization was also (negatively) transformed in the process (Wenger, 1998). The hatchery had not simply forfeited the services of one staff member, but the nature of Shallow River had been changed and ceased in important respects to be a learning organization. From these antagonistic actions and observable lack of concern in the goings-on around him, it is evident that Jack produces and reproduces the identity of an ordinary worker and less of an expert fish culturist.

One might argue that the "loss" of a single worker in the organization creates minimal impact. However, because of the dialectical relationship between the individual and collective, this line of reasoning is suspect. A period of overlap certainly existed between the Jack who identified and later deidentified with the organization. The latter has prevailed, for I witnessed other instances that revealed that Jack's actions were aligned less and less with the collective motives. Ultimately, both organization and individual suffered for neither entity could be fulfilled without the other. If history is said to unfold within the lifetimes of persons (Holland & Lave, 2001), then Jack's actions created structures and conditions that reinforced his negativity towards the organization over time. Through these behaviors, an altered identity was steadily fashioned, that of deidentification with the organization.

Coda

Research in organizational identity has been likened to the Tower of Babel due to the many voices coming from different disciplines that are sometimes at loggerheads (Hatch & Schultz, 2000). This chapter puts forth a non-reductionist approach using CHAT that goes some way towards unraveling the conceptual confusion surrounding this phenomenon. Building on identity as both a structural feature and contingent achievement arising from social interactions, this study focuses attention on activity as the molar unit of analysis. While others have hinted that a dialectical approach might break the straightjacket that have hitherto restricted explaining organizational identity from either the individual or collective pole, my empirical study addresses and fleshes out these concerns. If anything, the principal attraction of CHAT is its ability to overcome the dichotomy of the individual and collective for all activity is simultaneously individual and social. Contradictions within activity systems further permit useful lenses for analysts to appreciate how organizational identification is transformed, resisted, stabilized or threatened. Here, organizational identification, was associated with learning situations and alignment of interests between individual and collective—individuals grew in knowledgeability, as did the organization through the expansion of socio-material resources that enabled new action possibilities to occur at a generalized level. Conversely, deidentification was associated with stasis in learning, both in the individual and collective.

Chapter 8

Background to Chapter 8

This chapter on the sociocultural theme of history was submitted for review in the spring of 2005 to the journal *Social Studies of Science* (SSS), which is the premier outlet for articles pertaining to the social dimensions of science and technology. The present text had a convoluted past and its writing had preoccupied my thoughts even when I was engrossed in other aspects of the dissertation for two primary reasons, which I will explain in turn: the tribulations of the data collection process and the extended search for an appropriate explanatory framework.

Of all the chapters, this proved to be the most challenging in terms of data collection. Up to the winter of 2003, I was satisfied with the reading and building up of a large collection of public-domain texts on the Salmonid Enhancement Program. I gradually realized that these painted a lopsided picture for all documents, especially those generated from interested stakeholders, were motivated to present a certain version of reality (Lee, 2004). Furthermore, our interviews with a variety of people associated with SEP (e.g. fish culturists, biologists, technicians) were revealing different and oftentimes conflicting perspectives of SEP depending upon their work histories and positions within the organizational hierarchy. It was at this time that I felt compelled to incorporate less accessible material (e.g. government memos, letters, minutes) to gain a better

understanding of enhancement-in-the-making prior to the closure of any black-boxes[31] (Latour, 1987).

Gaining access to provincial and federal records stored in Victoria and Burnaby by invoking the *Access to Information and Privacy Act* proved to be the easy part. The two-year wait before I could view relevant material kept at the National Archives in Ottawa effectively precluded this option although it was felt that it would have been most informative. Another setback occurred when senior officials from the Pacific region of Fisheries and Oceans Canada—the parent organization for SEP—whom I approached in June 2004 did not seem interested in my historical research. This was despite assurances of confidentiality and the possible benefits to the organization arising from our work. Significantly, whether it was related to this particular exploratory meeting or not, I felt that some informants seemed reluctant to participate in the project and avoided me thereafter, which again reinforced my desire to rely extensively on textual materials at that point to tell my story of SEP.

Deciding upon a suitable explanatory framework for this chapter also proved problematic. Certainly, CHAT provided the overall structure that this project was situated but I wanted to seek more precise tools and finer instruments by which I could dissect the data. Inspired by Dr. David Middleton who had spent his sabbatical with Michael in the summer of 2003, I first explored understanding SEP from the point of collective remembering and social memories. This tied in nicely with the different versions of what

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[31] A concept from science studies, it refers to the removal or obscuring of controversies and disputes in the process of fact construction. Once something is a black-box, it is taken as a given or settled fact and can be used as a resource for future action (e.g. the acceptance of germ theory).

SEP was that I was uncovering from our interview data but it remained elusive to discover any overarching event or situation that *all* participants could identify collectively. The situation here was unlike David's work with the interactional forms of reminiscing about a major historical episode like the Second World War and hence this form of analysis could not allow me to capture the richness of SEP that I wanted. By late fall that year, I began looking at salmon enhancement through the three foundational pillars of geographical thought—place, space, and nature. What excited me was that these concepts were inherently dialectical with social|material components and therefore were agreeable bedfellows with CHAT. Although some of these ideas were explored in my poster presentation at the annual meeting of the American Society for Environmental History in April 2004, it was difficult to expand these concepts for an SSS audience, our target destination journal. My readings thus shifted back to the literature on science studies, with my search image focused on works of history, technology, and institutions.

Using the popular actor network theory to describe salmon enhancement remained a convenient possibility although I gravitated towards what is known as the social shaping of technology (SST) whereby social factors (e.g culture, politics, personalities, institutions) were described as dialectically interacting with technology. Certainly, this would have made a coherent and exciting story for technological adoption in salmon enhancement was generally reflective of societal influences in British Columbia. I also revisited the writings of Marxist geographers, environmental historians, and historians of technology as some were making bold claims about the trend towards turning the natural world into a commodity. In typical fashion, Michael wanted to push the envelope and advance CHAT and thus we finally substituted the SST framework with the concept of

contradictions to analyze SEP as a sociotechnical entity.[32] One might reasonably assume that these multiple false starts and dead-ends were a supreme waste of effort for a graduate student hard-pressed for time. Yet, without this sifting and searching process, my intellectual growth in a number of social science disciplines would have been severely stunted—no gain without pain as it is often said.

The intense theoretical discussions before we decided on the concept of contradictions—inherently built on a dialectical materialist conception of individual and collective human history—were perhaps reflective of the uncertainty that we had in treading on unfamiliar ground. We were initially keen to adopt the model of qualitative change from quantitative changes, which had been developed in German Critical Psychology (Holzkamp, 1983). After wrestling with this promising methodology for a number of weeks, it seemed but to provide a partial explanation to account for changes in SEP as well as being somewhat mechanistic in procedure. By then, Michael had been rereading parts of *The Capital* by Marx and works by the Soviet philosopher Evald Il'enkov that triggered off what he knew about catastrophe theory—it is in discussions with him that I came to learn about dialectics and the role of contradictions. All these different strands of thought then symbiotically combined to produce what we see in the final form of Chapter 8: an explanation of salmon enhancement in British Columbia, especially during SEP, using the dialectical concept of contradictions. This form of

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[32] The adjective *sociotechnical* refers to the dialectical production of social and technological/material elements. It therefore opposes "arbitrary and misleading. . . distinctions between 'social' and 'technical' elements, institutions or spheres of activity" (Russell & Williams, 2002, p. 128). As such, I take sociotechnical entities or systems as activity systems writ large. The former concept is however what scholars in the field of science studies are accustomed with and hence this phrase was adopted in this chapter.

accounting accords well within a sociocultural perspective and contributes to the "H" in CHAT.

As such, this chapter is distinctly different in tone and content from the rest of the dissertation. The writing used a critical narrative mode of representation that sits somewhat uneasily between pleasing historical and sociological purists (MacKenzie, 1996; Megill, 1989). When one appropriates (social science) concepts to explain history, this mode seems to offer the most compelling and readable interpretation of events for a wide audience (Skocpol, 1984). Whereas it might be accused of simplifications or of anachronistic applications of theory (Pannabecker, 1995; Scranton, 1991), achieving a clearer sense of the issues surrounding salmon enhancement was the desired tradeoff here. Above all, my retelling aspired to be simultaneously a deeply human, and a moral story (Cronon, 1992). Certainly, for supervisor and student it was the first explicitly historical piece that contrasted with much of the previous micro-sociological work that Michael was known for involving timescales in the range of milliseconds. To the best of our knowledge, the span of over a century in salmon enhancement is one of the longest timeframes analyzed among other published workplace studies based on CHAT. Because this was written for an audience that appreciates, indeed demands, articles that marry scientific and sociological standpoints, I needed to address these interests upfront while balancing the historical materials. Indeed, there was a constant temptation to write a purely historical piece rather than one for the domain of science studies due to the sheer frustration that I was experiencing in addressing scientific material and unfamiliar social theory concurrently. What readers see here in Chapter 8 is therefore a version that is 35 percent shorter than the original manuscript that was first submitted to SSS. Upon the

editor's recommendation, I revised the text to conform to the word limit of 15,000 words and also flagged in detail the theoretical aspects of the paper, which previously had been buried under the mass of historical details and footnotes. This was a good reminder that SSS was a social science journal that privileged theoretical contributions to the field above all else.

Chapter 8 begins by stating how humanity faced two seemingly exclusive needs. On the one hand, an increasing world population required sufficient levels of food. On the other hand, unless there were adequate safeguards for food sources, the latter could disappear within a few lifetimes. These contradictory forces acted not only on a global scale but also could be observed within sociotechnical systems concerned with the production of food such as fish. Such forces might then be expected to constitute contradictions that—when reacting within the system to changing conditions—would promote sociotechnical transformation. Based on archival and ethnographic data, I then identified three interrelated contradictions within salmon enhancement in general and SEP in particular that had driven this sociotechnical or activity system over the past 120 years. With the initial motivation of generating socioeconomic growth through the doubling of salmon catches, SEP had undergone a qualitative change from a production to a conservation emphasis. Ongoing censure of highly efficient hatchery technologies that were built by members of this organization in the past failed to appreciate the cultural-historical contexts or inherent contradictions within SEP and hence was largely unwarranted. Besides a new articulation of sociotechnical transformation on a historical scale using the concept of contradictions and the change from quantity to quality, the analysis informs how we conduct ourselves as a responsible species towards the Pacific

salmon. If there were one take-home message that I could share with others, it would be distilled into seven words: salmon enhancement is politics by another name.

Making and/or Saving Salmon: The Transformations of a Sociotechnical System

As an avid follower of the news, I am struck by the frequency of reports announcing new dangers in/to human food supplies. Over the last twelve months alone, consumers have variously shunned poultry, eggs, beef, and salmon for fear of disease or chemical contaminants here in British Columbia alone. At other times, one hears of the potential time bombs in modern agriculture that relies more and more on genetically modified though uniform plant species. These dangers—an expression of nature that "bites back"— are said to be the unwanted consequences arising from human interference with nature (Schrepfer & Scranton, 2004). Rising population numbers stretch current food supplies and the efforts to improve and increase food production threaten the finite resources in increasing ways (e.g. ecological, genetic). It appears almost inevitable that these seemingly mutually exclusive needs will collide or experience conflict, such as in fisheries, sometimes with compounded risks to both. Understanding the historical changes such food production systems undergo is therefore of utmost importance not only from a scholarly but also from a pragmatic perspective of survival of the human species. I therefore ask, "What then are the trajectories food production systems involving endangered species take over historic timescales?" Because these technoscientific issues of global significance have remained largely unexamined, my purposes in this chapter are twofold: (a) to *describe* the history of a large, state-sponsored salmon enhancement project that sought food production for socioeconomic growth, and (b) to *explicate* the development of this sociotechnical entity. In this account, I draw on the concept of contradictions, which express themselves as a function of both quantitative

and qualitative changes on the inside of this organization and in the socio-political and cultural-historical contexts.[33]

Socio-political and cultural-historical contexts

Marine fisheries, one of the biggest natural food resources in the world, confront many crises today. Ranging from over-capitalized high-seas fleets to those whose daily subsistence depends on nearby coral reefs, humankind is taking too much and too soon from the oceans. It is estimated that industrial fisheries would cease to exist in most waters within a few decades if left unchecked. Already, the cod fishery in Atlantic Canada, a once successful livelihood for Canadian and European fishers alike, has all but disappeared. To relieve these burdens on marine resources, the enhancement of fish populations through artificial propagation may perhaps offer a viable technoscientific solution.

One undertaking in this vein is salmonid enhancement in British Columbia, particularly the Salmonid Enhancement Program (SEP) and its precursors, which is the focus of this chapter. Eventually administered by the Canadian Department of Fisheries and Oceans (DFO), SEP had broad socioeconomic objectives besides attempting to reverse the downward trend of an important food item. For these reasons, various stakeholders expected much from it during the last thirty years of its existence. SEP also

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[33] This account differs in its theoretical grounding and style from other familiar descriptions of sociotechnical systems, such as actor network theories or the social shaping of technology. Nonetheless, readers familiar with the *Capital* (Marx, 1976) and the exegesis of its method of argument by Il'enkov (1982) will certainly detect family resemblances in what follows. Additionally, I eschew *causal-genetic* explications in favour of *historical-genetic* ones for the latter better accounts for new information entering into the transition from the explanandum of one phase and the antecedent of the following phase (Stegmüller, 1974).

was envisaged to be the catalyst in the transformation of small fishing and First Nations communities that were struggling with unemployment and lack of economic opportunities chiefly through the doubling of salmon catches. Regardless of conflicting verdicts about the ultimate success or failure of related efforts, salmonid enhancement has become integral to human life and the future of the salmon in British Columbia. Making salmon in British Columbia was not a typical case of "techno-arrogance" and the ups and downs that ensued (Grimes, 1998). Instead, this present analysis[34] shows how salmon enhancement was and is an evolving sociotechnical entity that reflects how we conduct ourselves as a responsible species vis-à-vis the Pacific salmon.

This cursory sketch already hints that salmon enhancement was conceptualized from potentially contradictory footings: producing food, saving a species, providing employment, and so on. These different approaches from scientific, political, and economic standpoints generated *inner contradictions* that shaped the trajectory of salmon enhancement by providing alternative resources for the actions of political, bureaucratic, and scientific decision makers.[35] In this analysis of more then a century of salmon enhancement programs in British Columbia, I identified three interrelated opposing tendencies/forces within the programs in general and SEP in particular: food production

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[34] Concerning data sources, I drew heavily on archival material, scientific reports, newspaper clippings, and interviews with staff from DFO. For details on the longitudinal fieldwork in Shallow River, see Chapter 2.

[35] See also page 11 and 158. Contradictions are never deterministic upon decision-making unlike physical forms of causality. Whether agents take one or another route depends on how accountable and better able they are to provide grounds for acting given the surrounding circumstances, which might be contradictory in themselves. For example, releasing large numbers of juvenile salmon into streams has always been popular despite low correlations between release and adult returns for it is seen as performing a visible, concrete action. This then is the foundation for my non-causal, generative mechanism using contradictions to explain sociotechnical change across historical timescales.

versus fish conservation; massive versus small-scale production; and, technological versus natural production.[36] These structural contradictions not only provided decision makers with resources for actions but also reflected the nature of salmon enhancement in diverse ways depending on the prevailing socio-political and cultural-historical conditions.

As I elaborate in the course of this chapter, SEP has undergone qualitative and quantitative transformations contributing to the switch between production- and conservation-based philosophies and choice of enhancement technologies. What appeared to be a sudden, qualitative change in expression of SEP can be attributed to the accumulation of small quantitative changes arising from the inherent contradictions within salmon enhancement and in the relation between SEP and its cultural context. It is, however, incorrect to say that SEP is a completely new sociotechnical entity today for old functions inherent within salmon enhancement have but temporally changed their roles or levels of importance. These contradictions therefore are persistent though oftentimes latent features of salmon production in British Columbia and they foreground the

[36] Production actions serve to maintain sufficient fish for harvests whereas conservation/preservation measures have the narrower intention of rebuilding and protecting wild or at-risk populations (Northwest Power Planning Council, 1998). These cross-purposes will accordingly influence the methods, scale and timeframes of enhancement. For the most part, once production issues are at stake, one can reasonably expect that massive releases of juvenile salmon through various artificial technologies will follow as long as demand exists. In contrast, if conservation functions are uppermost, one tends to adopt time-limited, smaller magnitude paths towards bringing up salmon populations to a certain level. As for the third contradiction between artificial/technological and natural production, I think of this in terms of a very general one that contrasts the continued assistance of some form of technology versus relying on the given biological abilities of salmon to spawn and grow in the environment. Hence, what counts as "natural" could include habitat restoration work that improves salmon spawning or rearing without leaving any long-term structures (e.g. improved gravel beds) in place.

conundrums of managing a hybrid food resource that is part biological, part cultural icon, and part commodified object.

In this explication of development and transformation within one sociotechnical entity, I first sketch the forerunners of (artificial) salmonid enhancement in British Columbia in the late nineteenth and early twentieth centuries. Next follows a description of a post-war period of intensifying experimentation and tinkering by scientists that prefigured the types of large-scale enhancement work characteristic of later years in SEP. Finally, I devote attention to SEP and the ongoing contradictions operating within its multi-objective framework. In striving to be a viable business venture and attain predetermined targets, planners deliberately chose what was known as "proven technologies." The socio-political contexts further provided conflicting signals in wishing for quick returns of fish while desiring SEP to adopt less artificial methods of production via natural or small stream enhancement. It was only when the mandate to double salmon catches was downplayed that these pressures to sustain fisheries abated.

Today, efforts to conserve wild salmon stocks are paramount in a transformed SEP, which continues to rely on massive artificial technologies developed in the past to achieve this. Ongoing criticisms of large and expensive enhancement facilities like hatcheries previously built under the aegis of SEP fail to appreciate the inherent contradictions in enhancement nor the cultural-historical contexts and are therefore largely unwarranted. I conclude this chapter with a discussion of the advantages of using the concept of contradictions in accounting for sociotechnical change and share some thoughts for an ecological ethic.

On a wing and prayer (1884-1937)

Colonized during the nineteenth century, the Canadian West Coast supported a thriving canning industry that completely depended upon one fish—Pacific salmon. Already in these early phases, there existed contradictory ideas about securing wild salmon stocks in aid of this enterprise. The lucrative profits to be made created strong external pressures to fully exploit the salmon in British Columbia. Yet, there was also concern for the industry had already demonstrated its ability to threaten local salmon runs with extinction (Lyons, 1969). For those in the business of fish husbandry, the arithmetic of augmenting salmon production seemed compelling and appeared to provide much-needed solutions. Believing in a direct correlation between salmon fry survival under artificial conditions and adult returns, some felt it theoretically possible to generate seven- to eight-fold increases of salmon through enhancement (Wilmot, 1875). Artificial enhancement was furthermore an activity with visible outcomes in contrast to habitat improvement, whose effects were less immediate or obvious to an observer. Little was known at the time about salmon biology other than that streams should remain undisturbed as much as possible. These contexts thus cultivated support in favor of *artificial* over *natural* enhancement and resulted in the building of the first hatchery here on the lower Fraser River in 1884 (Wilmot, 1885).

The prevalent notion of nature as garden with associated agricultural practices was further extrapolated toward the nascent field of fish husbandry. Because nature was thought to be wasteful, the human hand was needed to unlock its potential for abundance (Lichatowich, 1999). Monoculture already had proven to be highly productive in agriculture and transfer of its assumptions to pisciculture encouraged single-species

propagation objectives that effectively separated salmon enhancement from ecological wisdom. Far from characterizing these as (naïve) discourses of the late nineteenth century, the notion of improving upon nature still exists in contemporary discourses. Because all of these constitute resources for (discursive) action, these contradictory discourses mediated the historical unfolding of salmon enhancement, the nature of which depended on both inner and outer contexts.

By the early twentieth century, neither skeptics nor advocates of hatcheries could persuade their opponents to what extent the observed fish numbers were derived from artificial means or naturally occurring fluctuations. In 1922, the *Biological Board of Canada*[37] asked the biologist R. E. Foerster to study the impact of hatcheries (mainly for sockeye) on improving fish numbers. These experiments led Foerster to the conclusion that "[n]owhere has it [hatchery production] been found to have increased a stock of sockeye. It is even debatable as to whether it has succeeded in maintaining a declining population" (Foerster, 1968, p. 395). This sounded the death knell for these facilities and by 1937 all government hatcheries ceased operating.[38] Closure became so final that federal hatcheries for producing salmon—other than for experimental purposes—were not to be constructed again in the province over the next thirty years. Thus, one observes a qualitative change from operating to shutting down hatcheries based on a quantitative

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[37] Known as the Fisheries Research Board by 1937. It was a distinguished, federally funded scientific institution devoted to oceanographic, marine and fisheries research during its existence from 1898 to 1979.

[38] I seemed to have attributed more weight than necessary here to Foerster's scientific research in determining the closure of federal hatcheries. According to Joseph Taylor (personal communication to Michael Roth, 29 June 2005), scientific knowledge was one of many essential though not sufficient factors that policymakers had seized upon to justify their agenda. While I acknowledge this possibility, I maintain that any appeal to the authority of modern science has always provided strong reasons for accountability.

change in information. Furthermore, politics, institutional arrangements, budgetary constraints, and personal antagonism towards artificial enhancement by key scientists afforded changes in the external and internal contexts that contributed to this qualitative reversal (Evenden, 2004a; Taylor, 1999).

Tinkering and messing about (1938-1976)

During the previous era, many watersheds and coastal areas were still undeveloped and the lion's share of salmon harvested derived from natural reproduction (Taylor, 1998). This ability to eschew artificial enhancement technologies began to falter following World War II when British Columbians saw the seeming inevitability of environmental degradation; this recognition coexisted with a belief in technoscience as a panacea to resolve complicated resource issues. When policymakers realized that there was little left to halt or reverse the dropping harvests of salmon, technoscientific answers were sought to redress the input side of the salmon equation. This constituted a change in climate in favor of already existing ideas about large-scale production in artificial salmon enhancement.

Artificial enhancement is possible

After World War II, management strategies for salmon primarily focused on restricting fishing and protecting freshwater habitats (McDonald, 1978). Yet mounting environmental problems associated with urban growth, industrialization, mining, and logging were beginning to make their mark, providing for the emergence of a context unfavorable for habitat protection and production by natural means. Rising demand for hydroelectric power especially, led to the construction of dams that disrupted salmon

migration routes and impacted reproduction (Evenden, 2004b). Increasing harvests, too, added pressures on fish stocks. Being a far-ranging species that ignored national boundaries, salmon were intercepted wherever and whenever possible by high-sea fishing fleets.

By the 1960s, these quantitatively increasing pressures in both freshwater and marine environments were categorically linked to record low salmon catches in the province. In the context of these multiple quantitative changes, very different pre-existing interests in enhancement strategies were revived. Legislation and environmental protection, helpful as they were, had but temporally halted the decline in salmon without augmenting numbers in any significant way (Department of Fisheries and the Environment [DFE], 1978a), then leading to a questioning of the ability of natural production to maintain stocks. Because it seemed foolhardy to overlook the many new objectively measurable, quantitative changes in the environment (for example rising consumer demand, urban growth, habitat loss), technoscientific avenues were once more sought.

One major development and demonstration became a resource in the argument for artificial enhancement. Recently built artificial fishways[39] allowed salmon to successfully cross the narrowest point of the Fraser River and re-colonize hitherto unavailable watersheds as spawning grounds. Further theoretical support for artificial enhancement came from technoscience. Based on the theory of *maximum sustainable yield*, Ricker (1962) suggested that salmon numbers were but a fraction of those in the 19th century.

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[39] See Table 8.1 for brief descriptions.

This increased the room to maneuver for if the environment could in principle carry more fish, attention could then be directed towards redressing the supply/demand imbalance.

What followed was a gradual movement towards enhancement by massive technological strategies concomitant with a gradual decrease of reliance on natural production. These quantitative changes in opposite directions eventually led to the qualitative inversion in the dominant form of salmon enhancement from *natural* to *artificial* production.

The development of artificial salmon enhancement, large-scale production technologies and the eventual dominance of these forms were facilitated by other changes inside and external to the endeavor. Post-World War II British Columbia had seen the rising authority of scientists in the eyes of the public; technoscience and its practioners seemed to offer a welcomed degree of objectivity to address complex resource problems. During this time of scientific expansion, three agencies were active; the federal *Department of Fisheries,*[40] the independently governed *Fisheries Research Board* and the *International Pacific Salmon Fisheries Commission* (IPSFC). Research mounted by the latter was especially vital, for it fed into joint decision making with the United States about catch allocations (Roos, 1991).

Enhancement experiments advanced from obstruction removal and fishway investigations to developing sophisticated spawning channels, flow control techniques,

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[40] Known as the Department of Fisheries and Marine from the 1890s to 1930, the Department of Fisheries from 1930 to 1969, and finally Department of Fisheries and Oceans from 1979 onwards. At different times, fisheries was under the jurisdiction of the Department of Environment, and, Department of Fisheries and Forestry from 1969 to 1978.

and hatcheries in the 1960s.[41] Not all forms of activity were immediately successful; some yielded ambiguous results while others clearly failed (Larkin, 1974). The outcomes of trials involving fishways and spawning channels nonetheless seemed promising provided certain conditions were met. By the 1960s, the Fisheries Research Board had explored lake fertilization for sockeye enhancement, which yielded outstanding preliminary results.[42] Since this technique did not involve any capital expenditures other than the cost of spreading chemical nutrients by boat or plane, it quickly became the poster-boy for enhancement experiments. Taken together, these experiments led to incremental increases in knowledge of factors that mediate salmon enhancement.

Follow the leader

Of significance, the record runs of hatchery-raised chinook and coho salmon in Oregon and Washington in the 1960s caught the attention of Canadians (Wood, 2002). No other demonstration of the capabilities of enhancement technology would have been more striking, for Canadian catches were at historical lows then. This was a critical qualitative change in the external environment that tipped policy makers towards reconsidering artificial enhancement in British Columbia. If asked to identify the reasons for their achievements, most American fish culturists would have pinpointed quantitative and qualitative changes in fish culture that had just arrived on the scene. At this point, American hatcheries were spearheading innovations in practices, for, unlike their northern neighbors, they had not diminished their regard for hatcheries after Foerster's negative assessment in the 1930s (Evenden, 2004a). If anything, the American

[41] For a brief description of these technologies, see Table 8.1.

[42] See Table 8.1.

dependence on these technologies grew over the years insofar as they constituted a cornerstone in US fisheries management.

In 1962, the Canadian Department of Fisheries constructed its first hatchery cum spawning channel on the Nanika River. Because it involved the ultimately unsuccessful transplanting of fry from one river to another, this bid by concerned biologists to save the local sockeye run was terminated after six years (Lyons, 1969). In 1968 the department then embarked on a larger pilot and research hatchery at Big Qualicum River to assess the newly discovered methods of disease control and improved fish diets. The construction of this hatchery signaled a genuine qualitative change in the system, for it was described as the "first of the modern enhancement projects to be undertaken in this province and has provided a model for other developments" (Fisheries and Oceans Canada [FOC], 2004a, ¶1). Without an evaluation possible before adult salmon arrived four or five years later, there was much confidence that the outcomes would be as pleasing as those in Oregon and Washington (Anonymous, 1969). Recognizing the tremendous growth potential of recreational fishing in British Columbia that existed simultaneously with the global demand for Pacific salmon, staff members continued exploring new techniques and location sites for long-term enhancement (Department of Fisheries, 1969; Department of Fisheries and Forestry, 1971).

Renewed confidence and interest

By no means in possession of a comprehensive set of scientific data, by the end of the sixties, technoscience was anticipated to offer workable alternatives to the various stresses on salmon. There was only one bottleneck in this scenario; once the problems in freshwater environments were conquered then the limits to production were thought to be

removed—a heady optimism similar to that shown by fish culturists of previous generations. At any rate, these external pressures that favored enhancement were beginning to dominate again just as it simultaneously caused changes on the inside of the Fisheries Department. Based on technical, managerial, and economic considerations, a number of streams flowing into the Strait of Georgia (located between mainland British Columbia and Vancouver Island) were soon identified as potential hatchery sites. No longer satisfied with ad-hoc developments, a coordinated blueprint was being devised and enjoyed the blessing of the Minister of the Environment (Jack Davis). A self-confessed promoter of "replenishment," Davis believed that it was possible before the conclusion of the second millennium to treble, even multiply several fold salmon numbers. In this way, massive production with artificial technologies would "improve on nature" and revive the languishing salmon industry as never before (Legislative Assembly of B.C., 1980, p. 3597). Together with anti-pollution measures, Davis made it clear to the Department and public that he wanted priority action on hatchery projects (Anonymous, 1969). He was accordingly defensive about any criticism alleging that artificial enhancement was upsetting the balance of nature:

> [w]hile we must do all we can to maintain the natural environment we also must develop techniques that will enable us to produce enough fish to offset these losses [from human population increase and industrial encroachment]. This rate of gain must equal the rate of loss in order to "stand still". If we are to increase our resources beyond present levels we must not stop at spawning channels but continue through hatchery propagation and perhaps to the eventual goal of complete domestication of the Pacific Salmon.[43]

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[43] From Library & Archives Canada (Burnaby), Accession number V-1998-00324-8, Box 3, File number 32-5-2-2, Scientific Investigations-Salmon-Management, maintenance & development of the resource [1970/01-1972/10], Letter to R Haig Brown, 16 February 1970.

The first production facility to be commissioned turned out to be located in Davis' own political constituency, Capilano (built in 1971), in North Vancouver (Meggs, 1991). Finally, the many quantitative and qualitative changes provided a milieu for artificial enhancement technologies in the form of hatcheries to gain a permanent beachhead after an absence of more than three decades.

Meanwhile, commercial fishers were keenly following these developments and requested a joint government-industry seminar to discuss their concerns (Department of Environment, 1974c). What the seminar participants read as background material was interesting, for it included a manuscript authored by a fisheries professor, Peter Larkin, subsequently published in the *Journal of the Fisheries Research Board of Canada* (Larkin, 1974). In the original version however, key passages unequivocally promoting enhancement were underlined. These strengthened the general conviction in artificial production than it otherwise might, for it came from an eminent scientist and known critic of technological fixes to resource problems.

Yet a critical disclaimer was glossed over: enhancement would always be risky. Writing about the unpredictable results that lay ahead, Larkin was explicit in what he felt to be the role of hatcheries—"akin to the roulette wheel in a gambling house and [that] there [were] many less glamorous but more certain ways of investing" in enhancement (Larkin, 1974, p. 1443). Being safe was better than being sorry though this path need not necessarily exclude the use of artificial technologies, which certainly presented a contradiction for decision-making (see Figure 8.1 below). The successful use of these, according to the experts, could prove harder to accomplish than rocket-science given the state of technoscientific ignorance about salmon (Larkin, McDonald, Parker, Neave,

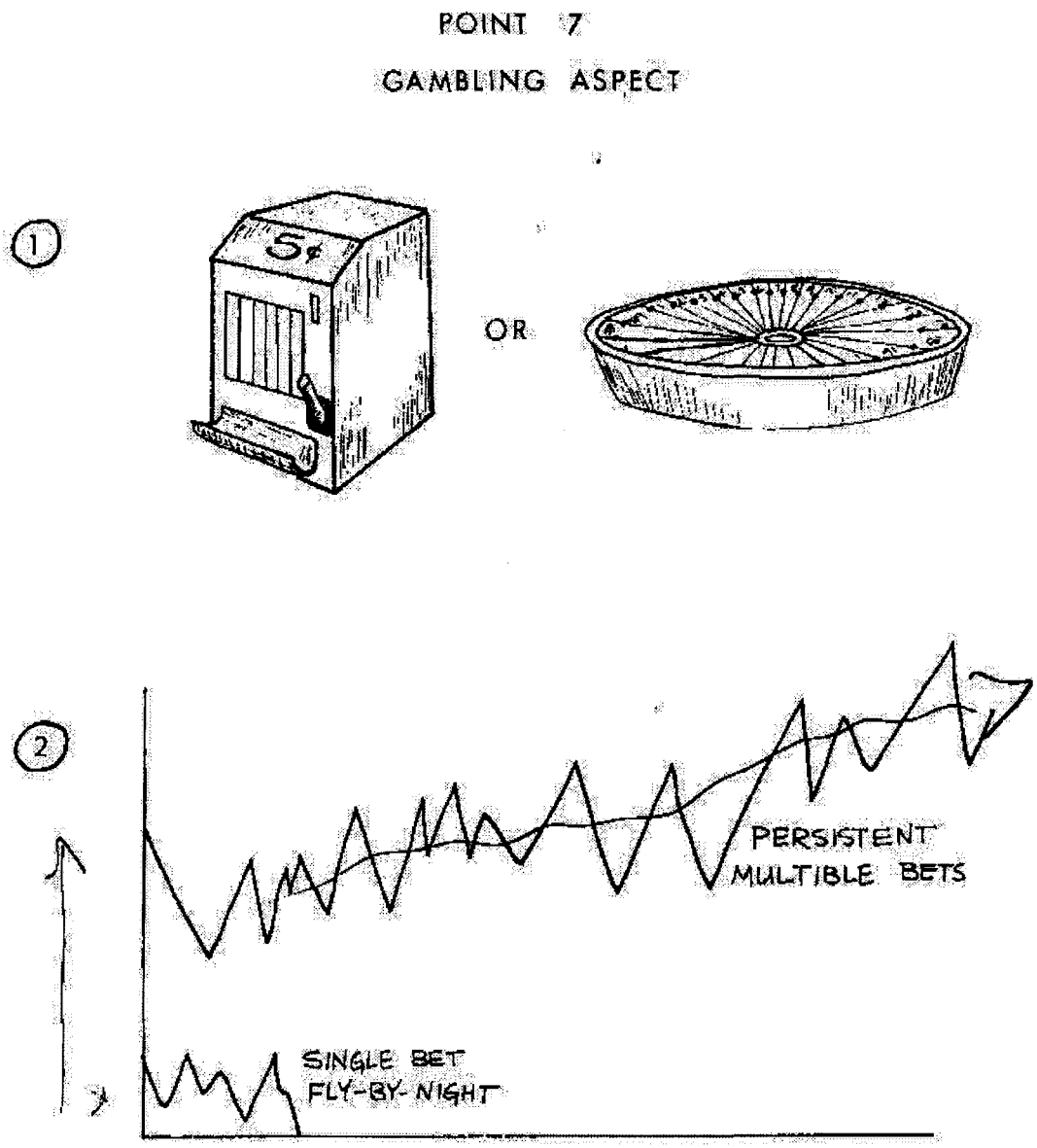

Figure 8.1. A reproduction of a slide from an overheard transparency used by Peter Larkin to illustrate the gambling aspect of enhancement. From University of British Columbia, Larkin P. A. Papers, Box 15, File 14 [Notes on Play It Again Sam, n.d.]. Used with permission.

Godfrey, & Ricker, 1969). The chief fisheries biologist, Dixon MacKinnon, had similarly compared artificial production to a gambling game, which inherently contained more contradictions. On the one hand, he reassured British Columbians that natural production of salmon would be the ecologically prudent mainstay for many years to come. On the other hand, he declared that the "high value of sockeye however, [made] the gamble enticing" (MacKinnon, 1968, p. 34). This latter sentiment echoed an earlier presentation whereby MacKinnon promoted technologies like spawning channels. "In this respect," he added, "we may eventually look toward the possibility of a form of semi-cultivation of a significant portion of our stock" (MacKinnon, 1963, p. 109). Unaware that things might not have been as upbeat as purported, attendees unanimously agreed at the close that no further justification for large-scale enhancement was necessary although various stakeholders (e.g., cabinet, public) had to be convinced of its worth.

At this point, conservation issues or habitat improvement schemes were far from the agenda of policy makers given the external climate that favored large-scale implementation of artificial enhancement. The latter seemed to atone for past political and legal failures to rein in the fishing fleet as it also compensated for quantitative rises in development and urbanization across the landscape. Yet, there was one complication that was downplayed in the euphoria. Insofar as past results from spawning channels, fishways, and lake fertilization projects were encouraging at least in certain cases, the same could not be said of any hatchery project in Canada as late as 1974. Low returns from Big Qualicum Hatchery were excused on the basis that it was an experimental facility while the other newly completed hatcheries were not expected to welcome their returns anytime soon save for Capilano (Department of Environment, 1974c). Even then,

it seemed a doubtful matter; from a batch of nearly 340,000 chinook eggs, only about one hundred three-year old and seven hundred two-year old adults managed to swim up Capilano River in 1974 (Childerhose & Trim, 1981). The number of coho adults seemed more promising for it was four times the anticipated rate with 40,000 returning that year.[44] A positive and sweeping role for enhancement was nonetheless portrayed to Cabinet when they were presented documents that worked on the assumption that local spawning channels were able to continue delivering at benefit-cost ratios ranging from seven to one to fourteen to one (Department of Environment, 1974a). And, lacking extensive data from local hatcheries, Canadian politicians deliberated whether to proceed with large-scale operations with the purportedly high benefit-cost ratios from the USA (from 3:1 to 7:1) as benchmarks (DFE, 1978a).

Countdown to SEP

In 1937, all government hatcheries had been closed. Yet the presence of incremental quantitative changes in a variety of factors, qualitative successes south of the border, new scientific knowledge, increased practical knowledge, and so forth created a fertile context within which a new organization devoted to salmon enhancement could emerge. Cabinet found the arguments by the Fisheries Department persuasive and granted in principle approval for a salmonid enhancement program. It was seen as a vital component within a new comprehensive plan to develop fisheries—the *Policy for Canada's Commercial Fisheries* (DFE, 1978a). On 24 March 1975, Cabinet's decision and a two-year planning period for SEP were publicly announced. Declaring that SEP

[44] Recruitment was erratic for it dropped to just 6,611 the following year and then rose to 25,255 in 1976 (Murray, 1984).

would bring a $400 million return for a $300 million investment, new Fisheries Minister Roméo LeBlanc assured British Columbians that it would be self-sustaining in terms of costs and would achieve its targets within fifteen years.[45]

A federal task force chaired by Ron MacLeod from the Fisheries Department oversaw various working groups examining the economic, biological, and technical feasibilities for the enhancement projects that were to come. Maintaining a close working relationship with Larkin, the two raised support among various rod and game clubs and provincial agencies, leading to a heightening of public expectations despite the absence of any supporting economic data. In view of the time pressures to deliver a workable strategy, there was talk of emphasizing the political attractiveness of SEP in lieu of hastily submitting a full economic analysis though this did not materialize.[46] Indeed, any delay in implementation would have been disastrous given the deteriorating business climate in the fishing and processing industry (McMullan, 1987). Disappointed with the two-year delay, the leaders of these associations had already expressed impatience in wanting to enjoy the benefits of enhancement at the earliest opportunity.[47] These foreshadowed the two-edged sword that popular support would bring for it cultivated grass-root backing for SEP intertwined with a moral obligation to deliver the goods.

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[45] Archival material from B. C. Archives, B.C. Environment & Land Use Committee Secretariat 1973-1980, GR1002 (hereafter ELUC), Box 37, SEP- General (1975-1980), Press statement by Hon. Roméo LeBlanc, 24 March 1975.

[46] ELUC, Box 36, SEP - Economic working group - Correspondence file 1(1975-1977), memo from D J Reid, Fisheries economist, to EWG, 19 August 1976.

[47] See ELUC, Box 36, SEP - Correspondence (1974-1978), letter from P A Larkin, to J R MacLeod, Fisheries & Marine, 20 May 1975.

The original desire by the Fisheries Department was to emphasize ecologically safer technologies that lessened the likelihood of serious harm to the environment. Furthermore, enhancement was only to supplement production whenever there was a clear advantage (MacLeod, 1975). Said differently, interventionist technologies like hatcheries or spawning channels became the last resort when fishways, habitat restoration, and other less potentially damaging techniques appeared to be failing (Larkin, 1979; Narver, 1973). This meant that small, geographically distributed projects that concentrated on rebuilding endangered or threatened stocks were to be normative. Rather than committing prematurely to projects that could neither be scaled-up if proven successful nor be aborted if shown otherwise, SEP designers wanted to use low-impact techniques that emulated natural conditions as far as possible.

The Associate Deputy Fisheries Minister, who insisted on making SEP more politically acceptable by emphasizing its relevance to fisheries, overrode these precautionary tactics.[48] Planning for SEP was therefore reformulated; conservation and restoration of endangered stocks remained a priority but it had to improve commercial fishing as well (DFE, 1978a). This decision reinforced the existing contradictions within salmon enhancement; equal attention was to be devoted to seemingly opposing goals of food production (leading to wealth generation) and species conservation. Calling for an exquisite balancing act even under the best conditions, it saw decision makers in SEP compromise one mandate at the expense of the other depending on prevailing socio-

[48] From Allen Wood who was then chief planner for SEP, cited in Gardner, Peterson, Wood, and Maloney (2004). Wood did not identify the minister but it was presumably Ken Lucas who held this position from 1974 through at least 1976 (ELUC, Box 38, SEP - Public participation (PIP) - Correspondence file 1(1976 - Feb1977), memo from G Sinclair, consultant, to BCTG, 31 January 1976).

political forces. These opposing tensions were also reflected in the choice of enhancement technologies in the arsenal of SEP as I elaborate later. Suffice to say here that hatcheries in particular have endured a love-hate relationship with British Columbians ever since they were created a century ago. Embodying multiple contradictions, they play a role in fish production as well as in conservation efforts as their factory-like efficiencies potentially threaten the continued survival of Pacific salmon. Upon receiving final Cabinet approval, SEP was officially launched on May 30, 1977.

With good intentions and a certain arrogance (1977 - present)

When it was created, the Salmon Enhancement Program was the consolidation under a federal body what had been uncoordinated enhancement efforts in post-war British Columbia. A multitude of quantitative and minor qualitative changes provided a context for a major qualitative change in the way that the salmon crisis was tackled and earned the reputation of being *the* largest undertaking in the world to support food fisheries through artificial technologies (DFE, 1977a; 1978a). The avalanche of juvenile salmon that soon followed was as much a reflection of heightened confidence in technoscience as well as an avenue to bypass the conundrums in resource management by politicians, bureaucrats, and scientists. Attempting to achieve various socioeconomic goals through the doubling of salmon catches, SEP planners adopted a heterogeneous array of strategies and technologies to rebuild fish populations as I now describe.

SEP goals and benefits

At the outset, SEP was geared toward large-scale fish production. Described as a profitable socioeconomic venture with associated environmental objectives rather than a

purely biological or conservation program, SEP attempted to double the catch to 19th century levels of between 300 to 360 million pounds per annum, then twice as great as yields during the 1970s (DFE, 1978a; MacLeod, 1977; McDonald, 1978). Making salmon was the means to certain ends—food production, the creation of prosperity, and other public and environmental benefits captured within a five-account system, namely: (a) national income, (b) regional development, (c) Aboriginal people, (d) employment, and (e) resource and environmental preservation. All projects developed under the auspices of SEP would, and could be comprehensively evaluated by these five criteria that proved to be contradictory in actual practice. It brought so much excitement among Canadians that politicians were eager to use SEP as a vehicle for personal advantage and studies were commissioned to assess the suitability of an identical program in Atlantic Canada (First Ministers' Conference, 1978; Hilborn & Winton, 1993).

Embracing a coherent balance of projects backed by state-of-the-art scientific and economic research, SEP sought to positively manipulate the ecological system.[49] Reassurances were constantly given that this obligatory cost-recovery program in SEP was ecologically sound (Larkin, 1979). The concept of enhancement was said to be simplicity itself and it was even suggested that salmon were custom-designed by Nature for artificial propagation by virtue of their remarkable homing abilities. Therefore, one reaped in abundance what one sowed (Gwyn, 1977). But the strongest argument for embarking on enhancement of this scale was perhaps a negative one. Simply, it was believed that "scenarios 'without' the Salmonid Enhancement Program [would be]

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[49] See ELUC, Box 38, SEP - Board meetings [1978-1979], Executive summary B.C. Task Group Meeting #13, Annex IV, 1-3 December 1978 for comment about balance and DFE (1977a) for manipulation.

difficult to predict. Without *any* action...natural salmon production could be reduced by at least 30% by the year 2007" (DFE, 1978a, p. 44). Admitting that catches had recovered somewhat from the all-time lows during the early 1960s, this anomaly was discounted due to the mitigating effects of the pre-SEP facilities and increased fishing effort.

Ultimately, officials alleged that Pacific salmon were on the brink of extinction and that fisheries managers had already run out of low-cost production and management options. Given the extent of departmental infighting, high staff turnovers, frequent and abrupt changes in fisheries policies, the administration of salmon enhancement by a relatively independent organization promised some stability (McMullan, 1987). Indeed, these fisheries managers faced a challenging job arbitrating an industry that not only could drain government subsidies but one that threatened civil disobedience (Walters, 1995). Vocal lobbying from fishers and First Nations bands often succeeded (Winton, 1991) and decision making in many respects was "reduced to a series of desperate attempts to meet demands . . . without visibly destroying the resource" (Pearse, 1982, p. 37). Due to these quantitative changes (that is, less fish, less control, and options), indulging in conservation efforts and small-scale fish production models were viewed as unthinkable under those trying circumstances. In view of these predicaments, the use of proven enhancement technologies appeared to furnish solutions aligned with the sentiments of governments and user groups.[50] Bureaucrats felt that at last they were on

[50] Technology was said to be the "one positive factor in the future prospects of Pacific salmon" allowing fish culture to emerge from the dark ages (Department of Environment, 1974b, p. 6). The missing ingredient holding back the benefits of enhancement was immediate action for there was "no problem deciding what to do or how to do it" (Fraser, 1976, p. 6).

the cusp of a new dawn whereby surpluses rather than scarcity would have to be controlled (DFE, 1977b).

Fiscal and technological resources

Initially targeted funding levels led to planning consistent with, and, supporting a production ideology in artificial enhancement. Working within a fifteen-year timeframe, SEP was to be divided into two phases of which the first (from 1977 to 1982) was promised joint federal and provincial funding to the tune of $157.5 million ($448 million in 2003 $). With annual funding and implementation plans subject to annual revision, flexibility in operations was imperative. The construction and maintenance of large facilities like hatcheries and spawning channels was estimated to siphon off 80 percent of effort and capital expenditures in Phase I alone (DFE, 1978a; Pearse, 1994). This phase was also critical in that it was meant to be a learn-by-doing period whereby it would trial enhancement technologies, generate new technoscientific knowledge and options for the future. This process would therefore incrementally change existing knowledge that could be used to argue for changes elsewhere in the system.

In Phase II, financial accountability and optimization, which became internal and external quantitative factors, featured prominently in official rhetoric that subtly delimited the range of operations in SEP. This phase, contingent on the overall success of Phase I, was to be funded at about $30 to $60 million per annum. As long as the minimal production of 190 million pounds of increased salmon production was attained, it was agreed that any immediate termination of investment after Phase I would provoke neither

adverse economic nor biological consequences.[51] For the program as a whole, planners benchmarked themselves against a benefit-cost ratio of 1.5 to one rather than one to one (Brown, 1981). This was believed to be achievable and this figure was even inflated to between three to one and five to one when discussed in the provincial parliament (Legislative Assembly, 1980).

A continuously increasing array of technologies and strategies supported SEP in its production efforts (see Table 8.1 below). Specific location sites for enhancement sometimes had a combination of technologies (for example spawning channels plus hatchery) instead of a solitary kind. Together with spawning channels, hatcheries are the major installations in SEP that annually discharge juveniles numbering between 300 to 400 million when SEP first started to about 600 million fish currently (FOC, 2000a). Of all of the different technologies, hatcheries have attracted the most controversy and the rhetoric decrying their use has been especially colorful. They have been criticized as cement dinosaurs sanctioned by a SEP leadership top heavy with engineers (Farrow, 1984; Hume, 1990).[52] Derided to be "fancy-looking, expensive, risk-ridden operations" (Larkin, 1984, p. 16) or fish palaces (see Figure 8.2 on p. 204) producing wind-up fish[53] (Bruhn, 1993), DFO now maintains 26 large facilities in British Columbia (FOC,

[51] This figure is a summation of the anticipated extra 50 and 140 million pounds produced annually from Phase I and II respectively at no costs to the government (DFE, 1978a).

[52] Meant to be pejorative or cynical, members of this profession are in truth adept at the "social" intricacies of their tasks (MacKenzie, 1996).

[53] Fish deficient in aggressive qualities favoured by anglers.

Technologies	Description
Human controlled spawning and rearing combined - Hatcheries	Most interventionist approach with the greatest threat to genetic diversity of salmon. Ranging from massive facilities to small plywood outfits favored by community groups, they: 1. supplement natural production 2. rehabilitate production where stocks have declined 3. educate public and tourists 4. support community enhancement groups Hatchery operations involve obtaining eggs from broodstock, fertilizing them and then nurturing the juveniles to a certain stage before releasing them back to the ocean. By 1993, they were considered to be the single largest production component in SEP.
Artificial habitat with natural spawning and/or rearing - Channels	Artificially improved stream beds that provide optimal spawning or rearing conditions. Factors that are usually controlled include water flow, temperature, gravel size, predation, and adult spawner density. Often used in combination with hatcheries, these two technologies contribute to the bulk of enhanced salmon in British Columbia.
Lake fertilization/enrichment	The controlled addition of nutrients to stimulate plankton growth for sockeye fry to feed upon. In streams or lakes that suffer from low productivity, this method can noticeably increase size and survival of juveniles.
Fishways	Various structures that assist the passage of salmon over natural (for example rapids) or man-made obstructions (for example dams) so that upstream spawning areas can be colonized.

Table 8.1. Main enhancement technologies and strategies in SEP. Adapted from Fisheries and Oceans Canada (1993b), Gardner, Peterson, Wood, & Maloney (2004) and McDonald (1978).

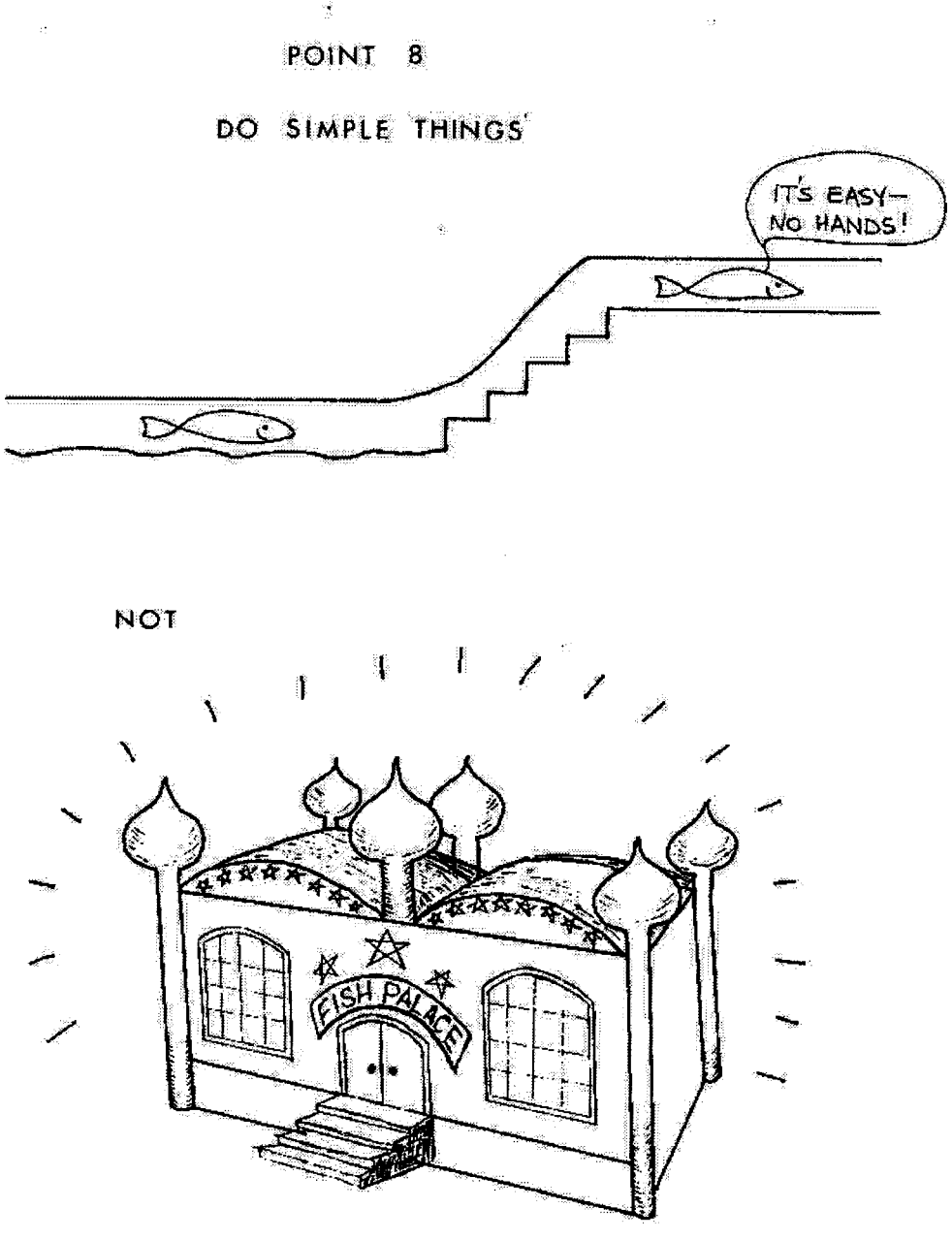

Figure 8.2. A reproduction of a slide from an overheard transparency used by Peter Larkin to illustrate the need for doing "simple things" (i.e. non-intrusive, less artificial) in enhancement as opposed to building what he called "fish palaces"—hatcheries. From University of British Columbia, Larkin P. A. Papers, Box 15, File 14 [Notes on Play It Again Sam, n.d.]. Used with permission.

2004b).[54] Because Canadian efforts lagged behind the Americans, the former avoided a number of "design and practice problems" (Gardner, Peterson, Wood, & Maloney, 2004, p. 162). This paid off when Canadian hatcheries began outperforming all other facilities for Pacific salmon, which then saw American fish culturists heading north to learn from DFO (Kadera, 1979).

Salmon enhancement today

Today, SEP no longer is a standalone organization in DFO, although many of the enhancement facilities that SEP deployed continue functioning and the acronym SEP circulates freely in contemporary discourse. Evaluating its performance after three decades, a scientist remarked that making salmon proceeded with a degree of arrogance although motivated by the best of intentions (Riddell, 1993, p. 350). The original objectives were indeed ambitious and generally have not been achieved while some aspects have endured much controversy especially the reliance on so-called *brute force* technologies like hatcheries (Josephson, 2002). On the one hand, commercial and recreational fishers have been supportive of enhancement and have frequently voiced their displeasure over threats of hatchery closures. Furthermore, a number of local salmon conservation groups have defined their identities through the usage of these highly interventionist technologies as opposed to the more ecologically benign methods. On the other hand, an observer is not incorrect to detect a recasting of emphasis in SEP over the years that has focused less on massive fish production at the expense of conservation work saving endangered stocks.

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[54] There are about 19 large single-type hatcheries (FOC, 2004c) and over 120 smaller community-based ones in British Columbia and the Yukon (Gardner, Peterson, Wood, & Maloney, 2004). Numbers always vary with closure of (underperforming) facilities.

It comes as little surprise to discover that neither of these conflicting aspects in the mandate of SEP were absent at any time; different manifestations of the organization dominated over time. It was only when there were objective changes in the socio-political environment that it allowed for a change of function, entitling one member of a pair to predominate within a contradiction. Because these contradictions were always inherent in salmonid enhancement, they presented potential resources for human agency in making salmon whether concretely realized or not. In turn, the situation provided a context for agents to orient towards. I suggest that salmonid enhancement and SEP as an evolving sociotechnical entity can best be understood from this non-deterministic and profoundly dialectical approach. In what follows, I recount the original SEP objectives containing the three interrelated contradictions. Because of the shifting socio-political and cultural-historical milieu in British Columbia that fostered quantitative and qualitative changes within it, SEP is now a very different sociotechnical entity three decades later.

Inner contradictions drive the development of SEP

I have identified three internal contradictions in salmonid enhancement, and SEP in particular: production versus conservation; massive versus small-scale production; and, technological versus natural production. Rather than either-or choices, SEP incorporated these interrelated pairs of alternatives, which resulted in tensions and pulls in its operations. Both external and internal factors that impinged upon these systemic contradictions fostered a series of quantitative changes that made SEP assume the form it did in the late seventies—a sociotechnical entity attempting to produce large quantities of fish using the most efficient technologies and strategies then available. It was not that conserving and protecting salmon stocks was unimportant; indeed, conservation remained

a stated goal of SEP. However, as long as the organizational mission of doubling salmon populations existed, all energies were mobilized and channeled towards manufacturing fish. I now explicate these production imperatives that constrained SEP early in its operations and how they influenced the adoption of particular enhancement technologies. I then describe the mixed signals in public opinion—a prime shaper in the direction of SEP—in wanting a form of industrialization without the perceived standardization of products that came with it, which constituted another context for the expression of various tensions within SEP.

Production at all/no costs?

Within SEP, there existed a tension between a stated need to maximize output of cheaply produced fish and the pursuit of other socioeconomic dividends from the program. This tension is evident in the following excerpt from a letter written by a provincial economist to his superiors. In this letter, he requested a clarification of the terms of reference for SEP:

> Is it producing x numbers of fish or in maximizing the social and economic (income and non-income) benefits from the Program? The distinction between the two objectives would not be necessary if they were not operationally compatible, but it is in my experience that they are not . . . Until an explicit decision is made as to which planning objective takes priority, the Program's development will be slowed and the full potential of either objective will not be realized. (Letter from G. Robinson, 22 December 1977)[55]

When Robinson's superiors replied a few days later, his concerns were seen as unnecessarily polarizing—fish production was not in conflict with other SEP

[55] ELUC, Box 36, SEP - Economic working group - Correspondence file 2[1977], letter from G Robinson, Special Projects Unit to J O'Riordan, 22 December 1977.

objectives.[56] Such problems in reconciling the multiple goals in SEP were, in fact, not confined to economists but prevalent among other personnel as well.

> A part of the in-house conflict between proponents of different project scales, types and functions may be the result of different goals of different professional and organizational groups...engineering goals tend to emphasize the facility and professionalism; whereas the biological goals tend to emphasize the production and fish related factors of operations. (FOC, 1980b, p. 20)

If those inside the organization were unclear about aspects of daily operations or direction of SEP, the public was presented with and expected SEP to adopt a broad approach to managing the food resource including modifications to fisheries management and protection of stocks. However, Cabinet and the Treasury had approved a restricted set of priorities for SEP—profitable manufacture of salmon over the longest duration (FOC, 1980b). Official SEP rhetoric thus simultaneously included implementing production and non-production oriented goals (e.g. conservation, education, resource protection). Yet, it became obvious at the beginning that massive fish production and the associated technologies to realize this aim dominated over other objectives. At least four elements in the internal and external environment contributed to the dominance of production rather than the conservation pole.

First, SEP was seen as an integral element of the new fisheries management plan even though it was a standalone organization—manufacturing fish was unavoidable. Not just any species were to be enhanced but those that were the staples of commercial fisheries such as sockeye, pink, and chum (DFE, 1978a). Second, the five account criteria were not equal but hierarchically ordered and the environmental account was usually

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[56] ELUC, Box 36, SEP - Economic working group - Correspondence file 2[1977], letter from E H Vernon, Asst Dy Minister of Conservation to J O'Riordan, 28 December 1977.

subsumed to fisheries management in practice. This meant that fisheries managers sometimes overrode warnings by SEP biologists about taking unacceptable risks with the enhancement of certain stocks because maintaining sufficient fish for harvests was paramount (Healy, 1993). Commentators also express agreement that there was a "built-in bias towards accepting the risks of overexploitation" coupled with a "structural bias against precaution" in managing Canadian fisheries (National Research Council, 1999, p. 51). Third, whether SEP was entitled to proceed to Phase II depended upon increasing total catch by about one-third to nearly 200 million pounds. To prove that this was a viable prospect, SEP planners deliberately mobilized projects that could deliver tangible results quickly. In the memorable words of one fisherman, "[t]he program sounds okay, but God help them [SEP staff] if it doesn't work" (Oguss & Evans, 1978, p. 69). Fourth, technoscience at the time lacked the information and political power to counter or refine the underlying momentum towards maximizing production for fisheries (Winton, 1991). Taken together, it is thus not difficult to see how these internal and external factors incrementally favored massive fish production rather than conservation priorities within SEP in its early years.

There existed another external force that pushed SEP towards embracing production all the while constraining the very goal it was intending—financing. The ability to achieve the predetermined targets in SEP was closely tied to funding, which ultimately depended on the health of the national treasury (Legislative Assembly, 1980). Because of a promotion of fiscal restraint in the civil service, SEP was obliged to extend Phase I by two years without additional financing. Coupled with unexpected inflationary costs, these circumstances halved its spending power (Pearse, 1982). Another external

constraint emerged when SEP was granted only $52 million for capital expenditures.[57] Out of this reduced sum, nearly 20 percent had to be devoted to the modification and maintenance of the facilities inherited from the IPSFC and earlier projects. Spending was thus tightened although mitigated by the secondment of salaried staff from other government departments and a growing body of unpaid volunteers in the field. Despite these fiscal troubles, fish production needed to remain high: "the rate of return of adults is a critical factor to the economics of the investment. It is particularly important that returns are high as early as possible after the investment" (Clay, 1974 in Larkin, 1974, p. 1455). Neglecting to place economic issues at the vanguard would have jeopardized the future of the organization and led the federal government to think that SEP funding was a poor investment. Reminding one of ethical investing, SEP was to be run according to business principles, paying close attention to the bottom line, without neglecting its moral accountability to the people of Canada (FOC, 1984).

Enter the massive technologies

The prevailing domination of production over conservation on the inside of SEP led to the mutual development of large, technology-heavy facilities over small, natural enhancement strategies, despite the fiscal limitations. That is, an inner contradiction developed as SEP focused on capital-intensive means of salmon production in the face of funding shortages. In the early years of SEP, the organization dedicated itself to hatchery and to a lesser extent spawning channel construction (Gardner et al., 2004, p. 106). Large projects in Phase I, mainly hatcheries, sprouted at the rate of one or two a year except in

[57] ELUC, Box 38, SEP - Board meetings [1978-1979], Salmonid enhancement board meeting No. 79-1, 23 Jan 1979.

1979, which saw a record of seven being started. These structures did not fail to attract media attention and support from local communities, which directly stood to gain from increased salmon production. In all, hatchery projects (including those in combination with spawning channels and smaller Community Economic Development Program [CEDP] ones) rose steadily to a total of 123 over the next decade (FOC, 1993b).

Rather than adopting a passive role towards helping a dwindling food resource, MacLeod in his capacity as Director of SEP had promoted salmonid enhancement as an economic engine that helped fisheries. In his opinion, a "fish is beautiful" stance was insufficient.[58] Once this consciously aggressive role was established on the inside, it remained to decide between the options available to achieve massive enhanced production in SEP (Fraser, 1976). While making salmon could have been realized by either artificial or natural techniques, given the troubled state of the fishing industry at that time the former alternative would have been hard to resist. Furthermore, lake fertilization, spawning channels, and hatcheries, which were the most efficient technologies stood out with their high benefit-cost ratios (Glover, 1979; Larkin, 1974; Walters, 1995). Once the budget was approved, it also became "difficult to spend [the money] meaningfully in a short time period" (Wood, 2002, p. 8) thus privileging capital-intensive projects.

During this period, the nature of decision-making processes favored forms of *massive, technological* enhancement over *smaller, natural* ones as practical and accountable expressions of agency (FOC, 1980b). Three elements can be discerned. First, SEP staff was held accountable to guidelines that explicitly forbade the usage of

[58] ELUC, Box 39, SEP - Task force - Correspondence [1974-1980], Draft records of B.C. task group meeting No. 6, 30 Apr - 1 May 1977.

experimental technologies on a production basis until these had undergone a period of testing (DFE, 1976). Second, the recent successes of the large hatcheries on the Columbia River provided incentives to use this technology in Canada as well. Third, a project gained approval only when it simultaneously fulfilled the criteria of enhanceability (having well-defined costs and risks, technically and biologically feasible), technical desirability (increasing technoscientific know-how and social/economic dividends) and manageability (posing little threat to wild stocks) (DFE, 1978a, p. 25–27). What usually happened was that these considerations were independently evaluated thus leading to a scaling-up of projects and the maximizing of economic gains above other priorities (e.g. the environmental account).

Minister LeBlanc expected about 60 major projects to be completed before the end of Phase I, whereas MacLeod wanted to operate up to 170 major facilities (i.e. hatcheries, spawning channels) at program maturity, an organizational challenge that nevertheless had a lot of support on the inside (DFE, 1977b, 1978b). Criticisms that made reference to the research that had led to the 1937 closure of sockeye hatcheries were attributed to "misinterpretation and economic maladies" (DFE, 1978a, p. i). A DFO scientist reassured the public that virtually every region with Pacific salmon runs was working to boost their depleted stocks and that hatcheries were de rigueur technologies.[59] In the mind of the chief planner of SEP, it was apparent that

> [i]t is impossible to take 50 million lbs by natural stream enhancement. We mixed where possible. But there was no doubt that hatcheries were and still are the fail-safe route. There is less risk involved and they require less expert

[59] ELUC, Box 38, SEP - Public participation (PIP) - General [1977-1980], InfoSheet 4, 12 October 1976.

> manpower. They also produce more fish. Stream enhancement doesn't produce a lot of fish. (Morisette, 1980, p. 54)

At its most fundamental level, SEP planners faced a hard choice between enjoying potentially large numbers of salmon from artificial enhancement and fewer or no fish from natural methods (e.g. habitat improvement).[60] As mentioned, these are characteristics that I describe as the contradictions between massive versus small-scale production and between artificial versus natural production. And, the benefits accruing from large-scale artificial technologies were convincing during the prevailing socio-political and technoscientific context at that time. Besides their higher productivity, these facilities promised better protection from disease outbreaks or environmental disasters, superior operational control, and economies of scale. Large facilities also made it possible to augment scientific knowledge by means of rigorous research and a re-colonization of water bodies previously made barren by development (Pearse, 1982). Indeed, some stocks of had fallen to such low levels that recovery was impossible independent of some form of technological assistance (FOC, 1985). Given the shortage of qualified staff, it made good sense to concentrate manpower in centralized localities rather than redistributing work over many small and inaccessible natural enhancement projects. By the same token, concentrating enhancement effort on a few river systems would have prevented the fishing fleet from dispersing geographically. Large hatcheries could also be permanently staffed, which was an important consideration at a time when unemployment loomed as a major social ill; hatcheries multiplied work opportunities for

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[60] ELUC, Box 38, SEP - Public participation (PIP) - General [1977-1980], Draft records of B.C. Task group meeting #3, 15-16 January 1977.

rural and Aboriginal communities more than any other form of enhancement technologies (FOC, n.d., 1985).

A variety of quantitative and minor qualitative factors favored the most promising "proven technologies" mutually consistent with their pre-set targets. Fish production via massive technologies also received indirect support from the five-account system used to evaluate SEP. A project scoring highly on the national account might not rank equally well with the environmental account and thus tradeoffs had to be considered within and between projects. However, the sheer volume of weighing all non-quantifiable information (e.g. education, environment) became overwhelming. Economists, biologists, and engineers had more confidence in numerical figures like benefit-cost ratios as a common referent, which therefore became the norm (Brown, 1981, p. 86). The use of such figures disadvantaged natural enhancement, for it was all but impossible to quantify its productivity (e.g. through recapturing tagged fish). The huge expenses required for monitoring baseline production also hindered scientific justification and bureaucratic confidence in natural enhancement such as habitat improvement (Harvey & Greer, 2004).

Vox populi, vox deus

The focus on fish production and commercial aspects of salmon enhancement had repercussions in the public, which created an external context that shaped the nature of SEP and its ultimate reversal from fish production to conservation. British Columbians increasingly expressed reservations that included, for example, issues about the absence of catch enforcement, public education, habitat protection and enhancement in small streams (FOC, 1980b). From a second and larger string of public meetings held throughout the province in 1978, some individuals were dissatisfied with the direction

and philosophy of SEP. Because SEP was moving rapidly toward big hatchery facilities, it was accused of being at the service of the fishing lobby (FOC, 1980c). Others warned that hatcheries posed acute genetic and disease risks to wild salmon while most wanted to see hatcheries play a closely monitored, supplementary role in salmon enhancement (FOC, 1979). Insofar as to what the role of artificial enhancement in the province was, it was felt necessary and enjoyed the backing of commercial and sports fishers (Oguss & Evans, 1978). However, which particular strategies and techniques were most appropriate remained open (Pearse, 1982).

SEP staff was all too aware of the frequently conflicting demands from their shareholders (the Treasury, Cabinet) and markets (fishers, processors, consumers) (FOC, 1980b). Trying to balance what the public wanted with the very survival of SEP created many dilemmas in planning. Indeed, SEP had as its planning mandate a "dynamic and evolving process . . . that [would] be responsive to the legitimate and changing needs of people and to the targets of government for economic growth and social improvement" (DFE 1978, p. 23). One SEP biologist reasoned that "[t]he funding comes from all Canadian people. If the general public becomes disenchanted, as could happen, politicians might be influenced" (Stewart, 1980, p. 19). "It's the people who are going to decide how many fish we're going to have," MacLeod insisted (Gwyn, 1977, p. D1) that dovetailed with LeBlanc's earlier pledge to allow the public to call the shots for SEP in its entirety.[61]

Given the prerogative to influence the direction of the program, the public did but in a way that intensified the contradictions within SEP. "The public told us [SEP staff]

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[61] See foonote 45.

they wanted natural enhancement but they also told us they wanted 50 million pounds of salmon a year too," said then Chief Planner, Al Wood. He summed up the genuine dilemma that faced SEP by asserting that, "[t]he two things are mutually exclusive" (Morisette, 1980, p. 54). Wood, as other staff in SEP, recognized that what British Columbians wanted with regard to salmonid enhancement was a form of industrialization (a quantitative state) without the perceived standardization (a qualitative state) of products that came with it (FOC, 2000b, p. 2). On the one hand, DFO biologists, scientists, and some members of the public had argued for a slower though ecologically safer route of making salmon through less interventionist strategies. On the other hand, politicians, fishers, coastal, and Aboriginal communities expressed levels of urgency that could only be realistically met from sizeable enhancement facilities using artificial production. Despite the possibility of turning salmon into a mass-produced object through the latter route, history has shown that this was the preferred alternative that policymakers adopted.

A qualitative change in SEP

Even while the production imperative assisted by massive enhancement technologies was the dominant motive guiding SEP at this point, conservation issues were never absent. Both functions coexisted thus generating an inner contradiction in the organization. A gradual movement away from the doubling objective did unfold, although this transformation was never clearly documented nor formally acknowledged at first (Pearse, 1994). By the 1990s, in the face of a changing socio-political and cultural-historical context—a broad public appreciation for preserving wild salmon stocks and their genetic biodiversity—the conservationist aspect within SEP increased in importance

so that it eventually became the new dominant direction. In what follows, I describe this qualitative transformation as the result of quantitative changes even while doubts were being raised about the ability of SEP to fulfill its mandate.

More complex than anticipated

Halfway into Phase I, it became apparent that making salmon was more complex than anticipated, leading to public doubts whether salmon numbers could be increased at all. DFO officials continued to defend the program, citing severe inflation-mediated funding erosion as a major hindrance to increased salmon production (Hume, 1990). Other funding sources, too, dried up or never materialized: (a) the provincial support ceased in the early 1980s over differences in philosophy and (b) SEP was never financed as planned through the taxation or licensing fees (Gardner, Peterson, Wood, & Maloney, 2004). SEP management reminded the public that investment dividends would only come in the future thus requiring some patience at the moment (FOC, 1980a). Yet few years later, a report noted that enhancement probably did not increase overall salmon numbers, though without SEP, harvests might have been lower (Farrow, 1984). Some scientists started calling artificial enhancement a rip-off for taxpayers while also posing grave dangers to wild salmon stocks; some like Larkin went as far as declaring that the "extravaganzas of hatchery construction" were bordering on lunacy (Farrow, 1980, p. A17). To an observer, it might have looked very confusing and certainly contradictory; one the one hand SEP staff was pushing for greater efficiency in production and on the other hand, these actions were deemed deleterious for Pacific salmon.

To all intents, technoscientific mastery had reached a high point by now. It was said that the best hatchery managers and fish culturists could even grow fish in a toilet

bowl while private citizens boasted of their successes in artificial rearing performed in basements or in converted barns (Bernsohn, 1983; Hume, 1993; Meadows, 1983). While cognizant of the threats to the genetic integrity of wild salmon from the influx of enhanced fish, some hatchery managers were hopeful that the production mandate could be curtailed once these dangers were pinpointed. Likewise, only when the pressures on salmon populations were removed could other non-production goals be attended to more diligently. Prior to reaching this state, SEP was to double salmonid numbers as agreed. Community conservation groups certainly did good work but their small-scale recovery efforts amounted to little more than token gestures in the overall picture. Short of purposive action, undoing nearly a hundred years of damage was futile reiterated one hatchery manager:

> Boy Scouts and Girl Guides are not capable of mending such a colossal assault on the fish and fish environment. Volunteers can assist, of course, but only major action at large facilities will offset the decline of salmonids. (FOC, 1984, p. 33)

Change from quantity to quality

In the midst of these nagging doubts about the ability of SEP to fulfill its production mandate, SEP as a sociotechnical entity was undergoing a qualitative transformation from production to conservation as a result of several quantitative shifts. Instead of targeting sockeye, pink, and chum salmon—species that could be most efficiently enhanced—some fisheries managers started advocating the costly production of coho and chinook.[62] Favored by recreational fishers and the trolling fleet, these species were the weakest numerically thus facing the greatest vulnerability of local extinction. In the late 1970s and continuing into the following decade, there was a marked, relative

[62] Expensive in the sense of requiring a longer rearing time of up to a year in artificial environments like hatcheries before release.

increase in their release numbers (MacKinlay, Lehmann, Bateman, & Cook, 2004). Other statistics also reveal that prior to 1993, 65 percent of total SEP expenditures were related to their production (FOC, 1993b). While the enhancement of chinook and coho could have been part of the pre-existing overall drive to boost salmon harvests, I believe that these decisions by fisheries managers had incrementally favored conservation functions without attributing any conscious intentionality on the part of human agents.

In terms of supporting evidence for these trends, I document a major shift in policy in the mid-1980s when enhancement in SEP ceased being depicted as the sole means of producing more salmon (Pearse, 1994). In other words, production was now considered as *one* of many DFO policies. The doubling of salmon slowly spread across various programs within DFO rather than remaining a unique SEP contribution.[63] Another change in planning provided an internal context for the de-emphasis on production: fewer large facilities placed less demands on the shrinking SEP budget. There also existed a growing sensitivity of the ecological and genetic threats posed by hatcheries and an increasingly conservative organizational climate (Winton, 1991).

In this era of extreme budgetary constraints, supporting fish production through costly enhancement technologies came under pressure, allowing conservation tendencies to gain ascendancy on the inside. Phase II began two years later with no additional large facilities being built while some hatcheries were closed due to poor performance. New

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[63] Chided for behaving like an agency for social welfare and employment creation, a federal report recommended that the fisheries component of DFO refocus on the conservation, protection, and enhancement of fisheries (Task Force on Program Review, 1985). If these socio-economic responsibilities were hived off to other government departments or subject to economic forces, then it was believed that DFO could be liberated from any contradictions in its objectives.

enhancement work seemed to revolve around constructing cheaper spawning channels and small incubation boxes. Financial constraints also resulted in delays in implementation, severely slashed staffing, and funding in SEP (Meggs, 1991). Previously a standalone program reporting separately, the budget in SEP became integrated with that of DFO Pacific Region. More importantly, no specified production targets were set for Phase II (Pearse, 1994). Two consequences followed: cost recovery and answerability to stakeholders assumed lesser importance (FOC, 1993a). These decreased the pressures for production and allowed a renewed focus on conservation to strengthen within the organization. Although conservation and production functions are opposites, the rise of the former was enabled by the large technologies that had supported the latter and production hatcheries now became like conservation hatcheries.

Slowly, SEP was undergoing a transformation towards conservation and the goal to double numbers was internally deemed obsolete by the early 1990s (FOC, 1993a; 2000a). Other events reinforced the abandonment of the doubling objective in SEP. For example, in 1995 SEP was merged with the DFO Habitat Management section to form a new Habitat and Enhancement Branch that allowed for closer integration of enhancement with environmental concerns. New laws also came into effect (e.g. the Oceans Act, *A New Direction for Canada's Pacific Salmon Fisheries*) that upheld principles of sustainability, integrated management and a precautionary stance towards resource use. Undergoing yet another reshuffle, SEP became known as the Habitat Restoration and Salmon Enhancement Program,[64] which, beginning in 1998, ran for five years. Together,

[64] I continue using the acronym SEP as neither HEB nor HRSEP have caught on in everyday nor official usage.

these concurrent quantitative changes over time gave rise to a change of overall qualitative function in this sociotechnical entity that has been maintained to the present.

Hatchery technologies and salmon conservation groups

The changes in the external environment of SEP provided a context for the conservation tendencies on the inside to be expressed and strengthened. Accordingly, in the 1990s, hatchery technologies began attracting a negative press,[65] though they were the very places where public interest and involvement in conservation emerged and were supported. To understand this contradiction, one must realize that hands-on involvement in conservation has been long provided in SEP through its Public Involvement Program, which appealed to romantic sentiments in the public[66]: "there is a strong, latent demand to become directly involved—people want to get out into the field and do useful things" (MacLeod, 1975, p. 7). It has been found that nearly half of all the salmon conservation activities in British Columbia are associated with the use of self-run hatcheries guided by DFO advisors who themselves were often trained in fish culture. Whether volunteers are retirees or school-going children, these hatchery-related activities entail simple and foolproof methods that "give excellent bang for the buck" that other technologies are unable to match (Harvey & Greer, 2004, p. 27). That is, DFO transferred the expertise and tools from established fish culture and placed it in the hands of those passionate to do something for the salmon. These enhancement efforts visibly release large quantities of fish into local streams and are readily appreciated, which is a persistent feature of salmon

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[65] The literature is voluminous but Waples (1999) is a good point of departure.

[66] I do not want to belittle these volunteers nor SEP staff. From my research, I have encountered an unusually high degree of commitment to their jobs, of wanting to do whatever humanly possible "for the fish" as they have told me in so many ways.

enhancement. Thus, large hatchery facilities built for massive fish production contributed to educating a public that took an inimical stance to hatcheries; in the face of the changing socio-political and cultural-historical climate, hatcheries themselves underwent a qualitative transformation from fulfilling production to conservation.

Towards a cultural-historical account of sociotechnical transformation

The history of enhancing salmon in British Columbia can be characterized into three broad phases in the course of which three opposing tendencies on the inside of the enhancement movement expressed themselves differently as a function of the internal and external environment: production versus conservation, small-scale versus massive production, and natural versus technology-assisted artificial production. There was an initial (failed) adoption of hatcheries operating on a small scale, a subsequent period of intensifying interest and dependence on artificial technologies, and finally widespread and intense enhancement efforts as found in SEP and continuing to the present. The reliance (whether acknowledged or not) on natural production gave way to an embracing of technology-based enhancement because of the myriad post-war pressures in marine and freshwater environments. Due to a variety of developments internal and external to the organization, SEP either delivered in terms of massive fish production or it ceased to exist as a viable business venture.

At a later stage, SEP was freed from the doubling imperative when the responsibility of fish production came to be spread across several DFO branches rather than being the singular responsibility of SEP. Hence, conservation efforts for coho and chinook stocks grew in importance though these were never acknowledged to any extent. The upshot of gradual quantitative changes by fisheries managers together effected a

qualitative change of the dominant tendencies expressed in the philosophies and goals of SEP. These changes did not lead to new functions inside the program but instead encouraged the expression of pre-existing, contradictory goals. Initially present only latently, conservation efforts subsequently flowered throughout the 1990s while production concerns diminished. These contradictions within a sociotechnical entity mirrors global concerns about satisfying rising consumption levels worldwide while securing food resources on an ecological scale.

This cultural-historical account of salmonid enhancement and SEP in British Columbia reconstructs the development and transformation of one large, state-sponsored sociotechnical entity. I emphasized the presence of recurring contradictions within the system, which led to rather different ways in which the organization related with society depending upon the internal and external environments. The qualitative shift from one to the other form of activity was brought about by the interaction of incremental changes in quantitative determinants both inside and outside the organization. I also examined the relevant historical dimensions that gave rise to or enclosed the contradictions within the system and showed how real objective changes in the milieu fostered the emergence of some quality or expression of one of the latent functions within that system.

This way of understanding the historical evolution of sociotechnical systems offers some advantages, for it embodies complexity and indeterminacy. In such an account, the system under study is non-teleological: the internal contradictions offer a general set of affordances although one out of many possibilities will be actualized. Subsequently, the system qualitatively changes and once more presents new potentials for acting. One sees close parallels here with social theories that explain human intentions as

the interplay of agency|structure contingently unfolding across space and time. From its current focus on conservation for example, salmon enhancement might revert back to production-based patterns once the socio-political and cultural-historical contexts on the outside and its own inner context permit. In the absence of any Machiavellian actor, who stitches together a network of allies, I was drawn to this version rather than other forms of accounting for transformations in the system. Indeed, sociotechnical change need not necessarily presuppose entrenched powers, networks or predefined social interests (e.g. class, gender, race) but may indeed be better described by the structural, inner contradictions within the system. Established ways of theorizing sociotechnical change tend to gloss or black-box these heuristically interesting fault lines therefore denying analysts opportunities for uncovering the full extent of diverse resources for action within a system.

Conclusions

Making salmon in British Columbia has been an inherently contradictory process. This leads us to reconsider accusations that SEP bureaucrats have made a grave mistake by emphasizing hatchery technologies with the intent of achieving massive fish production goals. More than an application of technoscience to resolve a natural resource crisis, one sees how the decisions to use hatcheries have responded to both internal and external demands for more fish. Failure to take advantage of the seemingly most promising enhancement technologies then available would have compromised the survival and legitimacy of the entire organization and made decision making less accountable. Many present-day critics of hatcheries seem to have forgotten those past socio-political contexts that mediated continuously evolving SEP policies and its earlier

focus on salmon production. Much of this criticism views past events through the lenses of what is prevalent today and exposes a Whiggish account of salmon enhancement. Here, the current status of the story and its moral lessons (socio-political and cultural-historical emphasis on conservation) dictates the evaluation of past events in the SEP story and comes with a neglect of the profound contingency of those events that I highlight here. Accordingly, I feel that these criticisms or even calls to reduce drastically the number of hatcheries in the province now are largely unwarranted.

Whereas it is fruitless to assign blame to any party or to find simple stories concerning the salmon crisis, resource conundrums will not disappear if one ignores them. As an environmentally concerned citizen, I am conscious that artificial production has never mitigated the demand for more fish (Taylor, 1999).[67] This foregrounds tangled arguments about resource sustainability not only in local but also global food supplies as experts foresee the local extinction of Pacific salmon within a century. A less pessimistic scenario paints the long-term survival of *Oncorhyncus* dependent upon artificial technologies, which is again undesirable but likely. Fisheries Minister Leblanc once cautioned that he saw "no faster road to disaster than forgetting the very simple lesson that the biology cannot keep up with the technology—that the wealth of the oceans cannot yet match the greed of man" (Parsons, 1993, p. 359). Unfortunately, this insight has been sidelined far too often as witnessed in this cultural-historical account of salmon enhancement in British Columbia. Because the commodification of nature occurs in part

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[67] I recall Jevon's Paradox, which states that as improvements in technology increase the efficiency with which a resource is used, the total consumption of that resource may escalate instead of decreasing.

through political struggle, I believe the process of managing it wisely necessitates similar forms of action.

Coda

How does this account of the evolving sociotechnical system that was salmon enhancement assist further theorization in CHAT? Here, I attempt to explain, not merely describe how dialectical contradictions can push activity systems forward, which other scholars have been content to do thus far. One otherwise informative study by Barab, Barnett, and Squire (2002) typifies this theoretical blindspot in that the authors articulate a number of contradictions (or what they denote as "core tensions") that are important during the process of building communities. What is left unspecified is showing precisely how one member within a contradiction presented viable options for human agency, which this chapter had demonstrated. It seems likely that the study by Barab, Barnett, and Squire (2002) failed to document these crucial moments that can signify transformations in the activity system due to the two-year length of their fieldwork. That is, either no transitions were occurring or the phenomena were not captured by the researchers during that relatively brief timeframe. In contrast, I had over a century of data that could reveal whatever major changes that had occurred in terms of shifts within the three contradictions. Importantly, I suggest that the concept of change of quality from quantity provides the mechanism for these changes of state in the activity system. Here, small quantitative changes can accelerate the system towards qualitative changes that create a situation favoring one member within a contradiction, which then renders certain decisions and actions by agents more accountable. Although both contradictions and the

change of quality from quantity are Marxian inspired ideas, they have been combined here for the first time in novel ways to explain the evolution of an activity system.

Chapter 9

Discussion and Implications

My unique contributions to scholarship

In and with this dissertation, I have attempted to extend the sociocultural agenda, in particular CHAT, by investigating various aspects of work. As a collection, the chapters show that learning, expertise, and identity in the workplace are phenomena that are at once familiar and yet poorly understood. Besides providing more adequate explanations of the sociocultural themes of learning, identity, and history, the results of my work also suggest some changes to existing work practices. In what follows, I first revisit some of these contributions to workplace research before devoting space to the necessity and implications of a vigorously dialectical stance in activity theoretic research. The latter outcome is what this dissertation as a whole has done to transform how CHAT research is presently conceived and conducted.

Contributions to work practices

That one still can make new discoveries in the well-researched domain of workplace learning is evident, for example, in Chapter 3. I show in that chapter how some longstanding assumptions about the unlikelihood of learning in seemingly mundane or routine work environments have to be rethought. In a similar overturning of established wisdom, Chapter 4 joins the small body of studies that encourages access to participation by all members of an organization in forming the learning organization. No longer can the contributions of any particular group of employees be privileged; instead, everyone up and down the organizational hierarchy can play an important role toward

achieving collective goals and functioning as a collectivity. I also uncover what it means to learn and to be an expert in the workplace in the last set of studies that deals with learning (Chapter 5). Except for a handful of journal articles, few researchers have attempted eschewing the use of analysts' categories in explaining learning as part of the actual lived experiences of workers. Unless there are further studies in this area, efforts at meaningful change in work practices will be largely from analysts' perspectives.

A caution against the uncritical use of interviews to find out what people understand about their work in Chapter 6 dovetails with the chapter that precedes it. Too often, workplace researchers have used this popular data-collecting method without an appreciation of its limitations. This chapter hence sensitizes practioners to some of its problems by showing how issues of identity are perpetually at stake during the activity of "doing interviews." I break new ground in Chapter 7 by proposing a non-dualistic means of understanding identity and identification in collectives. The latter phenomena have proved conceptually difficult even for organizational theorists to define. But I suggest that thinking of (a) collective identity in terms of being a structural feature of organizational life and (b) collective identification in terms of learning and expansion of action possibilities can break the existing theoretical impasse.

I emphasize in Chapter 8 that to move forward in understanding any work activity, it is also necessary to perform cultural-historical analysis. I propose that the notion of contradictions and the change from quantity to quality together provide a novel mechanism to analyze how activity systems evolve.

Contributions to cultural-historical activity theory

Above all, I have aspired to advance CHAT in new directions through the study of work. It is somewhat ironic that the real benefits to theory (and practice) derived from these six investigations call for a re-emphasis on the very concept that has usually received short shrift by activity theorists in North America—dialectics.[68] Indeed, I contend that CHAT research can remain fruitful and relevant toward solving real-world problems only through the adoption of a vigorously dialectical stance. Let me now clarify how this approach has been modeled in this dissertation by an analogy with the act of examining a plant cell under a light microscope.

Although the same cell, the views obtained with a microscope objective set at a magnification of 600 times will be different, almost unrecognizable, from that observed with a low-powered lens. Neither magnification is inherently superior to the other for each has levels of discrimination appropriate for different purposes; one for revealing sub-cellular detail and the other for visualizing gross morphology for instance. Normally, an experimenter has to toggle *between* magnifications to comprehend the *interrelationships* between the organelles and overall cell structure that is nearly impossible if the microscope is operating at a single magnifying power. In similar fashion, some chapters in this dissertation zoom in and describe fine-grained studies of workplace learning, expertise, and identity[69] in workers (Chapters 3 and 5). I also switch the

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[68] It is speculated that this is partly due to ideological or historical factors for there has been a widespread disavowal of ideas (mistakenly) associated with totalitarian communist regimes (Roth, personal communication, March 31, 2005).

[69] Although a different context from Shallow River Hatchery and salmon enhancement, Chapter 6, which is about identity formation during interviews, constitutes another example of this microlevel analytic orientation.

"magnification power" and take a higher order perspective when I consider how the activities of fish culturists like Jack co-constituted Shallow River Hatchery just as the organization enabled or constrained their workplace learning and identities (Chapters 4 and 7). Saving the widest field of vision (structurally and temporally speaking) for Chapter 8, I concentrate here on the systemic contradictions and contingencies occurring in the artificial manufacture of salmon in British Columbia. Chapter 8 shows that despite the great improvements in the state of enhancement technologies over the years, the activity of making salmon embodies the same internal tensions as when it first began. Before the priority in SEP recently changed to that of conservation functions, Shallow River as a workplace was in a real sense not much dissimilar from the first hatchery built on the banks of the lower Fraser River in 1884. Each study in this dissertation barring one therefore functions to provide composite views with various discriminatory foci that together better explains the activity system that we call salmon enhancement.

Three dialectical units were especially salient and were articulated throughout this dissertation: individual|collective, agency|structure, and subject|object (c.f. Table 1.1 on page 29). I claim that social and learning research informed by CHAT would be mechanical and languid if one neglected to consider how these can support the analysis. I now explain how each of these dialectical units assisted in theorizing about my data.

1. The individual|collective dialectic

One cannot fully understand making salmon in the province without examining the work of individuals like Jack, Erin, the support biologists, technicians, statisticians, community advisors, administrators, and a whole host of other people associated with salmon enhancement. When we read that SEP was successful, for example, in releasing a

total of 500 million fry in one year, the image of SEP as an abstract organization and the workings of its massive enhancement technologies usually comes to mind. It is rare that one remembers that this achievement is due to the combined efforts of all the individuals associated with the organization. These are real human beings, in flesh and blood, such as we encounter them in several chapters. Hatcheries, spawning channels, and other technologies are just shorthand notations that camouflage the workings of human agency in fulfilling the motive of making salmon in this activity system. According to one story, after a visitor was shown around the colleges, libraries, playing fields, and other buildings belonging to the University of Oxford, this person was genuinely puzzled and asked of his host, "But where is the university?" (Ryle, 1949). If someone were to ask a similar question, "But where (or what) is SEP?" the inquirer would again be committing a category mistake for SEP is located in what every person in SEP does.

On the other hand, one cannot understand what any fish culturist, or any other person associated with SEP does without examining the organization or the collective as a whole. Without this activity system whose constituting members are united by the joint motive of salmon enhancement, the actions of every individual would be meaningless; the individual works to reproduce the organization for what it is. I highlight this analytic inseparability of the individual|collective dialectic in Chapters 4 and 7 whereby I argue that one cannot subdivide learning and identity into individual or organizational levels. Organizations that support workers' learning and the expansion of action possibilities are more likely than not to be organizations that also learn and innovate. By the same token, these kinds of organizations readily foster the development of workers' identification with the collective through the creation of new socio-material resources that are then

available for others whether concretely realized or not. In turn, the transformed activity system can now further stimulate new concrete forms of participation and learning by individuals. Here one can see how large structural features of SEP were conducive (or not) toward learning in agents. At the same time, SEP only can be said to be a learning organization insofar as its individual members are learning and expanding their action possibilities. However, negative situations can prevail when these resources are absent or denied within the activity system leading to the attenuation of learning and identification in workers—as I have shown when Jack withdrew from participating in the fish culture conferences and hatchery experiments.

2. The agency|structure dialectic

Chapters 4 and 7 can be alternatively theorized through the relationship of the agency|structure dialectic, which foregrounds how making (or denying) socio-material resources can change existing social structures that encourage or hinder learning. That these resources are available at a general level in society and can be utilized by research participants, consciously and unconsciously, is one of the topics I raise in Chapter 5 about learning from members' discourses. I also shift the focus away from culturally available discursive resources to the notion of contradictions as potential resources for human decision making in Chapter 8 about SEP to demonstrate that one makes history but not as one pleases. Together with the individual|collective dialectic, these two dialectical tensions have taken centre stage in much sociological theorizing.

3. The subject|object dialectic

In the first chapter I explained that subject and object in any activity system exist as a dialectical unit, two sides of the same coin so to speak. During the process of activity,

both entities undergo transformation just as the entire activity system itself undergoes change. Because the modes of participation (and learning) are now different, the identities of agents are similarly no longer the same. This is the general principle behind the arguments I make in Chapter 6 regarding identity formation during the activity of research interviewing as well as the potential for learning in mundane work environments (Chapter 3). Failure to consider subject|object relations would have resulted in a drastically altered interpretation of events in that the focus now hinges on what psychology has termed *individual differences*—Jack and MacArthur are what they are because of their inherent personalities, abilities, or talents. Instead, I suggest that Jack was the expert fish culturist from his participation in an activity system that was only superficially static. In actuality, both person (subject) and the socially constructed setting of the workplace in Shallow River (object) were in mutual flux no matter how infinitesimal they might be. In the same vein, the identity of MacArthur as the expert scientist arising from that interview process (object) was not one that was solely attributable to him alone but was jointly constructed from interviewee and interviewer as subject during activity.

Implications

Writing an account that interweaves the dialectical units of subject|object, agency|structure, and individual|collective has not been attempted before in any major study informed by CHAT. To date, published research studies have been narrowly focused and unquestionably non-dialectical, focusing on single levels of analysis such as students' discursive practices in classrooms or new technology adoption among user groups. I therefore see this dissertation as significantly advancing activity theory because

of its re-emphasis on dialectical analysis that integrates traditionally disconnected oppositions as mentioned. Only then can we see dynamic interrelationships heretofore overlooked and not flat, static representations of activity systems that continue to reify dualistic thinking.

One follow-up study from this dissertation will be to reexamine closely macro (i.e. British Columbian society), meso (e.g. hatcheries), and micro (e.g. fish culturists) linkages across the past two decades when Jack started working in Shallow River. This project would naturally embrace a strongly dialectical framework that is contingent, open-ended and non-causal in nature. What the findings would probably reveal, as in Chapter 8, is a detailed explanation of agency|structure across a medium term timeframe. I hypothesize that SEP, the hatcheries, and individuals have different trajectories that sometimes are aligned for a period of time. However, at intervals, these trajectories can break off, destabilize, and resist each other in unpredictable ways. We already have some indication of these intersecting activity systems when we saw how certain fisheries managers began advocating the so-called inefficient production of coho and chinook salmon that ultimately tipped the scales toward conservation functions in SEP on page 216. It would thus be interesting to see the reciprocal roles that Jack, Shallow River Hatchery, and SEP played during these defining moments (and contradictions) in the cultural-history of salmon enhancement in British Columbia.

If one espouses the strongly dialectical stance that I advocate, I imagine that it not only would enable CHAT to progress but also would have implications for current educational practices. Whether one considers the learning that occurs in workplace settings or school classrooms, similar issues are at stake. For instance, the process of

learning changes from being largely attributable to individual qualities or accomplishments[70] to being a social, collective venture for the socio-material resources that are made by oneself or others impinges on the opportunities for learning for self and others. This alternative paradigm that the dissertation findings imply about the inseparable linking of individual|collective learning is probably best encapsulated in the West African proverb that states, "It takes a village to raise a child."[71]

Critics may then legitimately ask who is at fault when things go awry or wrong—society or the individual? One possible response is that this is an inappropriate question. Rather, because the possibility not to learn, to loaf on the job, and other less desirable behaviors always exist as a generalized possibility in wider society, one should be mindful of rectifying these potentials first rather than blaming individuals who have but realized a choice that was available to them.[72] Such a radical point of departure from established norms is just another consequence of taking the individual|collective seriously in everyday work and living.

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[70] Present institutional apparatuses for learning are overwhelmingly geared toward the individual as the locus of attention. This is evidenced from classroom seating arrangements, teaching methods, assessment, and reward structures among others.

[71] Roth and Lee, S. (2004) allow a glimpse of this vision of learning in their account of science education as/for participation in a local community.

[72] This very argument was recently summoned in the defense of a young Singaporean, who on a government scholarship, had admitted to expressing racist remarks in his online diary. What followed next was a public uproar and calls for the removal of his scholarship. Apparently quoting Judith Butler (a noted post-feminist philosopher) in a letter to the editor of the main English newspaper, a letter writer (and friend of the accused) stated that "[t]he subject who speaks hate speech is clearly responsible for such speech, but that subject is rarely the originator of that speech. Racist speech . . . neither begins nor ends with the subject who speaks" (Pan, 2005, p. H11).

At the same time, learning from a dialectical perspective presupposes continuous changes in subject|object relations that is equivalent to identity. Rather than assuming that the goal of learning will be a reward in itself, educators will be conscious that (inter-) subjectivities are continuously (re-) made. Since identities that persist over time gain resiliency, they can be used as attributional resources by others in support of claims about who someone is. Teaching and learning becomes more than ever a moral and human endeavor in this light.

In closing, having a dialectical perspective offers a needed corrective against a form of smugness in sociocultural—or, for that matter any form of—research. This reflexivity compels one to recognize that our best and most recent interpretations of the social world are but works in progress, by-products of a particular age, place and of fallible human beings. Certainly, this lack of closure and certitude in taking a dialectical stance will be very frustrating to many.

> To learn from dialectical theory is to recognize that is always unfinished theory. As I have understood and presented it, dialectical theory does not elaborate a set of fixed propositions or a formula that can simply be applied to our research. . . . It is not a new model or paradigm in that sense. Rather, it marks a new sensitivity in our pursuit of . . . knowledge and informs us of a particular spirit and goal of research. For those who are dissatisfied with the lack of a clear-cut and precise definition of the dialectic and dialectical theory, I can only offer my own shared sense of dissatisfaction. (Warren, 1984, p. 196)

However, and this is where I am in full agreement with Warren (1984),

> [t]his is a problem, or perhaps an achievement, which seems inherent in the very concept of dialectic. It may be that the dialectic is somewhat like the neutrino recently "discovered" by nuclear physics. We cannot precisely measure or clearly define its mass, yet we know that somehow it moves us. (Warren, 1984, p. 196)

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Appendix 1

Ethics Approval Form

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Principal Investigator	Department/School	Supervisor
Michael-Wolff Roth Faculty	EDUC	

Co-Investigator(s):

Leanna Boyer [RA]
Lilian Leivas Pozzer [grad RA]
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