LEADERSHIP DEVELOPMENT AMONG SCIENTISTS: LEARNING THROUGH ADAPTIVE CHALLENGES

by

ANYANA BANERJEE

(Under the Direction of Aliki I. Nicolaides)

ABSTRACT

The purpose of this study was to develop leadership among a group of scientists by using learning approaches that support and challenge the development of capabilities for skillful and timely action. This study was guided by the following research questions: (1) What are the leadership challenges that early-career scientists face in the transition to an unfamiliar, multiprofessional, and multidisciplinary applied context? (2) How does a Collaborative Developmental Action Inquiry (CDAI) method work in practice to identify leadership challenges and develop leadership capabilities? and, (3) What can be learned about how CDAI methods create a culture of learning and leadership at the individual, group, and organizational system levels? Two action research teams, consisting of seven early-career scientists and their nine supervisors and mentors, engaged in monthly action inquiry sessions over a two-year period. Qualitative data were generated by recording, transcribing, and coding these sessions, as well as interviews, researcher notes, emails, and organizational documents.

Using first- and second-person inquiry practices, these emerging scientific leaders began to uncover that they experienced adaptive challenges in collaborating across disciplines, and in interpersonal dynamics in the supervisor–mentor –mentee relationship. In working across organizational boundaries, as part of their action learning leadership project, early-career scientists faced the adaptive challenge of obtaining high enough level organizational support for their creative ideas. The CDAI method generated a flexible learning space that adapted in five ways to both support and challenge early-career scientists to grow their adaptive leadership capabilities. CDAI methods generated a space for (1) connection and belonging then it adapted to (2) allow leadership creativity to emerge. In the context of a leadership action-learning project, the CDAI space reshaped to help early-career scientists (3) develop project strategy and (4) stay focused. The CDAI space challenged early-career scientists to grow their adaptive leadership capabilities by (5) exploring meaning making which resulted in deeper levels of learning from single- to double-loop and in some cases triple-loop learning. Implications for organizations wishing to develop capabilities to meet adaptive challenges include creating a micro-culture for learning and leadership with the potential to shift sub-cultures within large, hierarchical organizations.

INDEX WORDS: adaptive challenge, leadership, leadership development, entry-level, early-career, health, healthcare, public health, scientists, developmental action inquiry, action research

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DEDICATION

To my mother, Eligia Briceño and my father, Jay Banerjee, for loving and encouraging me in so many ways. To Sakyong Mipham Rinpoche, for reminding us of our human potential by bringing down the Shambhala teachings on basic goodness and enlightened society.

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INTRODUCTION

Public health is what we, as a society, do collectively to assure the conditions in which people can be healthy (Committee for the Study of the Future of Public Health, 1988). In 2003, the Institute of Medicine (IOM) study titled "Who Will Keep the People Healthy?" reported that the governmental public health infrastructure had been neglected, and an overhaul of its components, including the public health workforce, was needed to ensure quality of services and optimal performance (Gebbie, Rosenstock, & Hernandez, 2003). One of the key recommendations made was to prioritize leadership training among the public health workforce. Ten years later, there is still a critical need to strengthen the health workforce and its capabilities to improve the public's health.

The health workforce is very complex and comprised of many feeder disciplines (Koo & Miner, 2010), including technical disciplines emphasizing training in the quantitative sciences. For scientists in the health field, workforce development efforts often miss the mark, because they emphasize honing already strong technical skills and not the capabilities needed to work in an applied multiprofessional, multidisciplinary environment. Without the appropriate tools or support to meet these demands, professionals become frustrated, their performance suffers, and they are more likely to leave the field. Given that the health field is in need of a skilled workforce to meet the 21st century health system's demands, we cannot afford to lose skilled scientists. But what are these other non-technical capabilities that scientists need in order to meet the 21st century demands placed on them? This study makes an important contribution to

addressing this question. In the next section, I outline the events that lead to a genuine exploration of this question.

Issue Identification: Gap in Leadership Development

In 2008, I took on the role of running the Quantitative Science Fellowship Program (hereafter "the program"), an applied health post-doctoral program for scientists at the Center for Global Wellbeing (CGW), a technical health organization. I did not realize at the time that I was stepping into an adaptive challenge. Unlike technical challenges that can be solved with the skills at hand, adaptive challenges require learning, both to understand the problem and to implement a solution that often requires collaboration across multiple stakeholders (Heifetz, Grashow, & Linsky, 2009). For me, the adaptive challenge included the elements such as insufficient resources, compressed timelines for delivering outcomes, and complex interpersonal relations. There were an insufficient number of qualified staff members to run the program; stakeholders were disengaged and dissatisfied due to a perceived lack of support from top leadership; and there were big demands placed on the program staff to deliver quickly. However, 90% of the program staff had been fired prior to my arrival, so my team consisted of only two people who were not equipped to meet the challenges. The gap in leadership and management of the branch had also resulted in a deterioration of morale. There was an air of negativity and doom. Those stakeholders who had interacted with the branch thought either that it was now defunct or that it would dissolve within months.

Considering this mess, I had a big task at hand. I had to figure out my role, develop relationships, and implement a month-long orientation program for the new class of early-career scientists. These scientists had recently graduated from top-level advanced quantitative doctoral programs both across the U.S. and internationally. They were excited to be entering the noble health field and applying their quantitative skills to advance the field. However, weeks before their arrival, the post-doctoral program had almost gone under, and we were unprepared to welcome them.

Since the primary purpose of the branch was to train early-career scientists, my focus was on ensuring that their first exposure to the health field was going to be excellent. I was drawn to the adult learning issues that the branch was facing and, in particular, the branch's vision of developing leaders, as expressed in their program logic model. One of the long-term outcomes outlined in the program's logic model is "alumni in leadership, decision-making positions." I had reviewed the most recent training curriculum (2007) and found some interesting gaps. Despite having leadership as a long-term outcome and despite having supervision and mentorship as important support structures for the learning and service journey of the early-career scientists, leadership, mentor, and supervisor development were completely absent from the curriculum. Furthermore, all of the training was lecture-based, with little opportunity for reflection and making meaning of the 90% of the curriculum where learning occurs from experience. I was perplexed at what kind of future leaders were being trained, given what I saw as the curriculum.

I took the opportunity to do something about this gap, especially since I was now in charge of the program and had weeks before the early-career scientists arrived. With the power to make decisions about the training and to allocate funds, I found myself in a challenging yet exciting place. I reached out for help by contacting the best leadership consultant/trainer that I knew, and began to work with her to design the early-career scientists' first leadership training.

The new leadership training was not just new, but also in some ways a shot in the dark. I had only a few data points to work from. I quickly met with the branch chiefs of the other fellowship units and asked about their leadership training, but found the training to be either too expensive or not applicable. For example, one branch's leadership training was not for scientists, but was a "ropes course," an outdoor adventure course teaching leadership skills through outdoor experiential exercises. I did not think that a group of scientists would be open to that approach, especially since no expectation of any non-technical training had been specified. Therefore, I relied heavily on the leadership trainer, who had also been my leadership coach. Together we attempted to address the observed gaps by doing some basic things. We designed a pilot leadership workshop that included more interaction beyond the typical classroom-based lectures. The leadership pilot training involved three training sessions over a day and a half that focused on three types of skills: self-awareness, skillful communication, and team-building skills. I chose these skills because, in dialog with the leadership trainer, she indicated that these are common leadership development areas important for early-career professionals.

Overall, I received positive feedback that the training was useful, based on an analysis of evaluation survey responses. I had created a short survey and disseminated it to participants after the training. The closed-ended questions were designed to measure the effectiveness of both the trainings and the trainer. The questions were designed on a Likert scale ranging from "strongly disagree" to "strongly agree." The mean score was calculated for the closed ended responses. The open-ended questions were designed to get specific feedback on what was effective or not effective with the training. I conducted content analysis of the open-ended responses to obtain common themes in the comments. Feedback from the first pilot was generally positive and was used to refine the training for subsequent pilots.

I implemented three iterative training pilots over a two-year period from 2008-2010 and, during this time period, a pattern of issues began to crop up. The most frequent issues that the chief of the program (who was eventually hired) and I encountered in running the training program were issues related to the non-technical elements of early-career scientists' work. These issues were not, for example, related to their analytic skills or their ability to make sense of technical problems. Rather, the issues had to do with the "people element" of their jobs: interpersonal issues with their mentor or supervisor, feeling unmotivated/unsupported at their work site and consequent departure from the program, and the organizational culture dynamic's clashing with personal values, etc. Often these issues were raised with the chief and me when it was too late—for example, when a supervisor was looking for a way to "fire" an early-career scientist or when an early-career scientist had had enough and was ready to leave. As I looked at the pattern of

issues over a three-year period, it occurred to me that they were all rooted in lack of leadership capability on the part of either the early-career scientist or the supervisor and mentor. My view is that leadership is about creating conditions where people can be successful, and about mobilizing people and resources to move the work forward. I believe there are multiple levels of leadership. There is personal leadership, which is about moving yourself forward; there is group leadership, which is about working with others to achieve great things together; and there is organizational leadership, which is about working collaboratively to move through issues on multiple levels of an organizational system. I thought that the leadership development workshops that I was offering, with their focus on personal and group leadership, were meeting the needs of the early-career scientists, based on evaluations of the sessions. At least I believed that these workshops were exposing them to the notions of self-awareness, skillful communication, and team-work in being an effective scientist. I was wrong.

Workforce Development Office (WDF) of the Center for Global Wellbeing (CGW) is the organizational unit that houses the program I was leading. A standard practice within this program office is to hold "rounds" with current and graduating early-career scientists once a year to gather feedback on their post-doctoral program experience. Rounds conducted in June 2011 revealed that the 2010 group of early-career scientists did not respond well to the leadership training they had participated in at the outset of their fellowship. This training had been the most refined version of the leadership workshops, consisting of a day-and-a-half workshop focusing on the competencies of self-awareness, skillful communication, and effective action. The

pedagogical approach used included lectures, group discussions, and experiential learning exercises. According to the summary notes on the key themes from the feedback session, "the leadership training can be confusing since one might view oneself as a mentee" (Program Manager, 2011), and "the leadership seminar was a distraction, and not the right time for first year early-career scientists". Additionally, one early-career scientist offered a startling remark, "…we all have PhDs and we know what leadership skills are valued in the profession" (Early-career scientist, 2011). As such, "The unanimous opinion was that the leadership and the mentor/mentee training were not useful or relevant…a waste of time" (Early-career scientist, 2011). Early-career scientists recommended that the training be "CGW-centered; what it means and how to be a leader at CGW" (Early-career scientists, 2011) and for the postdoctoral program to "provide a forum so early-career scientists could get together and talk about their research" (Early-career scientists, 2011). Comments provided during the feedback session indicated that, based on their perceived role in the organization, early-career scientists were confused about why leadership training was being provided to them. Early-career scientists appeared to see themselves as having no reason to develop leadership capabilities that they might frame as only relevant for people in positions of authority.

Demand for complex leadership capabilities. Even though the early-career scientists felt that leadership development training was irrelevant to them, there is a demand placed on them that they have complex leadership capacities. Managers who hire early-career scientists when they graduate expect that they have leadership capabilities to be successful in their jobs. In the early part of 2010, program staff, along with

contractors, interviewed the hiring managers that hire most early-career scientists once they finished their fellowship programs. We conducted these interviews as part of the formal program competency development process. I analyzed notes from the interviews by coding and categorizing responses to questions such as, "When making hiring decisions, do you consider leadership capabilities?" and "What leadership capabilities do recently-graduated early-career scientists need?" I compared responses from hiring managers with the literature on leadership capacities that early-career scientists need in the 21st century.

The purpose of this comparison was to see whether the demand for leadership was a true demand or just something I was making up because of my interest in leadership development. What I found, by comparing interview data from hiring managers with the literature on leadership capabilities among early-career scientists, is that the expectation placed on scientists to have leadership capability is a phenomenon that indeed exists in the literature, and this expectation generally matches the CGW hiring managers' expectations that early-career scientists develop leadership capabilities in the broad areas of self-awareness, communication with others, communicating the impact of their science, and effective action.

Paradox at the intersection of practical and theoretical knowledge bases. There is a paradoxical tension at the intersection of the practical and theoretical knowledge bases. Early-career scientists typically do not see themselves as needing leadership capabilities, and yet the system expects them to enact a complex set of capabilities. The most common issues that early-career-scientists face have to do with the

leadership elements of their post-doctoral experience. Additionally, there is an overemphasis on technical competence which further deemphasizes the need to develop leadership capabilities. Early-career scientists who come to CGW are primarily trained in the technical sciences, with very little emphasis on leadership capabilities.

The way that early-career scientists interpret their role (as not involving leadership) and the overemphasis on technical capabilities results in a gap—a gap between the capabilities and the demand for them.

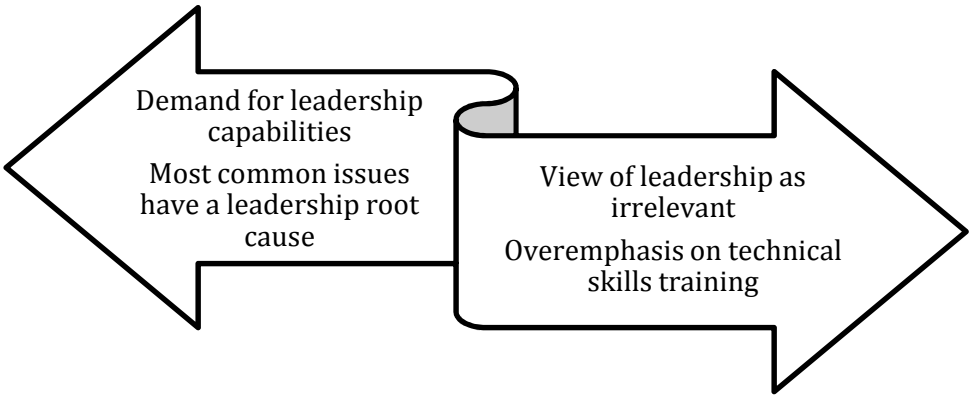

Figure 1. Paradoxical tensions: Situations generating a need to explore leadership challenges

While it is clear from the literature and the hiring managers' perspectives that leadership is needed, there is also a paradox in the literature. The literature on leadership capabilities among early-career scientists indicates that leadership is needed. However, how to develop leadership among early-career scientists is largely missing from the literature. The literature mainly focuses on how those who manage scientists can develop their management skills. Chapter 2: Literature Review, outlines this finding in more

detail. In the context of these two paradoxes grounded in assertions, beliefs, and experiences of views. I found a way into the conversation not by making another assertion. Rather, the action research process began with a question. What are the leadership challenges, if any, that early-career-scientists face?

Purpose

The purpose of this study was to identify types of leadership challenges that arise in a scientific health organization, and to develop learning approaches that support and challenge early-career scientists to grow their capabilities for skillful and timely action.

Research Questions

The following questions guided this study:

(1) What are the leadership challenges that early-career scientists face in the transition to an unfamiliar, multiprofessional, and multidisciplinary applied context?

(2) How does a Collaborative Developmental Action Inquiry (CDAI) method work in practice to identify leadership challenges and develop leadership capabilities?

(3) What can be learned about how CDAI methods can create a culture of learning and leadership at the individual, group, and organizational system levels?

CHAPTER 2

LITERATURE REVIEW

The purpose of this study was to explore the leadership challenges that early-career scientists face, and identify learning approaches that develop their leadership capabilities. The theoretical framework (Figure 2) that situates this study in the current scholarly literature and theory consists of (1) Adaptive leadership theory, (2) CDAI and its theoretical construct of meaning making, and (3) CDAI and its theoretical construct of action inquiry. The literature review concept grid (Table 1) elaborates on the theoretical framework by highlighting how it connects to the research questions in order to frame the study.

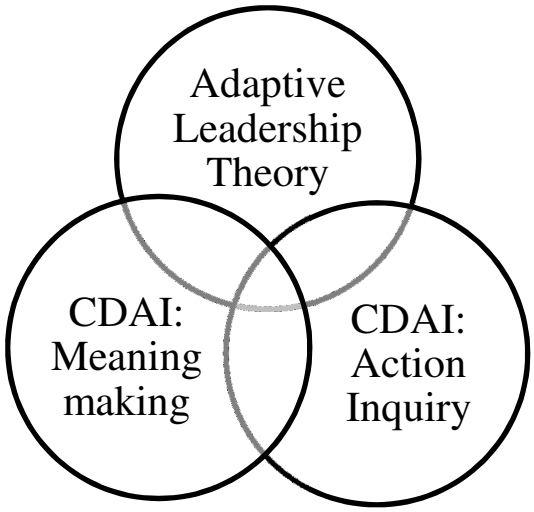

Figure 2. Theoretical framework: Theories undergirding the exploration of leadership challenges that early-career scientists face and approaches to develop their leadership

Table 1
Literature Review Concept Grid

Research Question	Conceptual Inquiry Based on Research Questions	Theory/Construct	Theoretical Elements	Theory in Context of Conceptual Framework
1. What are the leadership challenges that early-career scientists face in the transition to an unfamiliar, multiprofessional, and multidisciplinary applied context?	What are the leadership theories relevant to scientists? What is said about the leadership capabilities that scientists need?	The practice of Adaptive Leadership (Heifetz)	There is a distinction between adaptive challenges and technical problems that is relevant to early-career scientists in applied settings	(1) Applied settings involve adaptive work, (2) Leadership is being skillful in adaptive situations, and (3) One can lead in adaptive challenges without having to be in a position of authority
2. How does a Collaborative Developmental Action Inquiry (CDAI) method work in practice to identify leadership challenges and develop leadership capabilities?	How does CDAI create conditions for learning through adaptive challenges?	CDAI (Torbert)	Action inquiry (Torbert) Meaning making/ Developmental Theory (Winnicott, Kegan, Cook-Greuter, Drago-Serverson, Torbert)	(1) Action inquiry to raise awareness of challenges as leadership challenges and (2) Meaning making to adapt and evolve beyond challenges
3. What can be learned about how CDAI methods create a culture of learning and leadership at the individual, group, and organizational system levels?	How does CDAI create a shift in how learning through adaptive challenges occurs?	CDAI (Torbert)	Single-, double-loop learning (Argyris) Triple-loop learning (Torbert)	(1) Individual, (2) group, and (3) system level learning and impacts

Theoretical

Leadership Theories and Conceptual Frameworks

A primary goal of this research was to identify ways to develop leadership among early-career scientists in the context of paradoxical tensions. The goal of this section of the literature review was to understand what has been said about leadership, including the practice of adaptive leadership. To reach this goal, I begin by reviewing leadership theories—both traditional and contemporary.

Leadership is conceptualized and defined in many different ways. Some authors have classified leadership theories as traditional and contemporary, where leadership is a role (Northouse, 2010; Robbins & Judge, 2009a). Some authors have offered other ways of conceptualizing or viewing leadership. For example, Bass (1990) developed a classification scheme for leadership based on the multitude of definitions of leadership. In his conceptual framework, leadership can be viewed as (1) a group process, (2) a personality, (3) an act or behavior, (4) a power relationship between leaders and followers, or (5) a transformational process. Alternatively, leadership can be conceptualized from (6) a skills perspective. Still other researchers view leadership from new emerging perspectives that define leadership as a way of being (Avolio, Walumbwa, & Weber, 2009).

Traditional leadership theories have tended to focus on the leader (Robbins & Judge, 2009a) and his/her transactions in clarifying role and task (Robbins & Judge, 2009b). These include Trait, Behavioral, and Contingency, Leader-Member Exchange (LMX), and Leadership-Participation theories (Robbins & Judge, 2009a). According to Robbins and Judge, Traditional leadership theories make a contribution to understanding

effective leadership; however, they "…ignore the importance of the leader as a communicator" (Robbins & Judge, 2009b, p. 446). Contemporary theories aim to address this gap by going beyond a leader's transactional role to a transformational role, whereby inspirational communication is considered by proponents to be essential.

According to Robbins and Judge (2009a), Trait theories distinguish between leaders and non-leaders based on "personality, social, physical, or intellectual attributes" (p. 420). Trait theories, popular until the 1940s, represent the earliest stages of leadership research, and began with the perspective that leaders are different from non-leaders as a function of their personal characteristics. Robbins and Judge indicate that researchers at that time organized traits around the "Big Five personality framework" (p. 420), suggesting that the Big Five traits predicted leadership. The Big Five traits include extraversion, conscientiousness, and openness. However, as Robbins and Judge indicate, while Trait theories are good at predicting the appearance of leadership, these theories do not distinguish between effective and ineffective leaders. For example, a person who is extraverted may appear to be a leader, but that does not necessarily mean that he/she is effective when put in a position of leadership. The assumption underlying trait theories is that leaders are born. The implication of this approach to leadership is that it makes no sense to attempt to develop leaders, since they are either born with specific leadership traits or they are not. An organization operating under the Trait theory assumption would focus on identifying people with specific leadership traits.

Behavioral theories, popular up until the 1960s, emerged to address the gap that Trait theories left by identifying specific leadership styles or behaviors that effective leaders practice (Northouse, 2010; Robbins & Judge, 2009a). The Ohio and University of

Michigan behavioral studies of the late 1940s were the most comprehensive behavioral trait studies. The Ohio studies concluded that effective leaders exhibit two categories of behavior: initiating structure and consideration. Initiating structure refers to "…behavior that attempts to organize the work, work relationships, and goals" (p. 423). Consideration refers to "…the extent to which a person is likely to have job relationships that are characterized by mutual trust." (p. 423). The Michigan studies had similar results, but came up with different categories. Effective leaders were "employee-oriented" and emphasized interpersonal relationships. Effective leaders were also "production-oriented" (p.423) and focused on the technical or the task aspects of the job. The assumption underlying Behavioral theories is that people can be trained to be effective leaders.

Robbins and Judge concluded that both Trait and Behavior theories add to the understanding of leadership effectiveness, but they do not take into account the context that a leader is in: "Missing is consideration of the situational factors that influence success or failure. Some leaders may have the right traits or display the right behaviors and fail" (p. 425).

To address the weaknesses of Behavioral and Trait theories in omitting the context, another group of theories emerged called Contingency theories. These theories aim to isolate key contextual variables that impact leadership effectiveness, such as "the task structure of the job, level of situational stress, level of group support, leader's intelligence and experience, and follower characteristics" (p. 437). Contingency theories of leadership suggest that the match between the leader's style and the situation matters (p. 426). The criticism of contingency theories is that they ignore the follower (p. 432). Leader-Member Exchange (LMX) theories focus on whether followers are in the leader's

"in-group" or "out-group." The Leader-Participation model looks into the leader's role in making decisions and the extent to which the leader involves followers in the decision-making process (Robbins & Judge, 2009a). Robbins and Judge conclude that all of the traditional theories help us to understand some aspect of effective leadership.

Contemporary leadership theories. Transformative and Authentic Leadership theories are examples of contemporary leadership theories that conceptualize leaders as inspirational people who motivate others through their ideas, behaviors, and what they say (Robbins & Judge, 2009b). A meta-analysis of theoretical and empirical developments in leadership (Avolio, et al., 2009) provides a useful summary of more recent leadership theories and literature: Authentic Leadership; Cognitive Psychology, and how it can inform a leader's decision-making processes and notion of self-concept; New-Genre Leadership; Complexity Leadership; Shared Leadership; Leader-Member Exchange; Followership; Servant Leadership; Spirituality and Leadership; Cross-Cultural Leadership; and e-Leadership (Avolio, Kahai, & Dodge, 2001).

Of all the ways that leadership can be conceptualized or theorized, approaches that view leadership as a process and that assume that leadership can be developed are most applicable to early-career scientists. As entry-level early-career scientists with advanced technical skills, early-career scientists are not assigned to formal leadership positional roles; therefore, theories that either focus on or imply that leadership is subject to those in positional authority are not relevant to the leadership process and action of early-career scientists. Theories that acknowledge that leadership is a developmental process are applicable to early-career scientists since, through this action research, I intended to explore with early-career scientists and those who support their development

what leadership means to them in the context of their post-doctoral applied fellowship program. This excerpt from Avolio (2009) is applicable to early-career scientists highlights that a willingness to develop one's capacity is related to developmental readiness:

> Another very promising area of research that has not received sufficient attention in the leadership literature focuses on understanding what constitutes an individual's level of developmental readiness or one's capacity or motivational orientation to develop one's full potential (p. 426)

Early-career scientists who are more developmentally ready may be more willing to develop their full potential. In this literature, the authors also indicate that leaders who are motivated to learn at the outset and who have higher motivation to lead will more likely "embrace trigger events that stimulate their thinking about their own development as an opportunity to improve their leadership effectiveness" (p. 426).

This research is relevant to developing leadership capacity among early-career scientists because it indicates that developmental readiness could impact how early-career scientists interpret challenging events and whether they learn from them to improve their capabilities as leaders.

The notion of developmental capacity and making meaning of context is useful for inclusion in conceptualizations of how leadership may be developed among early-career scientists. Developmental capacity is connected to developmental theory in that it is used to show how the way we make meaning evolves over time to be more complex and differentiated, and to have more integrity (Torbert, Livne-Tarandach, McCallum,

Nicolaides, & Herdman-Barker, 2010). The cognitive leadership literature may also be able to contribute, in that it examines a "broad range of approaches to leadership emphasizing how leaders and followers think and process information" (Avolio, et al., 2009, p. 427). Avolio, in his meta-analysis of new-genre leadership theories and concepts, points out that, "One of the essential building blocks in the cognitive leadership literature is the idea of a schema, which is a broad organizing framework that helps one understand and make sense of a given context or experience" (p. 427). Early-career scientists' schema may impact how they make meaning of themselves and their context, and thus how they view their leadership of themselves and others in that context.

Avolio (2009) raises a question about the implications of cognitive leadership literature that could be relevant for early-career scientists:

> If a leader has low self-concept clarity, to what extent can we expect that same leader to be self-aware? What are the implications for enhancing a leader's self-concept clarity or working self-concept about what constitutes the roles of effective leadership in developing that leader's self-awareness and performance? (p. 428)

The question of self-concept is applicable to early-career scientists because if they do not see themselves as enacting some dimension of leadership, then to what extent will they want to actively engage in leadership development?

The concept of shared leadership is useful in examining how leadership capacity can be developed among early-career scientists. Day and colleagues (2004) refer to team and shared leadership as a dynamic and emergent state that develops over the lifespan of the team. Pearce and Conger (2003) define it as "a dynamic, interactive influence process

among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals or both" (p. 1). If early-career scientists engage in Collaborative Developmental Action Inquiry sessions (elaborated on later in this chapter) they may be taking on the role of shared leadership, in that they are collectively leading each other. Shared leadership is a useful approach that was considered in this study, and according to the literature it should consist of three interdependent elements: shared purpose, social support, and voice (Day, 2004). These dimensions appear to overlap with the concept of a holding environment (Kegan, 1982), and what Drago-Severson (2009) further elaborates on in her five pillar practices for creating developmentally appropriate supports and challenges for leadership development.

The concept of a good holding environment came from Winnicott, an English pediatrician and psychoanalyst, who identified that the loving care and attentive holding a mother offers her child has important implications for the development of the child's psyche (Winnicott, 1965, 1986a, 1986b). Kegan (1982) extended the notion of a holding environment to adult development and referred to it as the "psychosocial environment" that is "the particular form of the world in which the person is, at this moment in his or her evolution, embedded" (p. 115-116). Drago-Severson (2009) describes a good holding environment, in the context of leadership development, as one that "both supports a person where he or she is in terms of making meaning of life experiences and challenges the person to grow beyond that" (p. 12-13). This definition borrows from the three functions of a good holding environment outlined by Kegan (1982). First, a good holding environment for learning must hold well by "meeting a person where he or she is in terms

of making meaning" (Drago-Severson, 2009, p. 58). Second, a good holding environment must at some point let go when the person is ready "by offering challenges that permit the person to grow toward a new way of knowing" (p. 58). Lastly, a good holding environment stays around "to provide continuity, availability, and stability during the growth process" (p. 58). Shared leadership, as described earlier, must have the conditions of shared purpose, social support, and voice, and these may be considered as important elements of the holding environment for learning and growing leadership in groups. This construct is pertinent for this study because a key exploration is not just individual leadership but also shared leadership and learning in a group.

Adaptive leadership. Many of the challenges faced by practitioners in the health field are adaptive challenges, where technical know-how is not sufficient (Koh, 2009). Adaptive challenges are those where the problem or solution is not clear; thus, learning among stakeholders is required to both define the problem and implement a solution (Heifetz, et al., 2009; Heifetz & Laurie, 1997; Heifetz & Linsky, 2004; Parks, 2005). As Howard K. Koh, Assistant Secretary for Health, U.S. Department of Health and Human Services, and colleagues indicate, "Public health starts with the foundation of science but inevitably requires moving into the dynamic realms of social strategy, political will, and interpersonal skill" (Koh, Nowinski, & Piotrowski, 2011).

Other scholars have noted that the 21st century is a time marked by increased change and uncertainty (Gregory, 2011; Lichtenstein et al., 2006; Uh-bien & Marion, 2008). Leadership models from the 20th century that are marked by hierarchical control and a focus on technical solutions are not effective for making progress on 21st century adaptive challenges. As Gregory (2011) indicates, leadership approaches that address

adaptive challenges "creates leadership that instead addresses today's rapidity of change to survive under constantly changing conditions" (p. 1). Being skillful in adaptive challenges requires a range of adaptive capabilities that complement technical competencies. These adaptive capabilities, in the context of being a scientist, require further exploration.

Adaptive challenges involves not only learning but also unlearning and transforming undergirding meaning-making habits In addition, such learning widens the aperture of choices of action that align with the complexities faced by early-career scientists transitioning to an unfamiliar work context after completion of their doctoral programs.

According to Heifetz and colleagues (2009), although there are many types of adaptive challenges, there are four basic patterns or archetypes that he and his colleagues have observed over the past thirty years: (1) the gap between espoused values and behavior, (2) competing commitments, (3) speaking the unspeakable, and (4) work avoidance.

Archetype 1: The gap between espoused values and behavior. This archetype refers to the gap between what individuals or organizations say they value and what their behavior actually is. An example of this gap is when "senior authorities advocate collaborative behavior but reward individual performance" (p. 79). The adaptive challenge is in closing the gap between espoused values and actual behavior:

> Closing the gap is a difficult adaptive challenge because people in the organization have been successful through their patterns of behavior and

> will continue to do what earned them success, especially when they are still recognized and rewarded for doing so. (p. 79)

Transforming the pattern of behavior so that the gap is closed is the adaptive challenge. The gap exists for a reason. Heifetz and colleagues suggest taking a systems perspective in diagnosing the adaptive challenge: "In what way does the gap's existence fulfill a need or desire for the individuals whose behavior does not reflect the espoused value?" (p. 80). In the context of a large bureaucracy, it may be challenging to identify the individuals who perpetuate dysfunctions for they may not even be aware themselves of the impacts of their actions. Nevertheless, the dysfunction serves someone or a group of people high enough in the organization that they can keep the gap going for their benefit, whether consciously or not.

Archetype 2: Competing commitments. This archetype refers to when an individual, group, or organization has commitments that are in competition with one another. Competing commitments are often resolved when organizational leaders make a decision regarding which commitment to favor, and doing so will "favor some constituencies while hurting others" (p. 81). The adaptive challenge in this archetype is making the decision about which commitment is a priority:

> Because these decisions are so difficult, many leaders simply avoid making them, or they try to arrive at a compromise that ultimately serves no constituency's needs well. As a result, the organization's commitments continue to be in conflict. (p. 81)

Overcoming this adaptive challenge appears to involve good decision making and awareness of the loss that someone or some group will experience:

> When competing commitments need to be resolved, the questions are, how will the decision be made: through a mandate from on high, by majority rule, through consensus where everyone involved must agree? What groups are going to lose something as a result of this decision, and what precisely are they going to lose? (p. 81)

In the context of a large bureaucracy, the decision-making processes are often quite complex with some decisions occurring at an informal level. Sometimes decision-making processes have not yet been documented especially for new initiatives. The implication is that resolving a competing commitment adaptive challenge in the context of absent decision making processes could require establishing decision making processes or raising awareness that a decision-making process is needed.

Archetype 3: Speaking the Unspeakable. This archetype refers to the challenge of not being able to raise the important content of conversations such as "radical ideas, naming the difficult issues, [or] painful interpretations of conflicting perspectives" (p. 82). Heifetz and colleagues describe this archetype as "two types of conversation going on" (p. 82). One conversation is what people are actually saying, and the other is what is being unsaid or "what is unfolding in each person's head," and "only a small portion of the most important content of those conversations ever gets surfaced publicly" (p. 82). This notion of two conversations unfolding at the same time came from Chris Argyris and Don Schön (1974) in their left-hand column exercise, developed to raise one's awareness of the way in which we also have two conversations going on—the private and the public one. By recognizing that there may be differences between these two

conversations, we can become more aware of the incongruity between what we say and what we think. The notion of skillful communication is important for this study because hiring managers of early-career scientists, as described earlier, expect that they will communicate well in complex contexts.

In the Speaking the Unspeakable archetype, the adaptive challenge is actually speaking the unspeakable, because doing so may "generate tension and conflict that will have to be addressed" (Heifetz, et al., p. 82). Additionally, giving voice to the unspeakable may make one "immediately unpopular and…lose standing in the organization (or even her job)" (p. 82). Furthermore, when there is a senior authority in the room, "it is riskier (and thus less likely) that someone will give voice to the unspeakable" (p. 82).

Creating conditions for people to say what seems unspeakable is critical for groups and organizations to make progress on adaptive challenges. When people from different perspectives feel safe enough to speak up, then the group/organization has access to a wider range of views, which helps inform adaptive solutions. As Heifetz and colleagues indicated, "only by examining the full range of perspectives can a group of people increase their chances of developing adaptive solutions" (p. 82).

Archetype 4: Work avoidance. This archetype refers to "avoiding the harder work of mobilizing adaptive change" (p. 84). According to Heifetz and colleagues, "in every organization people develop elaborate ways to prevent the discomfort that comes when the prospects of change generate intolerable levels of intensity" (p. 84). One of the work avoidance tactics that Heifetz and colleagues identified in their decades of work in

adaptive challenges is the tactic of focusing on only the technical parts of a problem in order to avoid the adaptive parts.

The existence of adaptive challenges and the need to develop adaptive capabilities has been supported by scholars in the disciplines of information technology (Kaminsky, 2012), medicine and health and environmental policy (Burke, 2007; Eubank, Geffken, Orzano, & Ricci, 2012; Haeusler, 2010; Thygeson, Morrissey, & Ulstad, 2010), public health (Koh, 2009; Koh & McCormack, 2006), and education (Daly & Chrispeels, 2008; Drago-Severson, 2009; Randall & Coakley, 2007). What has not been explored as thoroughly is the existence of adaptive challenges among scientists, specifically early-career scientists transitioning to an applied environment.

Leadership Capabilities Among Scientists

The literature on leadership capabilities among scientists focuses primarily on how to develop leadership capacities among people who interact with scientists from the perspective of positions of management. For example, an initial review of the literature on leadership in research and development (R&D) provides some insights into the specific leadership capabilities for managing scientists or technical people. In a meta-analysis of leadership in research and development organizations, Elkins and Keller (2003) reviewed 23 empirical studies, starting as early as 1967. The first conclusion that the authors made is related to the important role of engaging with stakeholders outside the organizational unit:

> …the R&D project leader not only has to lead internally and inspire team members but also he or she should engage multiple roles including

> external ones. Namely, the leader should also boundary span with important constituents outside the project group… (p. 601)

The second conclusion made in this extensive meta-analysis affirms the need for leaders to engage with others on a common vision:

> …transformational leadership appears to be an effective style for use in R&D contexts. The inspirational motivation of providing a common vision for the project enables team members from different disciplines to work together to bring a technological innovation to fruition. (p. 601)

Transformational leadership may be applicable to an informal group leadership context, whereby early-career scientists can be inspired by the vision of any one peer who is able to speak to the needs of the group. In a formal context of leadership roles based on authority, transformational vision may be more applicable to people who are in a position to facilitate the development of a common vision. Early-career scientists are entry-level staff and have not been known to influence research agenda. However, they may be able to influence the vision of their unit's research with the use of exceptional leadership capabilities.

The third conclusion is based on studies focusing on the Leader-Member exchange (LMX) literature. The authors summarize that: "…a high-quality exchange relationship between the project leader and the team members can lead to more creative and innovative outputs" (p. 602). This conclusion may be more applicable to those who supervise early-career scientists. From my own practice, I am aware that supervisors have an important influence on the development of leadership capacity among early-career scientists and their willingness to engage in developmental activities of any sort.

In another empirical leadership study, 118 R&D project teams from five firms were followed over time to explore three models of leadership: transformational leadership, initiating structure, and substitutes for leadership (Keller, 2006). The authors wanted to know which model best predicted team performance outcomes. Results indicate that "transformational leadership, initiating structure, and two of the substitutes for leadership (i.e. ability and intrinsic satisfaction) matter to R&D project team performance over time" (p. 208). The effect on initiating structure indicated that subordinates need their leader to provide direction and structure, and this may be something to consider when designing leadership development approaches for early-career scientists. Early-career scientists may need a little more structure at the outset of leadership development efforts, especially since we are attempting to increase a capacity that has not been traditionally developed within the program. The additional structure may provide the needed support that this group may be looking for.

The importance of team communication in project outcomes was tested in another empirical study of 56 R&D teams. Results show that team communication was "…significantly correlated with team performance" (Hirst & Mann, 2004, p. 152). Communication included the "Open discussion of diverse viewpoints [which] creates uncertainty about the adequacy of one's position, curiosity and information seeking to understand the contrary view…leading to high quality decisions" (p. 150). The authors also note the importance of reflection in scientific discoveries.

The impact of charismatic leadership was examined in a study of 178 participants comprising 34 R&D teams. Results indicate that leaders who inspire team members to look for new solutions, and who create a sense of belonging and cooperation in the team,

are associated with team innovation (Paulsen, Maldonado, Callan, & Ayoko, 2009). While the literature on R&D leadership does provide some interesting insights into the types of team leader behavior that foster team performance, the results appear to be less relevant for early-career scientists who are not in formal positions of authority.

There are a few select publications that frame leadership from a perspective that is applicable for early-career scientists. That is, leadership, as the capabilities needed to make an analysis, have policy impact, namely to make their voices heard, and to be included in important decision-making dialogues. I compared these publications with the leadership expectations that CGW hiring managers have of early-career scientists in order to situate the findings in the appropriate context for this research. Interview data were obtained by reviewing, coding, and analyzing transcripts of hiring manager interviews. The program conducted these interviews in 2010 as part of the formal program competency development process. I wanted to see how the expectations of hiring managers aligned with the literature outlining important leadership capabilities among early-career scientists.

What I found was that the literature on leadership expectations of early-career scientists generally matches the CGW hiring manager expectations that early-career scientists develop leadership capabilities in the broad areas of self-awareness, communication with others, communicating the impact of their science, and effective action. For example, CGW hiring managers expect early-career scientists to exhibit self-awareness and self-management leadership capacities. The literature reflects this capacity and, in particular, the need for scientists to be adaptable (McGuigan, 2010), and to reflect on and engage in self-development (Kishimoto & McGuire, 2010; Reeve, 2010;

Yeganagi, 2010). CGW hiring managers and the literature both express the need for scientists to work well with others and to eventually mentor and develop others' capacities (Kishimoto & McGuire, 2010; McGuigan, 2010). CGW hiring managers want early-career scientists to be able to translate complex models in simple ways. This is especially important for ensuring that decision makers such as division directors, state and local health leaders, and other healthcare administrators understand the analysis and can take it into account when making policy and financial decisions. The literature also reflects this need (McGuigan, 2010; Yeganagi, 2010). CGW hiring managers want early-career scientists to generate new analytical methods requiring creativity. Creating conditions for scientists' creative expression is outlined in the literature (Sapienza, 1995). Both the literature and CGW hiring managers reflect the leadership need for scientists to align their research vision with that of the group they are working with. That is, to move from working independently to working collaboratively (McGuigan, 2010; Reeve, 2010). CGW hiring managers and several authors express the need for scientists to be socially aware so that they can determine how they will use their skills to impact the most pressing social concerns (Fan, 2010; Kishimoto & McGuire, 2010; Reeve, 2010).

There are some discrepancies between what CGW hiring managers want and what the literature describes as leadership capacities among scientists. The literature outlines three areas of leadership capacity among scientists that are not reflected as expectations among CGW hiring managers: making sense of complex contexts, engaging in decision-making processes, and capacities needed to manage other scientists. For example, the literature makes reference to the need for scientists to make sense of the increasingly complex contexts that they now operate in (Cheng, 2010; Kishimoto & McGuire, 2010;

Touchie, Pressnail, Beheshti, & Tzekova, 2010). However, CGW hiring managers did not articulate this need as such. Second, the literature articulates the need for scientists to go beyond just using their technical skills to engaging in decision-making processes, where often those who are making the decisions are not aware of the relevant scientific evidence base. CGW hiring managers did not speak of early-career scientists engaging in decision-making processes. Rather they spoke of early-career scientists providing brief documents that help decision makers make their own decisions. To what extent does this speak to the power dynamics that early-career scientists and eventually alumni find themselves in? A search of the CGW human resources database shows that only one early-career scientist in the entire CGW (comprised of nearly 14,000 employees) is in a supervisory position where higher-level decisions begin to be made. One author wrote that being a good manager of scientists involves being caring, having good managerial skills, and being a good role model, in addition to being technically adept (Sapienza, 2005). CGW managers did not mention capacities related to managing others. Another author showed, through an empirical study, that a transformational leadership style (combining charismatic leadership and intellectual stimulation variables) had a positive impact on R&D efforts (Keller, 2006). Again, CGW managers did not allude to the possibility of early-career scientists' eventually managing others.

There are a number of leadership capacities that CGW hiring managers expect among early-career scientists but that were not expressed in the literature. CGW hiring managers want early-career scientists to engage in a developmental journey where they grow in confidence as technical leaders, where they are willing to have their limits tested, and where they move from dependence to interdependence. CGW hiring managers expect

higher-order communication skills from early-career scientists. For example, CGW hiring managers want early-career scientists to be willing to accept feedback without getting defensive. CGW hiring managers want early-career scientists to be able to communicate well with others, especially people from other disciplines. This involves being able to decipher the meaning that others are communicating, and translating that into a joint initiative. For example, a scientist may explain the need for an analysis using discipline specific terms different from other disciplines. Early-career scientists are expected to practice listening and inquiry skills, to be able to capture nuanced communication, and to translate that into policy analysis questions. CGW hiring managers want early-career scientists to be able to facilitate a conversation and come away with a collaborative project with someone who does not know what they want at the outset of the conversation. CGW hiring managers want early-career scientists to be able to explain the relevance of their analysis in different contexts. Additionally, CGW hiring managers want early-career scientists to have conflict resolution skills, as evidenced by the expectation that early-career scientists be able to creatively diffuse conflict. With regards to leadership capacities related to communication, CGW hiring managers expect early-career scientists to adapt their communication to different audiences and communicate in a tricky political environment.

CGW hiring managers expect early-career scientists to manage a number of paradoxical tensions. For example, they expect early-career scientists to maintain awareness of the organizational hierarchy, but also to know when to break the “chain of command” rules to obtain timely input and advice. Similarly, CGW hiring managers expect early-career scientists to hold another paradoxical tension difficult among

scientists—to be able to balance perfection with practicality. This refers to the ability to quickly develop an analytical model to answer a policy-relevant question without getting stuck in perfection mode and producing nothing at all within the time bounds. Lastly, CGW hiring managers want early-career scientists to be open to working on analyses that may not be technically challenging but that have policy relevance. Additionally, CGW hiring managers articulated an expectation that early-career scientists make sense of complex diseases (not complex contexts) and quickly transition into the CDC's technical and organizational culture.

Action Research

I begin this section with a brief overview of the overarching methodology used in this study, action research. I then focus on describing the theoretical elements of a particular school of action research, Collaborative Developmental Action Inquiry, which is the primary method used in this study.

Action Research is a type of applied research that involves systematic inquiry into the nature of a specific organizational problem with the participants who are affected by that problem (Merriam, 2009). Whereas traditional experimental/scientific research involves identifying generalizable explanations that can be applied to all situations, AR focuses on context-specific problems and solutions (Stringer, 2007). AR is a complex and dynamic process described as:

> A living, emergent process that cannot be pre-determined but changes and develops as those engaged deepen their understanding of the issues to be addressed and develop their capacity as co-inquirers both individually and collectively (Reason & Bradbury, 2008, p. 4)

The overarching methodology of AR is particularly well-suited for this study, because the phenomenon of leadership development among early-career scientists is so embryonic and unexplored. Thus, an emergent and dynamic process is appropriate to accommodate unexpected findings. AR methods and their emphasis on iterative cycles of action and reflection, collaboration, and democratic action (Coghlan & Brannick, 2010; Herr & Anderson, 2005; Reason & Bradbury, 2008) enabled me to explore an embryonic phenomena with those impacted by it. Additionally, AR methods enabled me to explore past, current, and emerging leadership challenges among scientists. As Chandler & Torbert (2003) indicate, AR seeks to understand phenomena across multiple time dimensions:

> Most social science studies seek to make casual links between predictor and dependent variables based on data or events that occurred in the past. In contrast, action research aims not only to understand past events, but also present phenomena, particularly the ongoing dynamics of human interactions in which one is participant, as well as future intentions and the forward design of joint organizing (p. 134)

Multiple time dimensions are relevant for this research, because this study met a real organizational need to develop leadership capabilities among early-career scientists, as it sought to simultaneously understand participants' past leadership experiences; frame current workplace challenges in the context of leadership; and design, with study participants, future leadership development opportunities.

AR methods enabled me to gather context-specific knowledge about the nature of the adaptive challenges early-career scientists face. Brooks and Watkins (1994b) indicate

that "action technologies have traditionally arisen in situations in which 'expert' knowledge has been found less useful than 'local' knowledge" (p. 5). In this study, I did not rely on an expert, such as a consultant, to tell us what the adaptive challenges were. Instead, I systematically asked the early-career scientists, their supervisors, and their mentors what their experiences had been. "Action technologies" refer to methodologies whose epistemology is aligned with the notion that we can come to know from our experience through cycles of action and reflection (Brooks & Watkins, 1994b). By engaging with early-career scientists, supervisors, and mentors through cycles of action and reflection, I was able, with my participants, to uncover the nature of the leadership challenges that they faced.

There are many models of AR (Coghlan & Brannick, 2010; McNiff & Whitehead, 2009; Reason & Bradbury, 2008; Stringer, 2007). Coghlan and Brannick's model (2010) of AR guides this study and involves a pre-step, as well as constructing, planning action, taking action, and evaluating action. Within each AR step, I employed the theory and methods of CDAI, which are described in the next section from a theoretical perspective. I describe the CDAI methods in Chapter 3 from a pedagogical perspective.

Collaborative Developmental Action Inquiry (CDAI)

Within AR, I had the choice to select which school of action research methods to use for this study. Since a key inquiry in this study was what are the leadership challenges early-career scientists face, and I was exploring this inquiry alongside an organizational need to develop leadership among early-career scientists, I needed an action research method that would help me to do two things at once: first, to explore the problem with those affected, and second, to simultaneously generate outcomes that would

help change (1) how early-career scientists interpret their role, and (2) their overemphasis on technical skills. CDAI is both a theory and a pedagogical approach. The next section elaborates on the key CDAI theoretical elements.

CDAI Theoretical Elements

There are two key CDAI theoretical elements: Collaborative action inquiry, and the use of developmental theory to describe how people, groups, and organizations can reliably and sustainably engage in action inquiry.

Collaborative action inquiry. The collaborative action inquiry theoretical construct in CDAI is based on the collaborative inquiry approaches common to action research. Collaborative inquiry in action research methods is informed by the seminal work on cooperative inquiry conceptualized by Heron (1985). Heron described it as a way to systematically engage reflection and action in a collaborative manner, so that learning occurs from individual and shared experience as people engage in a refined experiential learning cycle. Subsequent collaborative inquiry scholars added another dimension to the definition of collaborative inquiry by making a note of the inquiry question. Collaborative inquiry is "a process consisting of repeated episodes of reflection and action through which a group of peers strives to answer a question of importance to them" (Bray, Lee, Smith, & Yorks, 2000, p. 266). CDAI is collaborative in that, theoretically, it requires the voluntary participation of individuals who are committed to mutuality and collaboration (McGuire, Palus, & Torbert, 2007).

The process of collaborative action inquiry involves paying attention to one's experience on multiple levels to assess whether our actions, in the moment, are aligned with our intentions (Torbert, et al., 2010).

The action element of collaborative action inquiry refers to taking adaptive action in the very moment that we perceive a misalignment between intention and action. When we take such action, we are essentially adapting to generate alignment between intention and action. In order to make such adaptive changes, CDAI emphasizes awareness of our four territories of experience. According to Torbert (2004), improving our awareness to include our four territories of experience involves first recognizing "how limited our ordinary attention and awareness is" (p. 21). This approach of raising awareness aligns well with the intention of this study to both explore adaptive leadership challenges and develop adaptive capability in a context of emerging awareness regarding such phenomena.

A unique aspect of CDAI is the linking of action and inquiry. Simply by inquiring we are taking action, as Foster (2012) summarizes: "our actions may serve as inquiries by generating unexpected outcomes and novel information from our environment" (p. 1). Similarly, our inquiries may serve as actions: "all our inquiries are in some sense also actions in their framing, biases, omissions, modes of communication and impacts on the external world" (p. 1). The effective joining of action and inquiry involves being timely about our actions and inquiries (Torbert, 2004). Timeliness is important for the exploration of leadership development among early-career scientists in an applied setting, because the context in an applied setting is constantly changing based on external conditions of budget, priorities, and staff changes. Being timely in an applied setting is

relevant, because an effective action is ineffective the moment it is no longer timely.

An important aspect of this study that emerged through the iterative cycles of AR was the implementation of action learning as a leadership learning intervention. The collaborative nature of action inquiry in which the group developed "shared goals through inquiry, collaboration, and mutual uses of power" (Foster, 2012, p. 1) was essential, because the leadership project the early-career scientists took on could not be done alone.

To effectively and consistently practice collaborative action inquiry requires people, groups, and individuals to have certain capabilities. CDAI addresses this question of the capabilities needed by the integration of developmental theory into its theoretical underpinnings, which is discussed in the next section.

Developmental Theory. The integration of developmental theory has been noted as "one of the most important contributions of CDAI to the field of Action Research" (Foster, 2012, p. 6). CDAI uses developmental theory to raise the notion of developmental stage, and posits that adults differ in terms of what stage they are in (Torbert, 1976, 1987; Fisher & Torbert, 1995; Foster & Torbert, 2005). Some developmental psychologists indicate that developmental stage is more important than personality or preferences in predicting behavior (Cook-Greuter, 2004). This is relevant for leadership development, since leadership involves mobilizing people and resources to contend with adaptive challenges (Heifetz, et al., 2009). Mobilizing oneself and others requires action. According to CDAI theory and its developmental integration, our actions

become more effective, timely, just, and sustainable as our meaning making increases in complexity. The way we interpret the environment opens us to the multiple meanings of cognition (to recognize), emotions (affect), and the dynamics of interpersonal behaviors. This, in turn, impact action on the first-person (within ourselves), second-person (with others), and third-person (in the organizational system) levels (Torbert, 2004). Meaning making is relevant to this study of adaptive leadership because meaning making refers to how we interpret or make meaning of our experience. The CDAI method offers tools and approaches for making increasingly more complex in order to engage in the deeper double-loop learning to work through adaptive challenges. How we make meaning affects how we act (Cook-Greuter, 2004). Revisions in meaning making are related to successful adaptation (Cook-Greuter, 2004; Drago-Severson, 2009; Heifetz, et al., 2009; Kegan, 1982).

CDAI theory outlines a sequence of action logics that describe different meaning-making approaches. People, groups, and systems can transform their action logics as they "gradually gain the capacity to monitor all four territories of its activity and to develop greater congruity, integrity, and mutuality among them" (Torbert, et al., 2010, p. 6). Developing this awareness and capability to act in timely ways takes time, but is essential for engaging in applied and complex contexts that require more open and permeable ways of interpreting the environment. CDAI and its developmental focus have most recently been outlined as "widening circles of awareness and behavioral choices on a spiral of personal growth. As people progress through each developmental stage, the same set of basic issues like identity, power, and love get revisited at each transition" (Foster,

2012, p. 7). Identity, power, and our sense of being acknowledged became important topics in this study as early-career scientists moved beyond the limits of their role to enact leadership on behalf of themselves, their group, and the organization.

Meaning making evolves under the right conditions and depends on an individual, group, or organization's ability to digest single, double, and triple-loop feedback (Torbert, et al., 2010). Long-term practices such as "self-reflection, action inquiry, and dialogue as well as living in the company of others further along on the developmental path has been shown to be effective" (Cook-Greuter, 2004, p. 277) in supporting the evolution of meaning making. A key point is that a developmental shift requires the right conditions and time.

Empirical

Collaborative Inquiry

Empirical studies often bolster the theoretical literature. Since collaborative inquiry is such an important aspect of CDAI, in this section I elaborate on theoretical basis and empirical studies conducted using collaborative inquiry.

Collaborative inquiry is guided theoretically by John Heron's (1985) prominent work on cooperative inquiry and Peter Reason's (1988) work on participatory human inquiry. As Bray and colleagues (2000) comment on Heron and Reason's participatory worldview, "Participation and democracy are seen as essential for meaningful inquiry into the human condition and the resolution of dilemmas, questions, and problems, that are part of that condition" (p. 266).

There is a distinction between collaborative inquiry and action research that is important to note. Whereas the intent of action research is to make a change in the system, the purpose of collaborative inquiry is for those involved in the inquiry group to develop their own personal or professional capacities. As Kasl and Yorks (2002) note:

> …the purpose of action research is to change the system; the process is driven by a problem in the system. Action researchers gather information from many different sources within their environment for purposes of analysis and intervention. The action research team focuses its learning goals on the system. In contrast, the purpose of CI is for members of the inquiry group to change themselves. (p. 5)

Kasl and Yorks (2002) emphasize that "Collaborative inquiry (CI) provides a systematic structure for learning from experience" (p. 3). Key elements of CI are: (1) the iterative cycles of reflection and action, (2) peers as co-researchers, and (3) the inquiry question (p. 3).

Cycles of Action and Reflection

In one of the earliest collections of articles on the role of reflection and learning, Boud, Keough, and Walker (1985) raised some compelling questions regarding learning from experience:

> What is it that turns experience into learning? What specifically enables learners to gain the maximum benefit from the situations they find themselves in? How can they apply their experiences in new contexts? Why can some learners appear to benefit more than others? (p. 8)

The authors identified the importance of reflection as a key variable in addressing the above questions and in learning from experience. They note that "…reflection is a vital element in any form of learning and that teachers and trainers need to consider how they can incorporate some forms of reflection in their courses" (p. 8).

Various scholars have emphasized that learning from experience is facilitated by reflection (Boud, Keogh, & Walker, 1985; Jarvis, 1992; Kolb, 1984; Mezirow, 1997, 2000). Dewey (1933) first conceptualized the notion of reflection in learning and defined it as "active, persistent, and careful consideration of any belief or supposed form of knowledge" (p. 9). This "reconsideration" of experience and reinterpreting it to form new perspectives continues to influence current models of reflection. However, the difference between the models is when reflection occurs –either after the experience or in the moment of the experience.

Kolb (1984) and Jarvis (1992) both indicate that learning occurs when new conceptual meaning is developed *after* reflection on experience. Kolb's (1984) model of learning from experience that consists of four elements: concrete experience, observation and reflection, the formation of abstract concepts, and testing in new situations. According to this model, learning occurs when new conceptual meaning is developed *after* reflection on experience. The learner, then, engages in active experimentation based on the new conceptual meaning, which then leads to a new experience. Jarvis (1992) elaborated on Kolb's model of learning from experience, by identifying the learning responses from experience: (a) nonlearning (e.g., rejection), (b) nonreflective learning (e.g., memorization), and (c) reflective learning. Jarvis further extended reflective learning by identifying three types of reflective learning: (a) contemplation, (b) reflective

skills learning, and (c) experimental learning. Jarvis indicates that experimental learning occurs when "…theory is tried out in practice, and the result is a new form of knowledge that captures social reality" (p. 78). The notion of experimental learning that Jarvis brings to Kolb's theory of learning from experience is more aligned with collaborative inquiry, because Jarvis outlines a "…more interactive, systemic relationship between practice, experimentation, reflection, and evaluation" (Bray, et al., 2000, p. 9).

Mezirow (1997, 2000) indicates that reflection can happen more spontaneously. Instead of reflection being sharply divided from action as Kolb outlined, Mezirow indicates that reflection can happen in the moment of action. As Bray and colleagues (2000) summarize: "Mezirow points out that one can engage in reflection although taking thoughtful action, even it involves only a split-second pause to assess what one is doing." (p. 9). Regardless on when reflection occurs, action and reflection are key practices in collaborative inquiry because they are a: "…a powerful approach to learning from experience and, simultaneously, a valid method of conducting inquiry into the nature of experience" (Bray, et al., 2000, p. 10). Exploring the nature of experience through inquiry, reflection, and action are key aspects of collaborative inquiry.

Peers as Co-Researchers

Another important element of collaborative inquiry is the peer-like nature relationship between the members of the inquiry group. This collaborative emphasis is informed by the participatory worldview, as espoused by Heron and Reason (1997) and Torbert (1991). Heron and Reason (1997) underscore that co-operative inquiry is "…research done by people with each other, not by researchers on other people" (p. 8).

The participatory principle is also outlined by Coghlan and Brannick (2010) in discussing the collaborative nature of action research:

> …AR is a collaborative, democratic partnership. Members of the system that is being studied participate actively in the cyclical process [of action research]. Such participation contrasts with traditional research where members of the system are subjects or objects of the study. (p. 5)

Bray and colleagues (2000) elaborate on what it actually means to engage in inquiry *with* people rather than *on* them: "Each participant is a co-inquirer—shaping the question designing the inquiry process, and participating in the experience of exploring the inquiry question, making and communicating meaning" (p. 7).

In one collaborative inquiry group, the initiator made an adjustment to this participatory principle by taking into account the organizational context in which she was operating. Van Stralen (2002) describes a collaborative inquiry in which she and six nursing managers explored the challenge of increasing mutual respect and cohesiveness among management and staff. Van Stralen points out that, due to the organizational context of reliance on expert models, she purposefully adapted the traditional collaborative inquiry approach to match the culture of the organization. For example, instead of having participants assume responsibility for decision-making as is customary in traditional collaborative inquiry, Van Stralen slowly transferred responsibility in a culture that was used to expert models:

> Members of this culture are accustomed to expert models in which facilitators or trainers take charge. Participants expect formal direction and logical organization of learning activities. Recognizing these expectations,

> I knew I should begin the learning program as a traditional facilitator, but I also actively intended to transfer responsibility to the learners. (p. 19)

The author notes that the organizational culture she is working in expects more expert initiation, and so she initially assumed an expert role and then slowly transferred leadership to the inquirers in a skillful way:

> I planned a number of steps that gradually transferred responsibility and helped participants grow confident in their ability to assume leadership for the process. For example, in the first meeting I took notes about the emerging themes of reflection. In the second meeting I asked for a volunteer to record emerging themes and distribute these notes to all members of the group within five days. At the third meeting, I asked for two volunteers who would help plan and facilitate the next meeting. These volunteers met with me by phone. We repeated this pattern for the next two meetings. (p. 19)

The modified approach to engaging inquirers that Van Stralen used shows that collaborative inquiry, and in this case the participatory principle, can be adapted to match the reality of the organizational culture.

Inquiry Question

The final element of collaborative inquiry is the nature of the inquiry question. Since collaborative inquiry is based on an epistemological foundation of democratic participation (Heron & Reason, 1997), the inquiry question is generated by the inquirers based on their own needs and interests. Two basic principles guide the inquiry question: "(a) the inquirers can explore it through their own experience, and (b) every member of

the inquiry is equal relative to the others in terms of his or her ability to address the question" (Bray, et al., 2000, p. 12). The democratic nature of collaborative inquiry is expressed in these two principles whereby participants can both explore and address the inquiry question in equitable ways.

The inquiry question is also subject to change through the cycles of action and reflection. As Kasl and Yorks (2002) indicate, "participants organize themselves in small groups to address a compelling question that brings the group together. In order to construct new meaning related to their question, collaborative inquirers engage in cycles of reflection and action" (p. 3). New meaning is constructed through action and reflection. Furthermore, the answer to the inquiry is informed by personal experience: "Together, inquirers formulate a compelling question that they can answer by examining 'data' from their personal experience" (p. 5).

Table 2 demonstrates that the inquiry questions across empirical studies differed substantially, and this is evidence of the situated nature of the inquiry groups. In other words, the inquiry question is not a standard question, but instead it is based on a practical challenge that the group is compelled to address. Therefore, it is expected that inquiry questions will vary across groups. Furthermore, the majority of the questions across inquiry groups related to increasing personal or professional effectiveness. For example, an inquiry group of health clinic supervisors, Lehmann and colleagues (2004) sought to explore a challenge that permeated the organization for years regarding employee attrition and supervision. Their inquiry, "What are the factors that hinder effective supervision?" led the group to identify the root causes of poor supervision that the group had previously been unaware of. Another inquiry group wanted to improve the

environment for diversity in their organization (European-Amerian Collaborative Challenging Whiteness, 2002) and began with an inquiry related to first improving their understanding of what it means to be a member of a dominant society. In one of the earlier inquiry groups of counselors (Heron, 1985), the inquiry group sought to reach clarity on process: "What are the different states of being the clients go through?" A group of 11 community women (Smith, 2002) were driven by the inquiry, "What are the ways that we can lower the barriers to peer counseling?" In all cases, the inquiry questions were those to which answers could be found through personal direct experience with the phenomena underlying the question.

Some of the inquiry groups explored questions of personal identity or perplexing social complexity, such as oppression and hegemony. For example, in an inquiry among Jewish women (Rosenwasser, 2002) participants explored the question, "How does internalized Jewish oppression manifest in us, and what are the strategies for resisting and healing from this oppression?" Another group of women scholars (Pritchard & Sanders, 2002) who were challenged as women of color in an institution dominated by Western cultural hegemony explored the question, "What does it mean to be socially engaged, spiritually full Women-of-Color scholars?" In both cases, some personal transformation occurred. For example, in the case of the women scholars, an outcome of the inquiry group was realizing that education is a form of social activism and of implementing that way of knowing on a daily basis. In the case of the Jewish women, the inquiry group helped the women develop a sense of community, which they realized was a powerful antidote for the very issue of negative internalized messages that they were challenged with. In a third group of women exploring ways of empowering transformative learning,

the outcome of the inquiry group was an increased self-awareness of themselves as agents of transformation (Roberson, 2002). Another inquiry group explored the self-awareness of intuition in an educational setting (Zelman, 2002), and the group was able to validate intuition as a way of knowing.

A few inquiry groups used collaborative inquiry to improve curriculum design and teaching. For example, in one inquiry project consisting of six groups of teachers, the participants sought to find out how teachers can see themselves as constructors of knowledge instead of relying on transference of knowledge from others (Moran, 2007). An outcome of the inquiry group was discovering that inquiry groups themselves support young and inexperienced teachers to be more proactive. Another inquiry group consisting of nine teachers from nine school districts (Nelson, Slavit, Perkins, & Hathorn, 2008) wanted to find out how to best teach mathematics. The inquiry group generated learning and transformation of the group's beliefs about learners, learning, and instructional activities. These changes then contributed to how instructional design and teaching were approached. Another inquiry group of educators (Zech, Gause-Vega, Bray, Secules, & Goldman, 2000) engaged in a multi-level inquiry design whereby inquiry questions were addressed at multiple levels of the educational system: the classroom, the school, and the community of teachers. At the classroom level, the inquiry group of educators gained new insights on what constitutes evidence of student understanding. These insights resulted in changes in instructional practices. The inquiry groups developed new capacities among the educators, including the capacity to seek out and learn from multiple perspectives. At the school level, the inquiry groups led to increased awareness that the issue being grappled with (how to increase student understanding) was broader

than at first conceptualized. As a result, there was less blaming, and increased revision of assumptions regarding the issue. At the teacher community level, the inquiry groups resulted in the teachers seeing themselves as active constructors of their own knowledge. Furthermore, they discovered how to sustain collaborative communities of inquiry for continued learning.

There was only one inquiry group that used inquiry practices to guide leadership development (Foster & Carboni, 2009). In this inquiry group, multiple pedagogical approaches were used, in addition to inquiry, to develop practical leadership skills. These practices were personal cases, individual action inquiry projects, peer-coaching teams, and role modeling.

Table 2
Select Empirical Studies Using Collaborative Inquiry

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
European-American Collaborative Challenging Whiteness (2002)	13 groups and 50 participants, including faculty, adult students, and community members	Project purpose: To develop a personal understanding of what it means to be a member of the dominant group in society; to translate this new understanding into changed behavior and social action; to improve the environment for diversity		Most groups met face to face; several participated on-line. Inquiries ran for nine months; new groups formed each year	Action/reflection cycles; monthly reflection papers; end of semester report from each group; private electronic conference; sharing of learning with academic community	Participants report changed beliefs and behaviors, including more effective communication	
Foster and Carboni (2009)	40-60 evening MBA students	Project purpose: Revise curriculum using an Action Inquiry pedagogy for the development of practical leadership skills required in the real world.		Required leadership workshop with individual action inquiry projects	Action Science and Action Inquiry Learning practices from action science and action inquiry: personal cases showing Model 1 and Model 2 reframe,	Students develop new practical, actionable leadership behaviors: skillfulness that can guide action in new and unexpected situations; leadership as a	Evaluating impact of action science and AI methods on leadership development

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
					individual AI projects, self-directed peer coaching teams, role modeling	state of being	
Heron (1985)	Counselors	Inquiry: What are the different states of being that clients go through?		Three meetings at three-week intervals	Action/reflection cycles	Most refined map collectively developed by the group documented the stages that clients go through	
Lehman et al. (2004)	10 health clinic supervisors	Inquiry: What are the factors that hinder effective supervision?		Two workshops over five months	Action/reflection cycles Journaling	Identification of root causes of poor supervision	
Moran (2007)	Six groups each consisting of four teachers per group	Project purpose: To help teachers see themselves as constructors of knowledge instead of relying on transference of knowledge from others		Each team implemented a six-week project with a small group of pre-school children	Action/reflection cycles Journaling Implementation of collaborative teaching projects	Implementation of collaborative projects provided many critical components for generating collaborative inquiry Inquiry groups supported young, inexperienced	Need for more CI studies in more diverse setting over longer periods of time to better understand

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
						teachers to take deliberate action	how CI contributes to teachers' development
Nelson et al. (2008)	Nine teachers from nine school districts	Inquiry: How to improve students' command of mathematical and scientific language		Seven 1.5-3 hour meetings over one year	Action/reflection cycles	Development of an inquiry stance and engaging as learners supported transformations of teachers' beliefs about learners, learning, and instructional activities	How to overcome the intellectual effort and time needed to create powerful inquiry groups
Pritchard and Sanders (2002)	Five graduate students	To face the challenges of being women of color in institutions dominated by Western cultural hegemony	What does it mean to be socially engaged, spiritually full Women-of-Color scholars?	Six sessions in eight months	Action/reflection cycles	Implementing on a daily basis the lived reality that education is a form of social activism that is sustained through spiritual practices	
Roberson (2002)	Four professional women	To explore ways of empowering	How can [we] contribute to	Six-hour meetings at monthly	Action Inquiry Action/reflection cycles	Participants became more aware of	

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
		transformative learning and to experience collaborative inquiry as adult education strategy	the conception and nurture of learning communities that empower and transform?	intervals for one year	Process that facilitate transformation: Deep listening, storytelling, being present to others as companions on the journey, and being open to the presence of creative spirit	themselves and others as choice-makers and of themselves as agents of transformation	
Rosenwasser (2002)	10 Jewish women	To explore their internalized negative societal messages as Jewish women and to learn how to heal their self-hatred	How does internalized Jewish oppression manifest in us, and what are strategies for resisting and healing from this oppression?	Monthly six-hour sessions for 10 months	Action Inquiry Action/reflection cycles Traditional action/reflection cycles Then shifted to embodying healing practices: storytelling, songs, artwork, movement, and theater	Developed sense of community, powerful antidote to internalized messages Realization that shared pain resulted from systemic oppression	

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
Smith (2002)	11 community women diverse in race, language, and education	To explore collaborative learning and understand what is needed to expand a small organization devoted to peer education	What are the ways that we can lower the barriers to peer counseling?	Four-hour meetings at monthly intervals for one year	Action Inquiry Action/reflection cycles Collaborative storytelling to develop trust Ways of knowing	Inquiry group shifted from being learners who receive knowledge to being learners who construct knowledge Discovered that cultural differences can be a trusted, creative resource. Using rounds of public discourse, they tested new knowledge and developed new work	
Van Stralen (2002)	Six nursing managers	To heal fragmentation and separation between management and staff	How do we communicate in order to promote a culture of mutual respect and cohesiveness	Eight cycles of reflection and action in Eight months. Reflection sessions were four hours,	Action Inquiry Action/reflection cycles Guided visualizations Objects in learning environment to	Inquiry group expanded thinking and action to value personal relationships; authentic communication; work practices that	

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
			among management staff from departments, shifts, and facilities?	scheduled at two-week intervals	stimulate imagination Expressive arts for reflection Ways of knowing	promote community Demonstrated empowered leadership by taking action that resulted in a hospital-wide employee recognition celebration	
Yorks (2005)	11 action teams of practitioners and academic researchers from the U.S Dept. for Veterans Affairs (VA)	Project purposes: (1) address the issue of workplace aggression, (2) develop quantitative models that might be used to make the business case for the reduction of workplace aggression, and (3) adopt a practice-grounded action research model for the process		Meetings and projects over three years	Practitioner-based collaborative action inquiry Action/reflection cycles Learning practices from action science, reflective practice, org. behavior and learning: Reflection, dialogue,	Collaborative space dependent on time spent in collaboration Sustainability of collaborative space dependent on face-time with group; space is fragile, disrupted by strong personalities Action teams with greater collaboration and reflective	What practices can extend the effect of collaborative space in a virtual setting?

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
					learning, window, ladder of inference, harvesting the learning	behaviors were more effective; able to exert their leadership	
Zelman (2002)	Seven inquirers (six women, one man). Five are faculty and two are administrators	To explore the role of intuition in an educational setting; to nurture intuition among the inquirers and their students	How can we promote or nurture intuition?	Six sessions over eight months	Action/reflection cycles	Participants validated intuition as a way of knowing	
Zech et al. (2000)	Three CI contexts; Context 1: The classroom	To explore how to shift the focus of classroom instruction from memorizing facts to learning with understanding of	Classroom: How do my students develop understanding about place value?	Classroom: teacher and facilitator engage in six two-hour sessions in the spring ending with a two-week institute in the summer	Action/reflection cycles	Classroom: New insights into what constitutes evidence of student understanding; rethinking of and changes in instructional practices Overall: Deepened	How to sustain inquiry groups over time. Is an outside influence necessary to bring the community together to

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
		mathematics and writing		All three contexts occurred over a two-year period		knowledge of content and learning processes; seeking out and learning from multiple perspectives; viewing expertise as emerging from the group's shared inquiry and conclusions	further inquire into content knowledge and student understandin g?
Zech et al. (2000)	Context 2: The school	To explore how to shift the focus of classroom instruction from memorizing facts to learning with understanding of mathematics	School community: How do we structure learning tasks to support the development of student understandin g?	School community: Three all-day trainings plus monthly meetings	Action/reflection cycles	School community: Seeing the problem in terms of a broader picture of student understanding; less blame; revising assumptions	
Zech et al. (2000)	Context 3: The teacher	To explore how to shift	Teacher communities:	Teacher communities:	Action/reflection cycles	Teacher communities:	

Author (s) and Date	Subjects and Setting	Inquiry Purpose	Inquiry Question	Process	Learning Methods	Key Findings/outcomes	Needed Research (blank cell= future research not indicated)
	communities	the focus of classroom instruction from memorizing facts to learning with understanding of mathematics	How do my students develop understanding about writing?	Monthly meetings		Begin to see themselves as active constructors of their own knowledge; discover how to create and sustain collaborative communities on inquiry for continued learning	

Summary of Empirical Studies

The learning outcomes of the fourteen inquiry groups (Table 2) correlated on frequency and duration of meeting, and pedagogy. For example, inquiry groups that met more frequently and implemented pedagogies designed to yield deep learning (e.g. action science) had the most important learning outcomes within a level of learning (e.g. individual) or across levels of learning (e.g. individual, group, and system). For example, two inquiry groups (Roberson (2002); Smith (2002) met frequently and for long durations such as six-hours at monthly intervals and four-hours at monthly intervals, respectively, for one-year. These groups used a variety of methods to yield deep learning (as outlined in Table 2), and thus had had important first-person level learning impacts. These impacts included an increased self-awareness of being agents of change and a discovery that cultural differences can be a trusted and creative resource. This integrative finding across groups suggests that frequency, duration, and pedagogy have the greatest influence on learning outcomes.

Of the fourteen inquiry groups outlined in Table 2, two had insights solely on the phenomenon they were exploring (Heron, 1985; Lehman et al., 2004). Eight groups experienced learning at the individual level (European-American Collaborative Challenging Whiteness, 2002; Foster and Carboni, 2009; Moran, 2007; Nelson et al., 2008; Pritchard and Sanders, 2002; Roberson, 2002; Smith, 2002; Zelman, 2002). One group (Rosenwasser, 2002) experienced learning at the group level. Three groups experienced learning at the individual and group levels with systemic impacts at the system level (Van Stralen, 2002; Yorks, 2005; Zech et al., 2000).

The logistics of implementing the cycles of action and reflection varied depending on the question under inquiry. Table 2 shows that the inquiry groups met at various frequencies and for different lengths of time. For example, inquiry group duration ranged from as little as three weeks in one of the first inquiry groups (Heron, 1985) to as long as three years in a funded study (Yorks, 2005). Most groups met for a duration that ranged from six months to one year. The frequency of group meetings also differed across these empirical studies. The most frequent meeting intervals were every two weeks (Van Stralen, 2002). The most infrequent meeting interval was every two and a half months (Lehman et al., 2004), with the majority of inquiry groups meeting on approximately a monthly basis.

Summary of Chapter

My literature review on leadership theories revealed a promising area of leadership research focused on "…understanding what constitutes an individual's level of developmental readiness or one's capacity or motivational orientation to develop one's full potential" (Avolio, et al., 2009, p. 426). This research is relevant for developing leadership among early-career scientists, because it points out that an early-career scientist's developmental readiness will impact how they interpret their new work context and what kind of action they take. Early-career scientists are entering a new work culture requiring adaptation to many changes; thus, the notion of the capabilities needed to adapt and make an impact are more palatable to an organizational culture that may not be quite ready to see its emerging scientists as emerging leaders. Many stakeholders I have spoken with view leadership from the perspective of traditional and outdated Industrial Age models whereby only those in positions of authority have the right to develop leadership

skills. This traditional, top-down way of thinking about leadership is no longer appropriate in today's knowledge organizations because, "…the problems with which human organizations deal are simply too complex to be effectively coordinated by top down managers" (Uh-bien & Marion, 2008, p. xiii).

The literature on leadership capacities among scientists primarily focuses on how to develop leadership capabilities among people who interact with scientists from the perspective of positions of management. There is little empirical data on what leadership capabilities are needed by scientists who are not in formal positions of authority, such as early-career scientists. Some recent articles have articulated the need for scientists to develop leadership capabilities to move their science forward, be influential in policy-making discussions, and interpret increasingly complex contexts (Cheng, 2010; Kishimoto & McGuire, 2010; McGuigan, 2010; Touchie, et al., 2010; Yeganagi, 2010). I compared these capabilities with the leadership capabilities that CGW managers who hire early-career scientists expect, and found concurrence in the broad areas of self-awareness, working with others, communication, and effective action. This finding is important, because it shows that hiring managers expect that early-career scientists will have leadership capabilities to be successful in their jobs in line with the emergent literature on leadership among engineers.

My review of the Collaborative Inquiry literature resulted in my recommendation to explore other methods known to yield deeper learning and transformation, such as Action Inquiry (Brooks & Watkins, 1994b). Facilitating deeper learning and transformation is needed. In general, early-career scientists and their supervisors/mentors have not expressed an interest in or a recognition of the importance of developing

leadership capabilities. Yet the challenges they face require leadership capability. Thus, I believe, that action inquiry will help facilitate a shift in this way of thinking/behaving.

A gap at the intersection of the three literature streams reviewed is: How does the developmental approach, integrated with action inquiry, help to both understand the nature of the leadership challenges that scientists face and simultaneously develop their capability as emerging leaders? This study makes a contribution to answering this question.

CHAPTER 3

METHODOLOGY

To explore the adaptive challenges that early-career scientists face, I needed a methodology that would enable me to get my hands dirty, a methodology that would offer a thick description of the leadership challenges that early-career scientists face and how CDAI helps identify and develop leadership in an applied practice setting. I needed methodologies that would enable me to co-inquire about the leadership challenges early-career scientists face.

This study uses the methodologies of action research (AR) (Coghlan & Brannick, 2010; McNiff & Whitehead, 2009; Reason & Bradbury, 2008; Stringer, 2007), action inquiry (Torbert, 1991, 2004; Torbert, Herdman-Barker, Nicolaides, & McCallum, 2008; Torbert, 1999; B. Torbert & Taylor, 2008; Torbert, et al., 2010), and action learning (O'Neil & Marsick, 2007; Watkins & Marsick, 1993, 2010, 1996) to inquire about and reflect on the adaptive challenges that science early-career scientists face, and the support that they need in order to respond in a skillful and timely manner to adaptive challenges. AR, action inquiry, and action learning fall under the larger rubric of "action technologies," a term coined by Brooks and Watkins. Action technologies are methodologies whose epistemology is aligned with the notion that we can come to know, from our experience, through cycles of action and reflection (Brooks & Watkins, 1994a). Action technologies are particularly well suited for this study, because these methodologies directly engage those practitioners who are affected by the challenge being explored. As Herr and Anderson (2005) indicate regarding the trustworthiness of

AR data, “one test of the validity of AR is the extent to which actions occur, which leads to a resolution of the problem that led to the study” (p. 55). For example, insights from the practitioners in this study, namely the early-career scientists and their supervisors, inform the research questions to a greater degree than expert leadership trainers, who had previously been engaged to deliver the traditional leadership workshops, but were not meeting the learning needs of the early-career scientists. Brooks and Watkins (1994b) acknowledge the challenge of expert knowledge in contexts where “practitioners should know more about their lives and work and in more insightful and complex ways” (p. 5) than experts. Brooks and Watkins note that “action technologies have traditionally arisen in situations in which ‘expert’ knowledge has been found to less useful than ‘local’ knowledge” (p. 5). Figure 3 shows how these methodologies are connected in the meta-framework that guides this study.

Figure 3. Action technology meta-framework: AR, CDAI, and AL methodologies

There are a number of action technologies that draw from the individual's experience for the purposes of skillful action in the world. These include AR, action science, action learning, participatory research, and collaborative inquiry (p. 5). Each of these methodologies is intended to produce new knowledge that informs action. The primary method used in this study was CDAI. The key CDAI methodological elements employed in this study are summarized below.

CDAI Methodological Elements

CDAI was used to collaboratively inquire about and understand the types of adaptive challenges that early-career scientists face in their transition to CGW. CDAI is a pedagogical methodology, in that participants engage in reflection and inquiry in a collaborative manner so that learning occurs from individual and shared experiences. It emphasizes first-person (inquiry into our own actions in the world), second-person (inquiry into our action with others), and third-person inquiry (inquiry into how our collective actions impact the larger organization) (Torbert, 2004).

The basic notion behind CDAI is that, to collaborate with each other in more timely ways, we need to have an awareness of four "territories of experience" (Torbert, 2004), as well as have the capability to accept feedback, specifically single-, double-, and triple-loop feedback. Given my research questions and the context in which there existed a paradox around leadership development, I needed a community of inquiry to get at the root of the paradox described earlier. This paradox is one where there is a demand for early-career scientists to enact complex leadership capabilities. However, there is an over-emphasis on technical training and a disinterest in leadership development. This

paradox, in some ways, is the manifestation of an adaptive challenge. Adaptive challenges are not resolved with the knowledge at hand; rather, resolution requires multiple perspectives (Heifetz, et al., 2009). To get at the root of the paradox, I needed a methodology that would enable me to explore, with those affected by the paradox, what is occurring beyond what is simply being said—to explore the thinking, feeling, and being behind what is being said, or not said, about scientists and leadership development. I chose CDAI because, of all the action research schools, CDAI uniquely considers mental models, meaning making, and the timely joining of action and inquiry. These elements are essential for exploring the question of leadership challenge in the kind of fast-paced, applied multidisciplinary environment that early-career scientists operate in.

Three Types of Research

Transformational inquiry practices integrate three types of research. These are first-, second-, and third-person research practices. CDAI offers a comprehensive approach to integrating first-, second-, and third-person inquiry. Integration of these practices is connected to timely action: "One of the central claims of collaborative developmental action inquiry is that ongoing timely action requires the integration of three types of research/practice in the very midst of practice" (Foster, 2012, p. 4). This approach is relevant and important for this study, because the aim is not only for early-career scientists to develop their leadership capabilities individually and as a group, but also for them to use those capabilities to impact their organization. These three inquiry practices are further elaborated in the next sections.

First-Person Research/Practice

First-person practices refer to "efforts to expand and deepen one's attention to encompass four 'territories of experience' simultaneously" (Steckler & Torbert, 2010, p. 105), and to "establish alignment or integrity among them" (Steckler & Torbert, 2010, p. 105). The goal of first-person research practices is to increase first-person integrity. A CDAI pedagogical approach for increasing first-person integrity is reflection and meditation to gain greater awareness of the Four Territories of Experience (Torbert, 2004). The first territory is the experience of the outside world, the second is one's own experience of how we are performing/behaving, the third is one's action logics or ways of interpreting our experience, and the fourth is a greater awareness or "regardfulness for the dynamic quality and *source of attention itself*." (Steckler & Torbert, 2010, p. 106).

In this study, the first-person research practices, such as reflection and journaling, were introduced in the first two action inquiry sessions. Action inquiry sessions refer to the monthly meetings, with the two action research teams, where CDAI methods were applied to develop leadership capabilities. The intention behind these was to emphasize reflection in action on intentional behavior, but also to encourage me and the early-career scientists to look at multiple levels of experience (e.g., feeling and thinking) in order to understand why we don't achieve our intended outcomes (Torbert, 1991, 2004). This distinction was important and relevant for my research, because I am particularly drawn to the notion of awareness and of integrating data on multiple levels of experience in order to close the gap between intention and action. Additionally, the program is designed so that the majority of the learning occurs through on-the-job learning, and reflection in action is a key way that professionals learn (Schon, 1983). Action Inquiry

aligns well with the program's fundamental philosophy of learning from experience, in that action inquiry is intended to facilitate early-career scientists' learning through its emphasis on awareness of action and reflection in action (Torbert, 2004).

Second-Person Research/Practice

First-person research practices create the stepping stone for second person research. Once we have greater self-awareness, we can more effectively engage with others. Second-person research refers to relationships with colleagues, family, friends, and even strangers. From a CDAI pedagogical perspective, the goal is to increase mutuality (Torbert, 2004). Mutuality refers to "collaborative efforts" (p. 26), and this can be enhanced by "testing the congruence between our own and others' frames, actions and impacts" (Foster, 2012, p. 6). We engage in testing whether there is alignment between ourselves and others in conversation by using the Four Parts of Speech tool.

Four Parts of Speech. In conversations with others, we can increase our mutuality by engaging the four parts of speech (Torbert, 2004) that correspond to the four territories of experience described earlier. Framing is indicating what is important to you or the purpose for a given dialogue in pursuit of a shared purpose. Advocating is where we make a recommendation or state our goal. Illustrating is offering an example of what the advocacy looks like or has looked like in a concrete way. We finish the conversation with Inquiring, where we ask a genuine question, invite feedback, and seek input from others. From a CDAI perspective, one of the reasons that people rarely develop shared goals is because they do not frame and inquire; as a result they do not "test the impact of their words and actions in real time" (Foster, 2012, p. 6). A key leadership expectation that hiring managers expect is for early-career scientists to engage in skillful

communication with people from other professions and disciplines to develop shared goals. The Four Parts of Speech tool was introduced and role modeled throughout this study, and was the tool most often remembered by early-career scientists.

Action learning. Action learning is a method to generate learning from working together on real-time work problems (O'Neil & Marsick, 2007; Sims, 2010; Watkins & Marsick, 1993, 2010, 1996) Action learning was a second-person research practice implemented as an intervention in this AR study in response to data emerging from the action inquiry groups that signaled a need for early-career scientists to engage more actively in a real-time adaptive challenge. Furthermore, action learning is a learning method that has been documented as particularly effective and efficient for the development of leadership, because participants learn through doing (Raelin, 2006), and this approach is relevant for the development of 21st century leadership capabilities.

Case-based learning. To explore and gain perspective on adaptive challenges, some educators have found the use of case-based learning to be effective in supporting adult learning and development (Drago-Severson, 2009; Foster & Carboni, 2009; Fraser & Greenhalgh, 2001; Heifetz et al., 2009; Torbert, 2004; Yorks, 2005). Case-based learning or convening "occurs in a group and is a structured opportunity (i.e., with a protocol) to join with colleagues and engage with a case based on one's own experience…" (Drago-Severson, 2009, p. 153). Case-based learning was used to help early-career scientists describe their leadership adaptive challenges and begin to make meaning in new ways for more skillful action. This method was a good fit for this study, because early-career scientists were already familiar with the case study methodology. However, since leadership among early-career scientists is an embryonic phenomenon,

there are no case studies that apply in this context. Having early-career scientists write their own cases about their real challenges connected them more personally to their challenges and the need to develop adaptive capabilities. In this way, case-based learning both identified the challenges and created a context for engaging in the Four Parts of Speech to generate new meaning and action.

Third-Person Research/Practice

Third-person research practice refers to the impacts in the organizational system. An example of a third-person impact is creating and sustaining a community of inquiry within a dynamic system so that these interactions produce meaningful and timely acts by individuals, groups, and the system itself (Torbert, 2004). In the context of this study, the early-career scientists engaged in an action-learning leadership project that had impacts in CGW.

First-, second-, and third-person practices build on each other, and their "long-term aim is to increase first-person integrity, second-person mutuality, and third-person transformational sustainability" (Steckler & Torbert, 2010, p. 106). First-, second-, and third-person practices were implemented in this study. The intention behind implementing these practices was both to raise awareness of the adaptive challenges and to develop adaptive capability.

Action Research Group: Supervisors and Mentors

To accomplish the goals of this study, I initially formed one action research team (Table 3). I invited all of the supervisors and mentors from the 2011 cohort of early-career scientists to be part of the team, and held focused conversations with them on the

AR method and their role. The supervisor is primarily in charge of assigning and overseeing the day-to-day tasks of the early-career scientists. The mentor offers advice and guidance on early-career scientists' work and overall professional development. I chose the 2011 group of supervisors and mentors to collaborate with, because supervisors and mentors have an important influence in the holding environment (Kegan, 1982) of the early-career scientist, or the "…nurturing context in and out of which a person grows" (Drago-Severson, 2009, p. 57). In my personal experience in co-directing the program for the past 3.5 years, and also as a result of my own experience in developing my capabilities within the CGW system over the last 15 years, I can attest to the important impact that direct supervisors and mentors have in the growth of an individual.

The validity and ethics of this process were addressed by engaging in a contracting session with them and inviting them to participate. I also asked them what they needed in order to fully commit. The AR team asked for less frequent and shorter meetings. Therefore, to make the best use of their time, we agreed that they would primarily function in a design role. I would bring data to them from the intervention group, and we would reflect on it together to come up with the design principles for each action inquiry session with early-career scientists. By the end of the session, we agreed that they would take an active role in designing the action inquiry sessions and exploring leadership development among early-career scientists.

The AR team and I developed an approach for working together, and identified an organizational learning challenge of mutual interest. According to Coghlan and Brannick (2010), "…AR is a collaborative, democratic partnership" (p. 5).

Table 3
Action Research Team[1]*: Supervisors, Mentors, and Program Team Members*

AR Team Member	Role
Jason	Supervisor
Dennis	Mentor
John	Mentor
Bob	Mentor
Ryan	Program team member
Lauren	Supervisor
Elizabeth	Supervisor
Susan	Program Stakeholder
Anyana	Action Researcher

[1]Pseudonyms are used for all organizations and people referred to in this document except the action researcher.

On December 19, 2011, I convened this group to outline the AR process and request their voluntary participation in the cyclical AR process. All members agreed to participate. We assessed convergence around three areas: my research interests, a practical and strategic challenge, and the gap in the literature. We found convergence around the following challenge: What is the nature of the leadership challenges that early-career scientists face?

Intervention Group: Early-Career Scientists Action Inquiry Group

The group 2011 early-career scientists, consisting of seven scientists, were the intervention group. All of the early-career scientists were recruited into this study. They were recruited during their orientation program, a two-week program at the outset of their fellowship, in August 2011. During this program, early-career scientists participated in sessions intended to help them become acquainted with the basics of practice in the health field and the organizational culture of the CGW. I provided the background and intention of this action research study during the orientation training. I ensured informed consent by reading them my informed consent script, which was reviewed and approved

by the University of Georgia Institutional Review Board. The script included all of the necessary informed consent elements, including the voluntary nature of the study, the low likelihood of harm, how their identities would be protected, and that they could decide to opt out of the study at any time without repercussions (see Appendix A for IRB approval). I received verbal consent from each participant over the phone and emailed them the consent form outlining all of the consent elements, including voluntary nature of the study.

The intervention group consisted of seven scientists. The program admits only advanced technical experts who have earned a doctoral degree from an accredited university in one of the following disciplines: economics or applied economics, decision analysis, health services research or related health sciences, operations research, industrial engineering, public policy, or related quantitatively-oriented field. Physicians who have additional quantitative or policy training are also considered for admission (Unpublished data: State of the Program Report). This group allowed my action research team to gain insights about the leadership challenges that early-career scientists can face.

I used the most appropriate sampling strategy for this study, which was non-probability sampling or "purposeful sampling" (Merriam, 2009, p.77) of the 2011 cohort of early-career scientists.

Action Researcher Role

As the action researcher in this study, I took an explicit leadership role in engaging with CGW stakeholders on this research. For example, I actively engaged and collaborated with the AR team to explore, analyze data, and make design

recommendations for the action inquiry sessions with the early-career scientists. I facilitated the action inquiry sessions. I got people to the table by spearheading meetings with organizational stakeholders who had relevant perspectives on the research questions but might not have had time to be part of the AR team. I engaged in formal and informal follow-up conversations with AR team members and early-career scientists after our sessions for those who needed additional time to talk.

My role in the program and my relationship with the early-career scientists and their supervisors and mentors made this possible. As the Deputy, I am in a leadership role. This enabled me to have timely access to the early-career scientists and supervisors, and to be acutely aware of the strategic and operational challenges of running a program dedicated to developing early-career scientists. For example, I am aware that, over the past three years, a common challenge articulated by early-career scientists is their feeling of isolation from what other early-career scientists are doing. As a result of this feedback, a strategic priority of the program was to help early-career scientists to better adapt and contribute to the CGW.

Data Generation Methods

My action research team and I wanted to know how early-career scientists make meaning of their adaptive challenges, and how their meaning making influenced the actions they took in this action research study. Qualitative methods were particularly well suited for understanding the adaptive challenges early-career scientists face, because one of the strengths of qualitative methods is to capture the actions and meaning making of participants. As Maxwell (2005) states, "…in a qualitative study you are interested not

only in the physical events and behavior that are taking place but also how the participants in your study make sense of these, and how their understanding influences their behavior" (p. 22). To understand the meaning making of participants in adaptive challenges, I facilitated action inquiry sessions (3.5-hour meetings) where adaptive challenges were discussed using CDAI methods. My action research team and I reviewed and analyzed de-identified data from the action inquiry sessions to answer the research questions. I conducted individual interviews with early-career scientists at the end of the study to gather perspectives and learning. The AR and action inquiry methods generated rich descriptive data on the adaptive challenges early-career scientists face and their meaning making and, thus, enabled me to answer the research questions.

This study was approved by the University of Georgia and the CGW Institutional Review Boards (Appendix A).

Bounding

The primary data for this study consisted of ten action inquiry sessions (3 hours each) with early-career scientists, six meetings (2-3 hours each) with the action research team, individual interviews with all early-career scientists (seven total in the group), organizational documents, and researcher notes. For analysis purposes I bracketed data that would enable me to answer the research questions, such as data on the adaptive challenges, how CDAI helped to navigate early-career scientists through their adaptive challenges, and the learning outcomes from this study. I excluded data on topics such as side conversations, management of unrelated projects, and logistical details of

implementing the action learning project (e.g. reserving meeting space, securing vendors, etc.) because these data did not contribute to answering the research questions.

Data Reduction

Of the 1,820 pages of transcribed data that I bounded for analysis I reduced it to an analyzable data set by excluding data associated with content offered by the facilitator and subject matter expert. For example, this data includes facilitator remarks and presentations delivered by the subject matter expert.

Table 4
Data Generated to Address the Research Questions

Generation Method	Source of Data	Analysis Method	Trustworthiness
Action inquiry sessions	Early-career scientists 10 action inquiry sessions (3.5 hours each) Total: 35 hours	Constant comparative analysis Recorded sessions were transcribed; transcription was reviewed, and themes and categories were identified. Coded data and categories. Ruona (2005) analytic method	Member check, audit trail, and reflexivity
Action inquiry sessions	Action research team (supervisors, mentors and program staff that support early-career scientists) Six action inquiry sessions (2.5 hours each) Total: 15 hours	Constant comparative analysis Ruona (2005) analytic method	Member check, audit trail, and reflexivity
Leadership Development Profile	Sentence completion test analyzed by credible third-party organization and Bill Torbert	Analyzed by Bill Torbert	Bill Torbert is the creator of CDAI
Case-based learning	Early-career scientists Seven scientists presented seven cases	Constant comparative analysis Ruona (2005) analytic method	Member check, audit trail, and reflexivity
Action learning project	Early-career scientists Supervisors, mentors and program staff that support	Constant comparative analysis Ruona (2005) analytic method	Investigator triangulation; member check; document review; audit trail; peer review; adequate time spent

Generation Method	Source of Data	Analysis Method	Trustworthiness
	early-career scientists One project spanning 8.5 months		collecting data; and reflexivity
Interviews	Early-career scientists	Ruona (2005) analytic method	Member check, audit trail, and reflexivity
Meeting notes	Action research team Action inquiry sessions Meetings with program leadership	Ruona (2005) analytic method	Audit trail and reflexivity
Email correspondence	Study participants Program leadership	Ruona (2005) analytic method	Audit trail and reflexivity
Organization documents	Study participants	Ruona (2005) analytic method	Audit trail and reflexivity
Incidental observations	Study participants Program leadership Organizational members	Ruona (2005) analytic method	Audit trail and reflexivity
Casual conversations	Study participants Program leadership Organizational members	Ruona (2005) analytic method	Audit trail and reflexivity
Action research journal notes	Notebooks, audio recordings, emails sent to self to record observations and process in real-time	Ruona (2005) analytic method	Audit trail and reflexivity

Action Inquiry Sessions

Each action inquiry session was held in a neutral space. I provided lunch from 12:30-1:00 PM with the intention to create an atmosphere of collegiality and appreciation. Previous researchers of inquiry groups have advocated for meeting in a neutral space within the institution, and recommend changing where the inquiry group meets as the tone of the meetings change (Bray, et al., 2000). I opened the action session formally at 1:00 PM by first welcoming early-career scientists to the community of the practice group, summarized what we did during the last session, and provided the context and purpose for the current session. This approach enabled early-career scientists to understand how the sessions were intended to develop their learning and leadership, reinforcing the notion of a developmental approach to learning. This framing portion of the session took about 10 minutes. Then I invited a CDAI subject matter expert to provide some background on the CDAI method for the session. For example, in the first action inquiry session, which took place on November 17, 2011, the subject matter expert gave a 20-minute presentation on single-, double-, and triple-loop learning. To immediately ground the theory in practice, I engaged early-career scientists in one of the four pillar practices for developing leadership from a constructive-development theory approach (Drago-Severson, 2009; Kegan, 1982, 1994). These practices, adapted to the early-career scientists, were: examining work challenges, exploring leadership roles, engaging in reflection, and peer-coaching. For example, in the first action inquiry session, early-career scientists were asked to reflect on their performance requirements. The reflection questions, intended to help early-career scientists set the intention for the action

inquiry sessions and link these sessions to their everyday work, included the following: What do you think will come easily? What will be challenging? What kind of support do you anticipate you may need from your peers? What do you want from your supervisor in his/her role as mentor? What do you hope these action inquiry sessions will provide for you? The early-career scientists were offered journals, along with guidelines for reflection, to support their reflective practice. The next part of each session involved second-person research practice, whereby the early-career scientists shared their reflections on their experience with the pillar practices with the group at large. The final part of the session involved individual and group feedback on the session. This feedback was used to design the subsequent session. In this way, evaluation was integrated into each session. I recorded each session, with permission from participants.

Action Research Meetings

The format for the action research team meetings was similar to that of the action inquiry sessions with the early-career scientists. The AR sessions started closer to the end of the work day, at the request of the action research team, and were two hours in length. I offered snacks, tea, and water, and brought flowers to set the atmosphere. During each session, I offered a short framing presentation to set the context of our meeting, followed by theory, practice, reflection, and feedback on the session.

My role as the facilitator of the action research meetings was to facilitate, bring data for analysis from the intervention groups, and engage in learning and reflection with the team. I recorded each session.

Interviews

I conducted a group interview with all early-career scientists at the end of the study to gather their learning and conduct member checks of the adaptive challenges. Similarly, I conducted a group interview with the action research team as part of the evaluation and member check process. I also conducted individual interviews with early-career scientists to ask more specifically about their personal learning. All interviews were recorded and transcribed.

Data Analysis Procedures

My AR team engaged in ongoing data analysis of the action inquiry session themes. Action inquiry and AR sessions were recorded and transcribed to identify themes, patterns, and questions that were emerging from the data. I coded themes and tracked them using the Ruona (2005) qualitative data analysis method. This method involves systematically organizing, coding, sorting, and retrieving data using Microsoft Word with sorting capabilities. Similarly, interviews were transcribed and emerging themes coded.

Trustworthiness of the Data

According to Herr and Anderson (2005), an indicator of quality in action research is trustworthiness, which is similar to the notion of validity in quantitative research. In action research, quality or trustworthiness refers to a rigorous, participatory action research process. In this section, I outline the ways I ensured rigor and engaged my participants in making decisions about the process and interpretation of findings. I outline the methods I used to ensure the trustworthiness of the first-, second-, and third-person

data levels. I hired a developmental coach to help me process my first-person (self-reflection) data. Ensuring the trustworthiness of the data generated in the second-person (group) research space was an inherent part of the evaluation phase of each action research cycle. Trustworthiness, on a third-person level, refers to whether the action research changed anything. This study changed the views, practice, and action of leadership development among the scientists within the program. For example, before this action research, early-career scientists at CGW (approximately 400 graduating each year across fellowship programs) had never engaged in a group action-learning leadership project. At the conclusion of this study, the group of early-career scientists and their successful leadership project changed the way they were viewed in the organizational system. For example, some supervisors, peers, and other CGW staff began asking when the next action-learning project would take place, as if it was already a practice inherent in the system (Ryan, personal Conversation, February, 2012). That the project sponsors considered this study a success has led to the acceptance of adaptive learning and adaptive leadership as concepts and practices relevant to early-career scientists. Additionally, I have had dialogues with workforce development leaders both internally and externally to share findings, and they are interested in exploring ways to test the CDAI method in order to develop leadership within their contexts.

Audit trail. I documented the action research process using an audit trail. In this way the reader can replicate the process of the study and see the raw data in order to understand how I came up with the findings.

Member checks and triangulation of data. Data generated in the action inquiry sessions was shared in a de-identified format with the action research group.

Recommendations from the action research group in response to their analysis of the data were shared with the early-career scientists group. Additionally data from each group were summarized and re-shared with the groups to identify what else needed to be added or revised. For example, after the case-based learning action inquiry session, I selected the most poignant sections of the transcribed meeting (e.g., where individual early-career scientists were making meaning of a particular adaptive challenge) printed and distributed those sections to the early-career scientists at the subsequent action inquiry session for additional reflection and meaning making. Another example is the data on adaptive challenges that the AR group generated. Such data were summarized and re-shared with the group, and I asked the group to add to the list of adaptive challenges. Therefore, data generated along the entire AR process were summarized and re-shared with each of the groups.

The findings were shared with both the AR group and the early-career scientists' group, and I requested feedback on the findings.

The primary validity threats to my conclusions were bias in the selection of early-career scientists and supervisors, and self-report bias. I minimized the effects of bias in the selection of early-career scientists and supervisors by asking all early-career scientists and supervisors from the 2011 group to participate. Therefore, I did not exclude anyone who might have a negative view of developing leadership capabilities. To minimize the effect of self-report bias from both early-career scientists and the supervisors, I ensured that both were aware that what they said was confidential. I took measures to minimize the possible effect of my own authority by ensuring that I was not involved in either any early-career scientist evaluations or selections of possible awards for supervisors. Since I

was working with my major professor in two ways (as my major professor on this project and as a subject matter expert on action inquiry), it is possible that my major professor may have had an impact on the decisions around the choice of interventions or the analysis of findings. I minimized the impact of major professor's authority by engaging my AR team in all decisions related to interventions and analysis.

I validated the findings by triangulation of emergent themes and patterns in the action inquiry groups with interviews, and I checked for alternative explanations and negative evidence by discussing the findings from my AR team with early-career scientists, supervisors, and colleagues, and comparing the findings with existing theory.

Description of the Context

The site of this AR study was the Center for Global Wellbeing (CGW), a large technical, health organization that operates in the complex and adaptive health field.

CGW's Workforce Development Office (WDO) is committed to developing a competent health workforce by providing leadership in health-related training and education. WDO manages innovative, evidence-based early-career scientist programs to prepare the current and future health workforce to meet the emerging and ongoing health challenges of the 21st century. Early-career scientist programs are intended to develop competent health professionals through service competency-based curricula where the majority (90%) of the learning is expected to occur through required activities on the job, which may involve job coaching and professional development experiences. A common domain across WDO's early-career scientist programs' competency-based curricula is Leadership and Systems Thinking.

The Quantitative Science Fellowship Program (QSFP) is one of 10 cross-cutting early-career scientist programs within WDO. The QSFP develops quantitative policy experts into health practitioners who can operate effectively in the adaptive health field. For the 14-year history of this program the emphasis has been on the technical or quantitative sciences. However, over the past five years, there is evidence that the biggest challenges that arise in the two-year fellowship experience are adaptive and not technical. How does QSFP create the conditions for scientific early-career scientists to be successful in adaptive challenges? This AR case study involved collaboratively engaging with two AR teams to explore the nature of adaptive challenges faced by scientific early-career scientists, the capacities needed to be skillful in adaptive challenges, and how engaging the key individuals who are impacted most by gaps in adaptive capability can generate robust and relevant insights and recommendations for developing the next generation scientist—one who is technically capable but can also navigate adaptive challenges skillfully (Heifetz, et al., 2009). This site, therefore, is a microcosm of early-career scientist programs that emphasize scientific competence, but also wish to develop early-career scientists in capacities needed in the 21st century—a time of rapid change and ambiguity (Lichtenstein et al., 2006).

Major Stakeholders

The major stakeholders were: (1) the supervisors and mentors of the early-career scientists, (2) leaders and managers of programs that develop early-career scientists, and (3) the early-career scientists themselves (Figure 4).

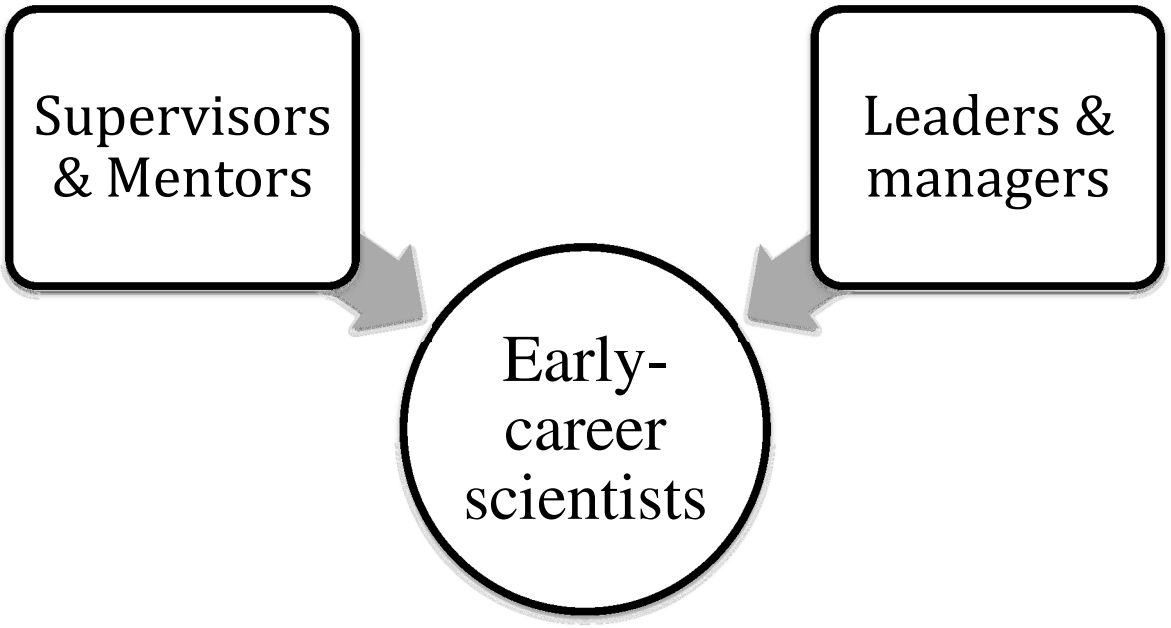

Figure 4. Major stakeholders: Key individuals impacted by the leadership challenges that early-career scientists experience

Summary of Local Challenge

A postdoctoral fellowship program aims to improve the development of its scientists. This program is responsible for training and developing the largest number of early-career scientists of a specific discipline. The program has experienced attrition in the past few years that were traced back to gaps in non-technical skills either on the part of the early-career scientists themselves, or those who support their development, for example, gaps in interpersonal communication, motivating staff, effectively translating technical skills to an applied context, etc. Yet the majority of early-career scientists and those who support their development do not see the relevance of developing non-technical capabilities for scientists.

To address the gap in non-technical skills, between 2008 and 2010 (prior to this research) I conducted pilot non-technical trainings under the rubric of leadership development, which offered training in the majority of the gaps observed. For example, the trainings were focused on competencies that had recently been developed for the early-career scientists related to self-awareness, skillful communication, and effective action. However, evaluations showed that there was still a disconnect between the training and the willingness of the early-career scientists to apply that learning in the workplace. A breakthrough was needed in order to motivate the early-career scientists and those who support their development to consider the relevance of developing leadership capabilities—in other words, these non-technical capacities—so that they would be willing to apply their learning to their workplace.

In the role of an action researcher positioned within this organizational unit, I took a CDAI approach to help this post-doctoral fellowship program over a two-year period. I

formed two action research teams comprised of the people impacted by the aforementioned challenge: the early-career scientists, and those who support their development (the supervisors, mentors, and key program staff who run the post-doctoral program, including the program director).

Rubric for Analysis

I analyzed the interventions and data generated on adaptive challenges using the adaptive challenge rubric (Table 5) to analyze the cases generated from the case-based learning intervention to describe and understand the adaptive challenges the early-career scientists reported. I also use the same rubric to analyze the adaptive challenges that arose when the early-career scientists engaged in their leadership action learning project. Table 5 was used in analysis by looking at the adaptive challenges and examining them against the questions associated with each of the archetypes. Table 5 outlined the four adaptive challenge archetypes, or patterns of challenge, that Heifetz and colleagues (2009) identified based on thirty years of experience in working with adaptive challenges. Exploration of the adaptive challenge involves asking questions to understand the type of archetype one might be working with.

Table 5
Analytical Rubric for Analyzing Adaptive Challenges

	Archetype 1 Gap Between Espoused Values and Behavior	Archetype 2 Competing Commitments	Archetype 3 Speaking the Unspeakable	Archetype 4 Work Avoidance
Inquiry to identify adaptive challenge	Is there a gap between what individuals/the organization says they value and what their behavior is?	Is there an individual or group of individuals whose commitments are in competition with one another?	Is there something that needs to be said but is not because it could generate tension and conflict that will need to be addressed?	Is attention being diverted to avoid the work and discomfort with change? For example: - Focusing on only the technical parts - Defining the problem to fit current expertise - Denying that the problem exists - Creating a proxy fight, such as a personality conflict, instead of grappling with the real issue -Taking options off the table to honor legacy behaviors
Inquiry to guide exploration of adaptive challenge by taking a systems perspective	Are there people involved whose pattern of behavior is contributing to the gap and yet earns them success?	Is an individual or a group avoiding making a decision about which commitment to favor?	Will giving voice to the unspeakable make the speaker immediately unpopular or cause them to lose standing?	Is there displacement of responsibility? For example: - Marginalization of the person trying to raise the

	Archetype 1 Gap Between Espoused Values and Behavior	Archetype 2 Competing Commitments	Archetype 3 Speaking the Unspeakable	Archetype 4 Work Avoidance
				issue ("shoot the messenger") - Scapegoating someone - Externalizing the enemy - Delegating the adaptive work to those who can't do anything about it (e.g., consultants, committees)
	Is there someone high enough in the organization who can keep the gap going for their benefit?	Will making a decision favor some constituencies and possibly hurt others?	Is there a senior authority involved that may make it riskier to give voice to the unspeakable?	
Adaptive challenge involves…	Closing the gap	Making a decision about which commitment to favor	Saying the important content that needs to be said	
Overcoming challenge involves…	Changing the patterns of behavior so that the gap is closed: - Rewarding new patterns of behavior the contribute to closing the gap - Redefining success	Requires good decision making	Creating a safe condition for voice to be given to the unspeakable. A full range of perspectives is included to increase the chance of an adaptive solution	- Identifying work-avoidance tactics - Redirecting attention

Adapted from Heifetz (2009)

Chapter Summary

To generate data to address the research questions I used the overarching methodology of action research. I selected CDAI, a school of action research, as the theory and practice to guide first-, second-, and third-person inquiry into the research questions. I formed two groups: the action research group comprised of supervisors and mentors, and the intervention group of early-career scientists. My role was to facilitate the two groups through the stages of action research to co-explore the research questions and generate learning on the first- and second-person levels with impacts on the third-person level. I ensured trustworthiness of the data by engaging in ongoing member checks, establishing an audit trail, and engaging in data triangulation between the two groups.

CHAPTER 4

STORY AND OUTCOMES

The objective of this chapter is to describe the process of implementing the action research project to develop leadership among a group of early-career scientists. Due to the complexity of this project, I describe the AR process in two sections. In this section, I describe the overall AR process. As I worked with the early-career scientists and their supervisors/mentors to implement the study, I came across a number of obstacles, especially at the outset. These obstacles are important to highlight, because they reveal the reality of the challenges that arise when attempting to make a change in an organizational system. I describe these obstacles in the section at the end of this chapter titled "The Dark Forces".

I remind the reader that, at the beginning of this AR study, both the early-career scientists and their supervisors/mentors were skeptical about the value of leadership development. This chapter details the extraordinary story of how all parties voluntarily accomplished a significant leadership feat. I begin this chapter with a description of the entry and contracting process; then I outline three AR cycles. The focus of AR Cycle 1 was inquiring about and framing leadership development in a context relevant for early-career scientists and those who support their learning. Once the AR team and the early-career scientists were well grounded in the challenge at hand (what the leadership challenges are and how we navigate them), the focus of the second AR cycle was on direct exploration of the leadership challenges each early-career scientist was facing in the midst of Cycle 2. AR Cycle 1 and Cycle 2 generated the group cohesiveness to embark on the extraordinary feat that occurred in Cycle 3. In AR Cycle 3, the group of early-career scientists transformed into a high-performing team that took on an unprecedented

leadership challenge that generated learning impacts at the individual, group, and organizational system levels.

Coghlan and Brannick's (2010) AR model serves as a guide for reflecting on the implementation of this AR study. According to Coghlan and Brannick's model of AR, the core AR cycles consist of a pre-step, constructing, planning action, taking action, and evaluating action. Each action research cycle in this study consisted of the above steps.

Multiple AR Cycles

While the phases of my action research outlined above appear somewhat linear, in practice what occurred was non-linear and dynamic. For example, within the overall two-year study there were multiple action research cycles (Figure 5), which I elaborate on in this chapter.

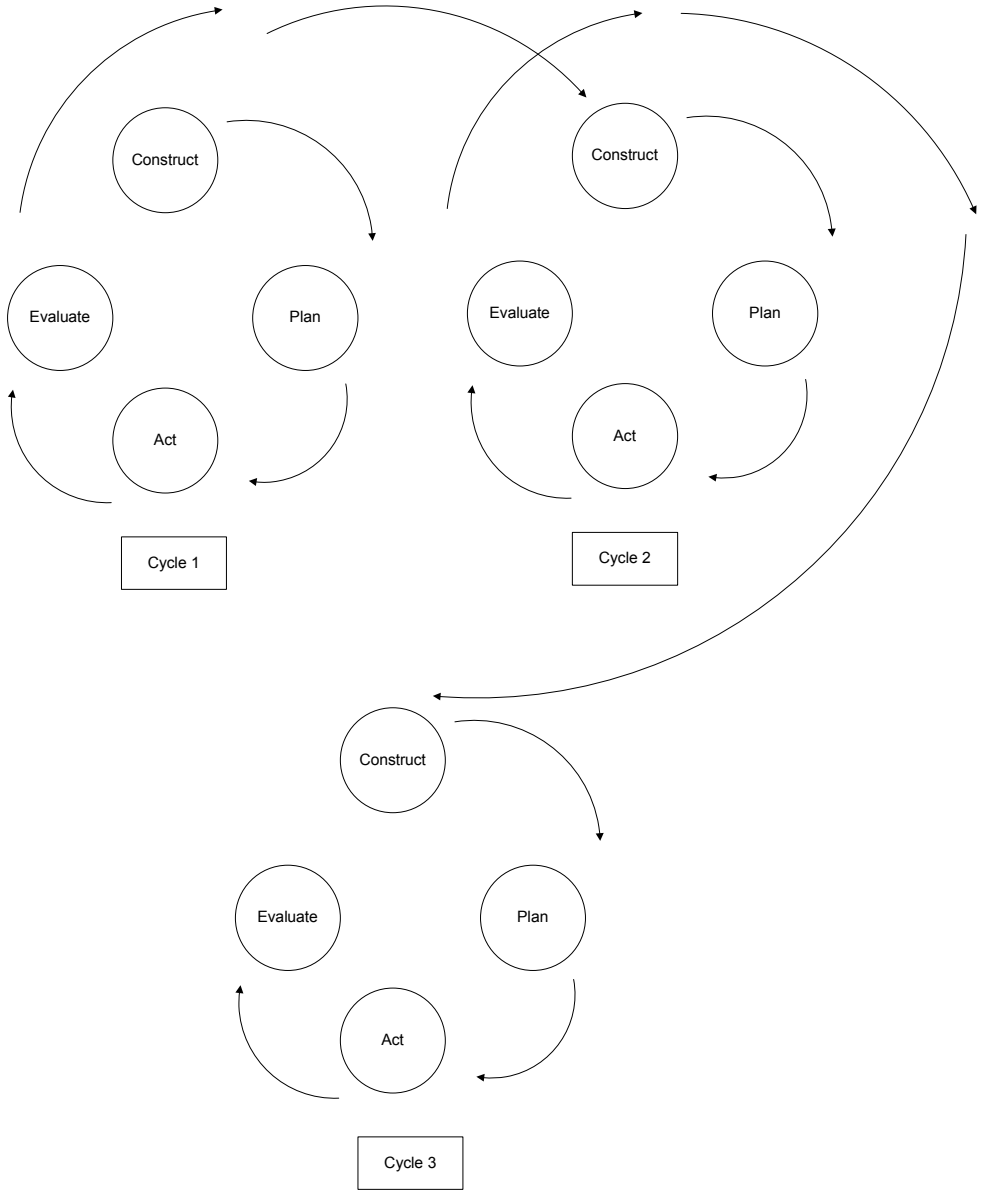

Figure 5. Multiple AR cycles

Dynamic Interactions

In addition, I convened an AR team and an intervention group. However, what transpired, as a result of my actions with educational intent informed by complexity theory, was the interactive dynamics of the two groups with each other and with members of the broader

organizational system. For example, in cycle one, the two groups met separately to engage in inquiry on the research questions. In cycle two, I engaged the two groups by sharing data from each group on the adaptive challenges each faced. In cycle three, the two groups met together to explore the action learning project. This approach resulted in simultaneous AR cycles with the two groups, instead of just AR cycles with the AR team.

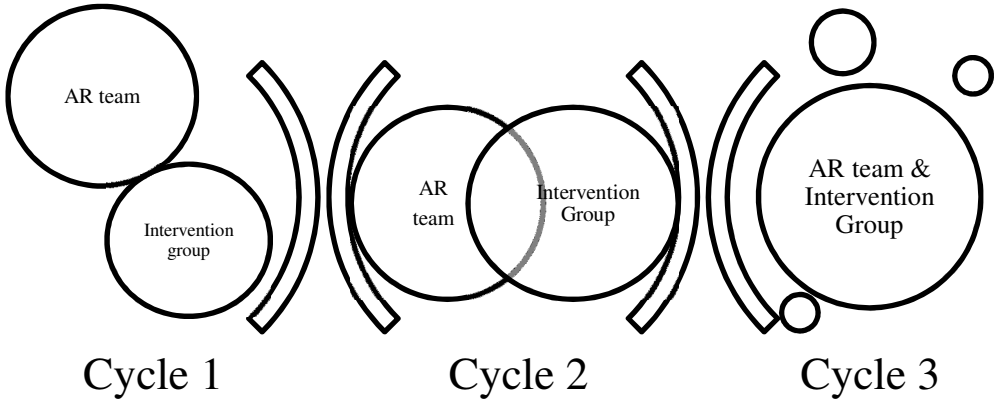

Figure 6. Dynamic interactions - one

Multiple AR Cycles and Dynamic Interactions

Although the intent was to have a single AR team and an intervention group, given the dynamics of time availability and formal power, what emerged were two action research teams. I facilitated AR cycles with each team. What emerged from this was a dynamic multiple-group AR process with actions and interventions occurring within, between, and beyond each group.

Table 6
Action Research Cycles and Key Outcomes

AR Cycle	Group	Primary Action	Primary Outcomes
1	Supervisors Early-career scientists	Inquiry	Reframing leadership as adaptive challenge
1	Supervisors	Learning activity	Supervisors also experience adaptive challenges Space is needed for connection and inquiry
2	Early-career Scientists	Case-based learning	First articulation of adaptive challenges Space is needed for connection and inquiry
2	Supervisors	Sharing data from cases	Space is needed for new learning on adaptive challenges among supervisors
3	Early-career Scientists	Exploring action learning	Commitment to engage in action learning
3	Supervisors	Co-mingling groups	Interactive dynamics between early-career scientists and supervisors energized early-career scientists in action learning project
3	Early-career Scientists	Action learning project	Action learning project completed

Entry

Entry into the client site occurred in 2011 when I began to dialogue with Ryan, Chief of the QSFB, about the possibility of conducting my study in the context of the program. The QSFB had recently been required by Division leadership to develop competencies for early-career scientists. This was an initiative spearheaded by the WDF Director, and a requirement for all scientific fellowship programs under her leadership.

I shared with Ryan the results of three leadership development pilot trainings and the challenges that remained, such as the need to better understand what leadership means in the

context of the program, how to best develop leadership capacity, and how to best involve mentors and supervisors in creating a learning environment in which leadership can emerge.

Contracting Process

In early spring 2011, I engaged Ryan in a contracting interview to explore convergence among three areas: (1) the strategic needs of the program, (2) my interests in leadership development, and (3) a gap in the field of leadership development among scientists. The result of that meeting was convergence around exploring the development of leadership capabilities through action research. This effort directly informed a key strategic imperative of the QSFB, namely the development of a competency-based curriculum for early-career scientists. I requested that we obtain buy-in from Division and Program Office leadership. Ryan agreed to focus the monthly meeting with the Division leadership on my action research proposal.

At the division leadership meeting, I provided background documents in advance, which consisted of a Microsoft PowerPoint presentation with background on action research; an outline of three proposals for engaging in action research in increasingly larger contexts within the program office; a one-pager comparing the validity criteria for action research with experimental science; and three abstracts showing examples of action research in the health field, competency development, and leadership development. Attendees were ready to engage in dialogue, as they had reviewed the documents in advance.

Of the three proposals shared, the proposal I recommended was to engage in action research for the exploration of leadership development challenges within the context of the QSFB. Division leadership asked questions regarding the differences between action research and what we were already required to do, that is, to engage collaboratively with others in the instructional design model that is the standard of the program office, ADDIE (Analysis,

Development, Design, Implementation, and Evaluation). Other questions related to the implications of sample size on the results, and the need for an IRB, since the work of action research is considered program improvement, and not research, within the context of the CGW. I addressed the questions, indicating that the process of action research can be adapted to the needs of the branch and program office. I reassured the Director that I heard and understood her concerns about an IRB, I would ensure that the action research process would not raise IRB flags, and that I would do my due diligence to ensure that we were within the organizational norms and culture for engaging in these types of explorations. Finally, I listened to her comment about sample size.

The Model for Contracting Analysis developed by Pinsker (1999) outlines four categories of questions that, when attended to, result in an effective contracting engagement. These categories are: (1) Are we a match? (2) What needs to be done? (3) How will we work together? and (4) What does the agreement look like? The category "Are we a match?" referred to engaging in dialogue with site sponsor Ryan to determine whether there was convergence around three areas: a strategic challenge in QSFB, a gap in the knowledge base, and my research interests. As indicated above, Ryan and I converged around the challenge of leadership development among scientists or, more specifically, early-career scientists. According to Pinsker, if there is sufficient overlap among the three aforementioned areas, then the conversation can continue to identify readiness for change, client/consultant congruence, who else needs to be involved in the decision, and what we each bring to the project. Ryan and I determined that what needed to be done next was to get formal Division-level approval from the Division Director and her Deputy. Ryan and I engaged in a conversation with the Division leadership during our next monthly update meeting. By the end of the meeting, the following agreements were made: (1)

agreement that the action research would focus on addressing the challenge of how to develop leadership capacity among early-career scientists, including a better understanding of what the nature of the leadership challenge is; (2) agreement that this challenge was a strategic imperative and, therefore, I could use one-third of my work time for any work related to this action research (this work was part of my performance plan as the third element associated with project management); and (3) agreement that I keep the Division leadership informed of major milestones. Additionally, it was agreed that this AR project would accomplish two goals simultaneously. The implementation of the AR cycles with early-career scientists would be considered their leadership development training. As such, I was able to secure the early-career scientists' time to meet together once per month for 3.5 hours to engage in action inquiry.

Outcomes of Entry and Contracting Process

Through entry and contracting, my client site (which is where I worked at the time of this study) and I agreed to focus the AR project on exploring the leadership challenges that early-career scientists face. We also agreed to engage both the early-career scientists and their supervisors/mentors. Additionally, I was able to secure work time to engage in this research and secure the early-career scientists' time.

Action Research Cycle 1: Framing Leadership

As indicated earlier, multiple AR cycles took place in this study. This section elaborates on Action Research Cycle 1. The focus of this AR cycle was to listen to the AR team and the intervention groups discuss what they thought the leadership development issues were.

Pre-step

According to Coghlan and Brannick (2010), doing action research in one's own organization involves a "pre-step" in addition to the basic action research cycle phases. In the pre-step phase, three types of activities occur: (1) developing an understanding of the context of the action research project, (2) defining the purpose or the future state, and (2) establishing collaborative relationships.

Prior to each fellowship cycle, "business as usual" at CGW is as follows: the Chief and I typically hold 1.5-hour meetings with supervisors and mentors to share logistical information about hosting an early-career scientist. For example, we would share information about the selection process, the training calendar, and the roles and responsibilities of the potential candidate. In mid-July 2011, the program convened a series of small group meetings with the supervisors and mentors of the incoming class of 2011 early-career scientists. The purpose of these meetings was to communicate the implementation of the new competencies and other logistical information in preparation for the arrival of their early-career scientists in August. However, with the action research motivation of engaging with others collaboratively, "business as usual" began to change for the better. I suggested to the Chief that we modify our approach in two ways: first, invite the experience of each small group to inform the dialogue, and second,

invite them into a more collaborative relationship with the fellowship branch. The Chief was open to the idea, so we added two more items to the standard agenda: (1) inquire with supervisors into what makes a successful early-career scientist, and (2) ask who would be interested in exploring further how to best support early-career scientists to be successful by developing their leadership. Six of the seven supervisors and one mentor responded positively that they wanted to be part of an AR team to provide input into how to best develop early-career scientists' leadership capabilities.

The dialogue focused around this central inquiry:

"In your experience, what makes a successful early-career scientist?"

My intention was that, by adding this open-ended question and shifting from one-directional information dissemination to collaborative dialogue, we would have a better sense of the context of the AR project and begin defining the future state, and the process itself would already embody a more collaborative relationship with our stakeholders.

The rationale expressed by the groups was that, the earlier early-career scientists can adapt to the CGW culture, the sooner they can start to perform effectively. I shared with the group some examples of the challenges that early-career scientists encounter in their transition, based on my experience in managing the fellowship program. These challenges have to do with the non-technical elements of their work, such as communicating and collaborating with others; staying motivated; and moving their work forward. I proposed that a monthly community of practice gathering with early-career scientists would enable them to begin articulating some of their challenges in transitioning to the CGW. All of the supervisors and mentors agreed to allowing their early-career scientists to be part of monthly collaborative developmental action

inquiry groups (action inquiry sessions). Many indicated that it was a good idea and said they wished this had been offered to them when they were early-career scientists.

Given the positive response from the mentors and supervisors regarding the relevance of the non-technical elements of work, I felt ready to invite them to be part of the action research team exploring the leadership challenges early-career scientists face. I sent an email to all of the mentors and supervisors of the 2011 early-career scientists, inviting them to be part of the AR process. Since this group is already so busy with their day-to-day jobs and supervising/mentoring early-career scientists, I was not surprised by the low response. I followed up with a personal phone invitation to the supervisors/mentors who had expressed the most interest during the small group meetings. Additionally, knowing that my Chief had more political clout than I did, I asked the Chief to make some personal invitation calls as well. By the end of this phase I had formed my action research team. We met to have a dialogue on the purpose of engaging in action research, and about what would make the engagement meaningful for them. The key finding from this first engagement with my AR team was that they had very limited time and wanted to meet only every other month for two hours. On the other hand, I would have the opportunity to meet with the early-career scientists once per month for 3.5 hours, since these action inquiry sessions became part of their competency-based curriculum.

In this phase, the politics of my action research began to emerge. First, the leadership of the program office that houses the fellowship program objected to the use of the word “action research” because it raised the red flag of experimental research. Second, one supervisor/mentor, who had been in the system for many years, tried to obstruct and stop my action research.

Constructing: Cycle 1 (What Is Leadership?)

According to Coghlan and Brannick (2010), constructing is a "dialogic activity in which the stakeholders of the project engage in *constructing* what the issues are" (p. 9). Constructing is a "collaborative venture" where the action researcher "engage[s] relevant others in the process of constructing and [does not act as] the expert who decides apart from others" (p. 9).

In this phase, a key activity was engaging in dialogue around the topic of leadership development among early-career scientists in the context of what makes an early-career scientist successful. I framed the conversation in this way because, based on my experience in co-managing the fellowship program, leadership is often confused with positional authority. For example, early-career scientists stated that leadership development training was not relevant for them, since they did not want to be the director of CGW or a leader of an organizational unit.

My AR team and I reflected on these themes from the small group meetings conducted in the pre-step phase, and began to reframe what leadership means in the context of the program: developing the capabilities to adapt. This is similar to the distinction that Fraser and Greenhalgh (2001) make between competency and capability. Competence is "…what individuals know or are able to do in terms of knowledge, skills, and attitude" (p. 799), whereas capability is the "…extent to which individuals can adapt to change, generate new knowledge, and continue to improve their performance" (p. 799). The authors emphasize that "…in today's complex world, we must educate not merely for competence, but for capability" (p. 799).

We start this cycle with two key insights from AR Cycle 1: (1) that leadership needs to be reframed to adaptive challenge, and (2) that engaging early-career scientists in leadership development requires some revisions. In this cycle, I focused on taking these two insights to the supervisor AR team (the supervisors).

In order to begin exploring leadership as adaptive challenge and make the needed revisions to how adult development theory is used to engage early-career scientists in leadership development, I decided to ask my action research team to help me in making those revisions. However, first they needed to experience the adult development approach so that they could make recommendations. Therefore, in the constructing phase in AR Cycle 1, my AR team and I began by exploring the adaptive challenges they saw their early-career scientists face, and how the adult development approach, with some modifications, may be used to explore and develop adaptive capabilities among early-career scientists.

To ensure that we were constructing the situation with "relevant others" (Coghlan & Brannick, 2010, p. 9), I also gathered the early-career scientists' perspectives on the challenges they were facing within 1-4 months of their entry into the organizational system and culture. Obtaining perspectives on the research questions from both the early-career scientists and their supervisors increased the outcome validity of this AR study. As Herr and Anderson indicate (2005), "Outcome validity also acknowledges the fact that rigorous AR, rather than simply solving a problem, forces the researcher to reframe the problem in a more complex way, often leading to a new set of questions or problems" (p. 55). The perspective of the early-career scientists on the adaptive challenges they faced helped to reframe the adaptive challenges that the supervisors had reported. This "ongoing reframing of problems leads to the spiraling dynamic that characterizes the process of most AR over a sustained period of inquiry" (p. 55). Additionally, from a research perspective, the triangulation of data on adaptive challenges from both groups contributed to the trustworthiness of this study's results (Merriam, 2009).

Another group I inquired with were the future supervisors and mentors of the 2012 class of early-career scientists. Ryan and I held an orientation meeting for them, and in that meeting I

raised the notion of challenges that early-career scientists face when they transition to CGW. After the meeting, I had some very rich informal conversations with seasoned supervisors about challenges that early-career scientists face. One supervisor said:

> Early-career scientists are often living in their heads…they have a difficulty with explaining and translating conceptual ideas to the everyday world…if early-career scientist cannot explain concepts they have lost it. This plays out how people perceive them. Like the brilliant mathematician that no one could understand...he turned off the working groups. (Supervisor, personal Conversation; December, 2011)

This quote is emblematic of the impact of scientists who are technically capable but lack capabilities to work effectively in an applied environment.

Planning Action: Cycle 1 (Inquiry with Early-career Scientists)

According to Coghlan and Brannick (2010), "planning action follows from the exploration of the context and purpose of the project, the constructing of the issue, and is consistent with that" (p. 9). The inquiry with supervisors around context and purpose outlined above generated data that successful early-career scientists are those who are able to adapt and communicate in the CGW culture. The first constructing inquiry with early-career scientists indicated that they are confused about what leadership means in the context of their fellowship. Based on these two data points, my AR team and I planned to act in two ways: (1) to inquire into how the incoming early-career scientists frame leadership and, (2) to offer an alternative way to look at what leadership means in the context that is relevant to their fellowship, namely, the capacity to adapt. Our rationale was that by inquiring into how early-career scientists frame

leadership from their experience, we can understand what kinds of shifts might be needed for them to begin to explore leadership from more up-to-date and practical perspectives.

Given that the AR team had very limited time to implement actions, they served more as a consultative group that I engaged with to coordinate on actions, share results of actions, and evaluate actions. At this stage, to increase my capacity, I engaged a subject matter expert on the CDAI approach to help me create a community of inquiry with both groups (the early-career scientists and my AR team). Her pseudonym for this report is Barbara.

Taking Action: Cycle 1 (Developmental Sessions)

In the taking action phase, the focus was on implementing the developmental approach to leadership training. Barbara and I designed two three -hour leadership framing sessions titled "Leadership in Action: Learning into Leadership" that occurred during the final week of the early-career scientists' two-week orientation training in late August 2011. The objective of these sessions was to pilot test the developmental approach as a way to develop early-career scientists' capabilities to act skillfully in adaptive situations. We also wanted to inquire into how early-career scientists make meaning of leadership.

There was some preparatory work as part of the leadership training. Four weeks prior to this session, early-career scientists were asked to write a two-page memo addressing a time when they took up their role as leaders, what support was helpful to them, and what they wished to accomplish in their fellowship program. Additionally, early-career scientists were asked to complete the Leadership Development Profile (LDP), a validated and reliable assessment of early-career scientists' meaning making capacity. We wanted to have a baseline for how early-career scientists tend to interpret situations, and thus how they take action in known and

unknown situations. This was relevant, given the data from supervisors stating that a successful early-career scientist is one who is able to adapt quickly. Meaning making is necessarily related to adaptation, since how we make meaning affects how we act (Cook-Greuter, 2004). Revisions in meaning making are related to successful adaptation (Cook-Greuter, 2004; Drago-Severson, 2009; Heifetz, et al., 2009; Kegan, 1982).

I invited the AR team to attend a three-hour session that would involve learning about the developmental approach and tools to support their early-career scientist in developing adaptive capabilities. The invitation included a request to complete the Leadership Development Profile (LDP) as their early-career scientists had done. The objective of the session was similar to the framing workshop with the early-career scientists: to introduce the developmental approach, to interpret the LDP, and to dialogue about the utility of this approach in providing supports and challenges for their early-career scientists' leadership development. The LDP instrument was disseminated to all of the supervisors and mentors who wished to attend. There were two supervisors who did not complete the profile because they were frustrated with the sentence completion instrument. Those who did not complete the LDP did not attend the workshop on the developmental approach where the LDP was debriefed.

I scheduled two workshops with my AR team to accommodate their schedules. Two supervisors attended the first workshop in October 2011 and seven attended the workshop in December 2011. The workshop began with me framing our engagement; then the CDAI subject matter expert provided an overview of the developmental approach for leadership, including an overview of the LDP.

An unexpected finding arose in AR Cycle 2. While the intention of the cycle was to further inquire into the adaptive challenges that early-career scientists face, what came up was

that the supervisors and mentors themselves face adaptive challenges in supporting the development of the early-career scientists. The challenges revealed included: (1) the confusion in roles between the assigned mentor and the assigned supervisor, (2) issues of scientific integrity when early-career scientists are being used to do analysis for the sole purpose of justifying past decisions, (3) the culture of the CGW, which forces supervisors to micro-manage early-career scientists, (4) keeping up with the fast pace of early-career scientists in order to complete the technical elements of projects, (5) conflict between supervisor and early-career scientist, (6) challenges to early-career scientists' knowing how to work at different levels of the system, and (7) the challenge of working in a system that trains one to have to know the answer, when in fact there is a lot of ambiguity in the health field. This challenge was expressed as how hard it is "to admit to an early-career scientist that I don't know" (Lauren, AR meeting, 2011). Remarks after the session included the following:

> I thought all was interesting. I particularly loved the tables you sent that indicate how best to work with individuals at each stage and to help them grow. This is a nice acknowledgement that: 1) not everyone is at the same stage; and 2) people need to master some developmental steps before they can take on others. With kids, the latter is obvious, but not as much with adults. (Elizabeth, October 2011)

> Taking time out of my schedule for an afternoon is not easy, but I am so glad I attended. (Bob, December 2011)

> It is rare to get the opportunity to talk openly with colleagues about how to best support our early-career scientists and get some helpful tools. (Elizabeth, October 2011)
>
> The Leadership Development Profile provided insights about me— I was surprised! (Lauren, December 2011)

These remarks demonstrate that the AR meetings were not only helpful for exploring the challenges early-career scientists faced but were also a source of learning and support for their supervisors and mentors.

Evaluating Action: Cycle 1

The memos, LDP, and observations from the session showed that early-career scientists are able to talk about the challenges they encounter in their fellowship. Evaluations from the leadership training sessions showed that, on average, early-career scientists rated the course as good or excellent. The most highly rated items on the evaluation related to the instructor (e.g., 3.85 on a four-point scale for the instructor's command of the subject matter and for the opportunity to apply/practice tools, methods, and concepts taught). The parts of the course that early-career scientists indicated as most useful/interesting were the discussions with peers, role-plays, and sharing experiences with others. Additionally, the tools for how to improve communication and resolve conflict were also reported as most useful.

Early-career scientists indicated that the session could be improved by allowing more time to work through concepts, providing articles before the class, decreasing the number of slides and lectures, and more interaction with others. Additionally, showing how the course applies to the assignment was another area recommended for improvement.

Based on the evaluation, observations, personal reflections, and reflections with my AR team, we concluded that, with an average rating of good to excellent on the leadership framing workshop, the developmental approach to increasing early-career scientists' capabilities to act skillfully in adaptive or unfamiliar situations was worth further exploring.

Additionally, we decided to follow up with early-career scientists informally within one month of the training to find out how they were applying the learning from the session, and what their biggest concern was within one month in their fellowship. Early-career scientists indicated that they were most concerned about getting a job after completing their fellowship. They would like more information about the nuances of getting a job at the CGW. Other early-career scientists indicated that they were not interested in staying at the CGW after completing their fellowship. Based on this conversation, my action research team and I decided to arrange for a short session on the topic of how to get a job at the CGW prior to the next leadership training. Additionally, the next leadership training would focus on how to develop adaptive capabilities that early-career scientists can use regardless of what job they get. This would address the needs of both the early-career scientists who want to stay at the CGW and those who did not.

Through inquiry with the supervisor and early-career scientist action inquiry groups, Research Question 1 was reframed to replace the word *leadership* with *adaptive challenge*, because the word leadership was causing confusion.

After the framing sessions, the early-career scientists began their fellowship and, thus, their work interactions with their supervisor, mentor, and other staff. During that time, I did not know whether early-career scientists were experiencing any technical, adaptive, or a mix of both types of challenges. I met with the early-career scientists for an informal lunch within one month of their fellowship to ask about whether any challenges were emerging. The majority of the

challenges mentioned were technical problems, such as the problem of getting appropriate software for their analyses or a problem with computers operating at sub-optimal speeds. I met with them again within three months and began to co-inquire with them, using the methodology of action inquiry to more deeply explore their challenges using first- and second-person inquiry practices such as the Four Parts of Speech, the Four Territories of Experience, and the Four Column Exercise (Drago-Severson, 2009; Heifetz, et al., 2009; Kegan & Lahey, 2009; Parks, 2005). These tools help early-career scientists gain greater self-awareness, use their speech to both inquire into and advocate for the unfolding situation, and uncover gaps between their intentions and actions. Through engagement of these tools it became apparent that early-career scientists were experiencing adaptive challenges. The challenges they shared three months into their fellowship were not purely technical, as they had indicated within the first month.

For example, the challenges they shared had to do with:

- confusion they were experiencing around their role: "They just don't know the role of the early-career scientist" (Early-career scientist 3)
- the power dynamics between one field of knowledge and another: "this hierarchy of knowledge is absurd" (Early-career scientist 1)
- their perceived lack of potential for impact as a function of their positionality: "[Yes, we may have unique knowledge], but it is hard for people to believe us because we are at a very low level" (Early-career scientist 4)
- the blindness to the needs of an early-career scientist: "…[my needs] are not on the agenda" (Early-career scientist 5) and, similarly,

- the insubstantiality of some of the projects they are assigned "…[another early-career scientist told me about] the struggle for early-career scientists to find projects that are interesting" (Early-career scientist 2)
- the ethical dimensions of their role: "…they [CGW programs who hire early-career scientists] want to use economics to justify their programs" (Early-career scientist 3), and
- the relationship between supervisor and early-career scientist, with the supervisor as an "over-protective parent" and the early-career scientist feeling as if she were a "petulant child" (Early-career scientist 1)

These challenges are "adaptive," because they are not solved with existing knowledge alone, by following a set of instructions (Drago-Severson, 2009; Kegan & Lahey, 2009; Torbert, 2004). Complex adaptive challenges can only be addressed by doing the adaptive work to learn new attitudes, beliefs, and behaviors (Heifetz et al., 2009). As described earlier, the action technologies used in this study are well-positioned to help early-career scientists develop new attitudes, beliefs, and behaviors.

The nature of the conversation with supervisors was remarkably candid. Reflecting on the 15 years that I have been working at the CGW, I have not experienced this level of openness in talking about work challenges.

After the session, the CDAI subject matter expert and I reflected on why it had gone so well, and we agreed that, while we would have appreciated the participation of more supervisors, the small group dialogue created a sense of safety and ease that enabled the participants to reveal their challenges. One participant remarked that, had there been, "six other supervisors looking at me" (Supervisor, December 2011) she would not have revealed what she did. Additionally, providing lunch created a relaxed atmosphere that connoted that this was not your usual training

experience. We noted the importance of framing these sessions in ways that were highly relevant to the participants. This initial session was framed from the perspective that all managers are required, in this political and economic climate, to substantiate the value of their programs. How do we help our early-career scientists become the next-generation scientist who can have a meaningful impact and bring value? In reflecting on past sessions with supervisors on leadership development, I noted that providing context before theory, and engaging in conversation versus a lecture, were changes we made, and these changes may have contributed to the positive response. Logistics such as sending the LDPs to the supervisors in advance of the session proved skillful because supervisors were ready with questions and remarks. Also, providing a simple agenda and demystifying leadership by defining it as the capabilities that early-career scientists need to act skillfully, seemed to work. Areas we noted that we could improve included decreasing the number of framing sessions around the developmental theory and approach. We decided to write a script and give a short introduction to overcome this tendency that we saw in ourselves to over-explain the approach. This cycle generated ideas for how to introduce the developmental approach in a scientific and bureaucratic organization. Most of the supervisors were willing to complete the LDP. They were willing to engage in a process of exploration, and with enough framing to make the work relevant to them, they fully engaged.

"I Would Have Let Him Go"

One day after the session on the developmental approach, I received a call from one of the AR members, Elizabeth, who is an experienced supervisor and mentor of early-career scientists. She indicated that the session had been helpful to her, specifically the view that people are at different stages of development and need different supports and challenges to grow.

Elizabeth especially appreciated the developmental tables (adapted from Drago-Severson) that I had supplied as a guide that showed the supports and challenges that could be offered to different learners at various stages. Together, the session and the tools helped her avoid firing an early-career-scientist:

> I hired an entry-level scientist and had great expectations. He is very new to the workforce. He was exhibiting behaviors that were aggravating me. I was thinking about firing him. But the session you offered and the paradigm of action logics took me out of a judgmental and angry mode. I recognized that different people at different stages need different things. The tables cut the work down for me; I place him as an Opportunist and offered him more direction. I see improvements already. Before I assumed they all came in at the same level…now I realize that part of my job as a supervisor is to understand where they are. Had it not been for that session, I would have let him go" (Elizabeth, personal Communication, February 2012).

Similarly, another AR member, who is a new supervisor of early-career scientists, sent me this email after the developmental session and our informal conversation, where we worked through her adaptive challenge in supervising her early-career scientist, Karen:

> **From**: Whitehorn, Lauren (CGW)
> **Sent**: Tuesday, May 01, 2012 01:11 PM
> **To**: Banerjee, Anyana
> **Subject**: Thank you!
>
> Anyana,
>
> I just had a really, really positive 1-on-1 meeting with Karen. She understood the "why" and "what" happened and realizes what we need to do next. She also apologized. We discussed and agreed on several changes. This will all work itself out. And, things will be much better from now on.

> Our conversation, leadership training tools, and the tools you sent yesterday really helped me in thinking about the situation, framing it, and balancing Lauren's skills and need for independence while being under CGW management. Your confidence in me as a leader was a life saver and all your advice and tools gave me the tools to better prepare me for today.
> I can't thank you enough for your support and guidance!!!
>
> Have a great week,
>
> Lauren PhD

These two incidents show that members of the AR team in supervisory roles, regardless of experience, benefitted from the developmental perspective and the tools offered in the session. This was an unexpected outcome, since the purpose of engaging the AR team was to help in generating ideas for helping the early-career scientists, which did occur. However, in addition to the original intention, what I found was that bringing people together also met a need for supervisors and mentors to develop their adaptive capabilities as well.

The experience of engaging the AR team in inquiry on the developmental approach showed that opening a space of inquiry where supervisors and mentors could self-reflect on their own challenges and action logics is needed.

Key Outcome: AR Cycle 1

Reframing Leadership as Adaptive Challenge

In the pre-step phase of AR, there were both listening and questions raised. The questions revolved around leadership among the two groups. The groups engaged the question of leadership from within the notion of adaptive challenges and the capabilities that identify such leadership. For example, during the first action inquiry sessions with early-career scientists, we

explored the essays they wrote on their experiences of leading, and what supports they received in those experiences that were helpful. We engaged in dialogue on the work challenges that they have struggled with in the past, and how AR might help us to uncover root causes and solutions to those challenges. We then ventured into the territory of leadership in the context of being a scientist. It became apparent that framing leadership as an adaptive capability was easier to conceptualize and thus explore. The word "leadership" was difficult for the two groups to understand, due to assumptions about what leadership means. As has been documented in the literature, this conceptual blockage is due to people confusing leadership with authority (Heifetz, et al., 2009; Parks, 2005). Based on data generated in the pre-step phase, where there were many dialogues on the challenges that early-career scientists face, a more palatable word that emerged instead of "leadership" was "adaptive challenge." Technical challenges are those where there is a clear problem and solution, and existing knowledge can be applied to generate a solution (Heifetz, et al., 2009; Parks, 2005). In adaptive challenges, neither the problem nor the solution are clear; thus, learning is required on the part of multiple stakeholders to generate a solution (Heifetz, et al., 2009). Research Question 1 was reframed from "What are the leadership challenges that early-career scientists face?" to "What are the adaptive challenges that early-career scientists face?" This reframing enabled both groups to engage in active dialogue on the adaptive challenges they face, instead of getting stuck conceptually on the word "leadership". Once leadership was reframed in Cycle 1, we engaged in inquiry around the adaptive challenges in Cycle 2.

Supervisors and Mentors Face Their Own Adaptive Challenges

A key outcome of AR Cycle 2 was the recognition that not only do early-career scientists face adaptive challenges, but their supervisors and mentors also face the adaptive challenge of *having to know* in a field that is ambiguous by its nature.

Organizational culture theorist Edgar H. Schein provides a detailed definition of organizational culture that is relevant to a dynamic that surfaced from listening to supervisors and is related to the pressure on supervisors to know. According to Schein (2004) , the culture of a group can be defined as:

> …a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct ways to perceive, think, and feel in relation to those problems. (p. 17)

CGW's culture is greatly influenced by how it became a leader in the health field, namely by responding to major health challenges with answers (CGW leader, group communication; August 2011). Within the context of a scientific culture with an emphasis on knowing all the answers with certainty, a group of supervisors acknowledged that their adaptive challenge is related to the pressure of knowing all the answers in a work context that is adaptive, that is, where often there are no clear answers to the problem or the solution at hand. As one supervisor indicated in the first AR meeting, "the challenge is keeping up with the early-career scientist and having to know" (Lauren, AR meeting; October, 2011). This is an example of the paradox of searching for certainty in the midst of ambiguity.

Action Research Cycle 2: Diving into Adaptive Challenges

In this cycle, we go deeper into the exploration of the adaptive challenges that early-career scientists face using case-based learning practice.

Constructing: Cycle 2

We start this cycle with the key insight from AR Cycle 1: Supervisors and mentors also face adaptive challenges in supporting early-career scientists. If mentors and supervisors form the holding container (Drago-Severson, 2009; Kegan, 1994) for early-career scientists, and they are facing adaptive challenges, what are the adaptive challenges that early-career scientists face? Additionally, insights from AR Cycle 1 indicated that early-career scientists needed a more applied approach to exploring adaptive challenges. Cycle 1 also revealed that leadership needed to be reframed in terms of what makes an early-career scientist effective, and that an effective early-career scientist, from the perspective of the supervisors interviewed, is one who is able to develop adaptive capabilities such as those articulated, including being able to "adapt to change, generate new knowledge, and continue to improve performance" (Fraser & Greenhalgh, 2001, p. 799). However, to this point no one had systematically asked early-career scientists what challenges they faced as they navigated their two-year journey. These questions are relevant because, if early-career scientists are well supported to achieve their goals and those of the organization, they are more likely to stay in the health field. This is aligned with the fundamental goal of the program to increase the number of early-career scientists in the health field.

In Cycle 2, my AR team and I learned from early-career scientists that they responded well to the developmental approach. Specifically, they were able to express their adaptive

challenges, and appeared to be open to exploring the supports and challenges they need in order to develop more complex ways of making meaning. I found that other intervention options considered, such as wholesale adoption of the Division of Leadership and Innovations' leadership program, were not considered viable.

Planning Action: Cycle 2

In the planning phase, there was a deeper exploration of the adaptive challenges early-career scientists and their supervisors face through action inquiry group sessions. I invited the early-career scientists to engage in case-based learning as a method to more deeply explore the adaptive challenges they experience and to begin to generate some themes.

Taking Action: Cycle 2

Early-career scientists wrote about their experiences of a current adaptive challenge. The goal was for the group to listen and offer perspectives about the case writer's challenge. Drago-Severson (2009) indicates, "this type of space for listening to alternative perspectives on and interpretations of events is designed to help the convener reconsider his or her thinking about and relationship to the events in the case" (p. 201). The early-career scientists reflected on their experiences at the conclusion of each case and began to revise their attitudes, beliefs, and behaviors.

Case-based Learning Protocol

Each early-career scientist submitted his or her case write-up electronically and it was reviewed by a CDAI expert. The expert offered questions within the case. Questions were intended to help each early-career scientist explore a different perspective, or highlight a way in which they were making meaning that perhaps was not helping them achieve alignment between

their intentions and their actions. I sent each case and the comments to each early-career scientist to review one week before they were scheduled to present their cases at the action inquiry session. During the action inquiry session, each early-career scientist had five minutes to summarize their case and ask for guidance around a particular question. Their peers, the CDAI subject matter expert, and I then verbally analyzed each case while the early-career scientist listened. The protocol was such that any early-career scientist who had just presented their case could not intervene in the case analysis, and this was meant to teach them and other case writers to listen and take a more reflective stance while peers reviewed their case. In the middle of the case analysis, the presenter of the case was invited to offer any clarifying comments or direction to the group about what issues to focus on. At the end of the case, the presenter was invited back to the dialogue to offer reflections on their learning.

The preliminary themes that emerged early on in this phase with the two groups related to the freedom and constraints that each group wished to exercise in getting the work done. For example, in one situation, the early-career scientist wanted more freedom and ownership in completing a project, whereas the supervisor wanted to exert more oversight and control. This dynamic generated an adaptive challenge, because both the supervisor and the early-career scientist require the capability to learn how to work together under seemingly contradictory ways of accomplishing their work goals. At the conclusion of the constructing phase, key themes emerged to describe the adaptive challenges that early-career scientists and their supervisors face.

The case-based learning method illustrated some of the types of adaptive challenges that the early-career scientists faced and the types of learning and adaptations they used to meet those challenges. Each of the case-based learning dialogues offered opportunities for the early-career

scientist to consider revisions or reframes regarding how they were interpreting and taking action in the midst of their adaptive challenge.

Through case-based learning in conjunction with CDAI methods, early-career scientists learned new ways to navigate through their adaptive challenges (e.g., reframing their perspectives, observing the dynamics of their new work culture, and inquiring and engaging with others on the basis of a common understanding of the work).

Evaluating Action: Cycle 2

The dynamics of the early-career scientist action inquiry group shifted when we moved from framing leadership in the context of adaptive challenges to engaging in collegial inquiry or case-based learning around the early-career scientist's current adaptive challenges.

There were positive comments regarding the use of case-based learning, but there was also reluctance to continue to use cases to learn about adaptive challenges. For example, positive comments about the use of cases indicated that early-career scientists appreciated the opportunity to talk about the specific challenges they were encountering. As Richard indicated, "I like the real-life stories" (Richard, group communication; January, 2012). For another early-career scientist, case-based learning allowed him to "voice my frustration with my workstation problem" (Richard, group communication; January 19, 2012), and for another the process of case-based learning acted as a "decompression valve" (Karen, group communication; January, 2012), because it enabled her to talk about her personal experience confidentially. The feedback from her peers and the facilitator, allowed her to put her challenges into context. A very poignant comment came from Karen, who said case-based learning was helping her develop her leadership capability:

> Yeah. And then thinking about the value of this in the context of the fellowship. If there's an exclusive emphasis on technical skills, you'll end up with people who are very technically competent, who—if the entire emphasis is to make leaders out of the early-career scientists and sort of the scientific cohort here, this (case-based learning) is moving in that direction, more so than repeated methods sections that don't give early-career scientists a chance to talk about the experiences and frustrations they're having. (Karen, group communication; January 19, 2012)

This comment is consistent with the literature indicating that case-based learning is "an effective way to support adult learning and development [and]…helps adults to make sense of and manage adaptive challenges" (Drago-Severson, 2009, p. 8).

Despite the positive comments, there was some reluctance to continue to use case-based learning, as expressed by one particular early-career scientist during the evaluation session: "I'm worried that if we do an incident every month, we'll run out of incidents" (Shawn, group communication; January, 2012). When I requested that early-career scientists volunteer to write another case for the next action inquiry session, no one volunteered. When I picked three volunteers, only one person accepted the offer. This was a signal to me that the early-career scientists were losing interest in writing cases, and I needed to engage them on their adaptive challenges using a different methodology. I also had an intuition, based on past experience with three other cohorts of early-career scientists, that the early-career scientists did not have numerous leadership challenges to talk about. Either the work that early-career scientists are asked to do does not typically challenge them beyond the technical/instrumental, or they may not yet be aware that they are grappling with adaptive challenge, so they do not have the language or

context to talk about multiple examples. Perhaps this is why they did not want to continue to write cases. I looked forward to interviewing early-career scientists so that I could check this assumption.

Overall, I saw a shift in the engagement of the early-career scientist inquiry groups when we moved from talking about adaptive challenges to engaging more deeply through case-based learning around their own challenges.

Evaluating Data with the AR Team

The next action I took was to share this data with the AR team so that we could evaluate it together. We reviewed the personally de-identified adaptive challenges that the early-career scientists wrote about. I facilitated a conversation and brought in the CDAI subject matter expert to help us make meaning of the adaptive challenges and come up with recommendations and next steps. Following is a comprehensive list of recommendations offered by the AR team. I was impressed that the recommendations were primarily about how the supervisors and mentors can adapt to creating better learning conditions to support early-career scientists through adaptive challenges. For example, a key recommendation was adaptive challenge training for the supervisors and mentors. This training is one that raises awareness of the notion of adaptive challenge and begins to explore how supervisors, mentors, and early-career scientists can begin developing adaptive capabilities. What follows is the list of recommendations:

- **Clarify Expectations:** Some of the challenges may be due to unclear expectations or understanding of the CGW culture. Set up expectations and acculturate early-career scientists early on, even during the interview. For example, develop a “Culture

Shock" pamphlet to introduce early-career scientists to CGW culture (e.g., CGW's internal review process, the early-career scientist is not a free agent, etc.)

- **Frame Approach:** Depending on the context, a tighter or looser style of leadership and management may be needed. Supervisors may need help in learning how to frame for the early-career scientist the approach they are taking based on context. Early-career scientists may need help reading the signals. For example, a tighter style when framed in context may be understood better by the early-career scientist.
- **Fluidity in Roles:** The supervisor and mentor change based on the project. The approach of assigning one supervisor or one mentor for the entire two-year fellowship is no longer appropriate given the changing context of projects. It is more realistic now to think of supervisory and mentoring elements that various people in the branch take up based on the project. The goal is to ensure that important supervisory and mentoring elements are covered for each project.
- **Clarify Roles:** The supervisory and mentoring team should meet before the early-career scientist arrives to clarify the roles and responsibilities by project.
- **Supervisor and Mentor Training:** Orient new supervisors and mentors to the challenges emerging from action inquiry sessions with early-career scientists (as shown in the tables). Hold multiple dates for the training and make it a requirement for all supervisors.
- **Establishing a Mentor for New Supervisors:** First-time supervisors may need a mentor who is separate from the early-career scientist supervisor or mentor.

- **Fresh Perspective:** Long-time supervisors and mentors may need to take a fresh perspective on what it means to supervise and mentor an early-career scientist in this day and age. For example: an early-career scientist is not a research assistant.
- **CGW Culture Has Interdependent Impacts:** When the Division micro-manages, this impacts supervisors, which then affects how early-career scientists are supervised.
- **Quid Pro Quo Model:** Encourage collaboration by implementing a model where money is transferred to the branch or division providing technical support.

The recommendation from the AR team that was most timely was designing, developing, and implementing the adaptive challenge training for supervisors and mentors. Within six months, the training was implemented with the next group of supervisors and mentors. The recommendation for a new kind of training (on adaptive challenges) and the feedback from the pilot session demonstrated that there is a need to convene people to dialogue about adaptive challenges. Feedback from the session included a request to have more frequent adaptive challenge training and to include the triad comprising the supervisor, mentor, and early-career scientists. A follow-up with this triad would offer all participants the context to engage in a conversation together on what adaptive challenges were emerging and how to work together to work through them.

The AR session in Cycle 2 ended with an informal sharing of impressions in response to seeing the list of adaptive challenges that early-career scientists reported on. The supervisors and mentors shared the following impressions about the action inquiry sessions:

> The action inquiry sessions are empowering early-career scientists to raise issues they would not have otherwise raised…the comfort zone for early-career

> scientists is to go inward…they need practice reaching out. (Jason, Personal communication; March, 2012)

One supervisor offered these comments to the Chief of the program as a sidebar comment in a phone conversation:

> They're [the action inquiry sessions] great…people are so skeptical about this kind of training. (Comments offered by Elizabeth to Ryan, personal communication with Ryan; March, 2012)

Additionally, Ryan indicated that supervisors, even very senior supervisors, were learning from the action inquiry sessions: "I think Elizabeth is learning a lot from [hearing what goes on in] the action inquiry sessions." (Ryan, personal communication; March, 2012)

Key Outcome of AR Cycle 2

Early-Career Scientists Do Face Adaptive Challenges

Case-based learning helped to increase awareness of adaptive challenges among the early-career scientists and the ways in which they met those challenges. What we learned was that, in the context of the CDAI method, these early-career scientists are able to try new ways of approaching complex adaptive challenges by observing each other's behavior, inquiring into their own frames of reference and how they interpret the challenges they face, and how they engage with such challenges to create effective pathways for change.

Adaptive Leadership Training for Supervisors

The data on adaptive challenges reported by early-career scientists was shared with the supervisor action inquiry group. A recommendation by the supervisors was to offer mandatory

training to all PE supervisors and mentors, and part of the training should clarify roles (the technical element of challenge) as well as raise awareness of the adaptive elements of the supervisor-early-career scientist relationship. Both trainings were developed and implemented in August/September 2012 as the new supervisors and mentors prepared to welcome the 2012 class of early-career scientists, the largest class in the last 10 years of the fellowship program. Evaluations of the trainings indicated that supervisors and mentors benefitted from the training and would like these trainings to occur more often.

Cycle 2 ended with a greater awareness of the adaptive challenges that early-career scientists face, and willingness by the AR team to support early-career scientists in becoming more adaptive. The next, and final AR cycle in this study, is the most profound of this journey, in that early-career scientists voluntarily selected a real-time adaptive challenge to explore collectively, one with learning impacts at the individual, group, and organizational system levels.

Action Research Cycle 3: Practicing Adaptive Leadership

Constructing: Cycle 3

We started this cycle with the key insight from AR Cycle 2 that early-career scientists do experience adaptive challenges. In this cycle, I focused on how the AR team and I could engage the early-career scientists in deeper learning around leadership adaptive challenges. What was the next process that would enable us to go deeper?

The case-based learning intervention was effective in raising and making meaning around the adaptive challenges that early-career scientists experienced individually. Adaptive challenges are solved with people from various perspectives (Heifetz, et al., 2009), and since there was such a diversity among the early-career scientists, it seemed like a natural next step to explore an adaptive challenge together. After exploring the various models for leadership development, the members of my AR team and I decided to engage the early-career scientists in action learning, which is considered to be "one of the newer models of leadership development that has gained growing popularity in North America" (Raelin, 2006, p. 152). We concluded that, since the core characteristic of early-career scientist programs at WDO is learning through on-the-job experience, action learning would be ideal because it is "a method to generate learning from human interaction occurring as learners engage in real-time work problems" (p. 152). True to the AR methods, this step was collaborative rather than dependent upon the researcher as "the expert who decides apart from others" (Coghlan & Brannick, 2010, p. 9). At the conclusion of the planning action phase, we (the AR team) decided to invite early-career scientists to explore the idea of an action learning project.

Action learning, as described earlier in the action technology meta-framework for this study, has been documented as effective for transformative learning, because action learning:

> …incorporates working on projects of major consequence, teaming with personnel from other functions, receiving continuous feedback on performance and behavior, reflecting on assumptions of current mental models, and having the opportunity to attempt new approaches. (Johnson, 2008, p. 88)

Furthermore, action learning has been documented as an effective adult learning approach for the development of complex skills such as leadership (O'Neil & Marsick, 2007).

I facilitated an action inquiry session focused on inviting early-career scientists to engage in action learning—i.e., a group leadership project. The parameters I gave the group were the following: the project had to (1) be personally challenging, (2) challenge the group to work collaboratively, and (3) offer the CGW system something of benefit. After the group went through a period of brainstorming and "groaning" (Kaner, 2007, p. 307), with the help of the CDAI subject matter expert and me, they were able to coalesce around one project: to conceptualize, design, and implement the first ever CGW Scientific Conference.

The action inquiry groups engaged in action learning as the next intervention in this AR study. The early-career scientists selected as their project the conceptualizing and implementing of the first CGW scientific conference. The objective of the conference, which early-career scientists determined collaboratively, was to promote interactions between scientists and non-scientists, and highlight how scientific research impacts population health by informing policy decisions. This project represented a need in the organization, and challenged the early-career scientists' adaptive leadership capabilities on a group and individual level. Organizational necessity and a project of consequence are important attributes of action learning projects (Johnson, 2008).

Planning Action: Cycle 3

Two action inquiry sessions in March and April 2011 were dedicated to group work around planning the CGW Scientific Conference.

When the early-career scientists collectively selected and committed to an action learning project, a change in group dynamic occurred immediately. Whereas, before the group project, early-career scientists dispersed after the action inquiry sessions, I noticed that after the selection of the project the early-career scientists immediately gathered together outside of the room. Email communications regarding their project began within one hour of the session and communications continued with energy and enthusiasm over the next five months. Whereas, before the group project, I received little feedback from early-career scientists on the content of subsequent inquiry sessions, early-career scientists now began engaging me before the sessions to ask for specific skill-building help, such as decision-making in groups and project management, relevant to the current challenge they were facing in the project process. A change in my role occurred as well. I was now more of a resource person who provided input as needed and held the space of the group's process interactions.

Intermingling of Groups

I convened the AR Team and the early-career scientists together. The intention of the first part of the meeting was for the AR team to offer advice to early-career scientists regarding their leadership project. During the second part of the meeting, I facilitated a dialogue where we further named the adaptive challenges we face in developing early-career scientists. We ended the meeting with the task of observing and examining the adaptive challenges that would emerge

within us and in our early-career scientists, noting any experiments that would help the early-career scientists apply their knowledge in new ways.

Feedback on the Leadership Project

The AR team, with my help and that of the CDAI subject matter expert, practiced offering supportive and challenging feedback to early-career scientists regarding their leadership project. Three early-career scientists introduced their 2011 leadership project: designing and implementing the CGW scientific conference. This project was an adaptive leadership project, in that they were applying their knowledge in new ways to generate individual, group, and potentially agency-level impacts. Early-career scientists provided a summary of their team's goals, roles, and shared planning documents, such as a draft marketing flyer, a conference booklet, and agenda. Early-career scientists asked for feedback, and we engaged in a dialogue where we were able to support them in the following ways:

The AR team offered genuine encouragement and indicated that the project was a good idea. The AR team made recommendations regarding how to increase attendance by: (1) the strategic move of engaging the "top brass" for input, (2) offering connections with good speakers on high-profile health field topics, and (3) showing how a change in the name of the conference could generate more attendance (e.g., adding disease modeling).

We (the AR team) was able to challenge early-career scientists' thinking in the following ways: (1) asking them to clarify their goals: Who are you targeting? What do you want the audience to leave with? (2) helping them understand the social/political context that would influence the successful implementation of their project, and (3) assisting in their reframing of what they could offer in addition to talks, for example, hands-on basic training for non-scientists.

One concern that arose was whether the action-learning project was taking up too much of the early-career scientists' time. We discussed the fact that the early-career scientists were dividing up the work, and that this project was building the underlying capabilities they would need to be successful. I asked the AR team in person and in email whether there were any other concerns that had not come up that anyone would like to raise. The AR team was content to continue to support the early-career scientists.

Early-career scientists received feedback from supervisors on their action learning project. This interaction of groups generated new ideas about how to increase the visibility of the conference and the early-career scientists' work. According to Complexity Leadership Theory "leadership can be emergent from the interaction and correlation of individuals and groups, then developing leadership capacity might include enhancing interactive dynamics within organizations" (Uhl-Bien & Marion, 2008, p. 333). Whereas before the action learning project, I met with the supervisors and early-career scientists separately and was the central point in the cross-fertilization of ideas (Figure 7), with the engagement of the action learning project, the supervisors and early-career scientists began to interact directly (Figure 8). This interaction resulted in the sharing of ideas from early-career scientist to supervisor and vice versa.

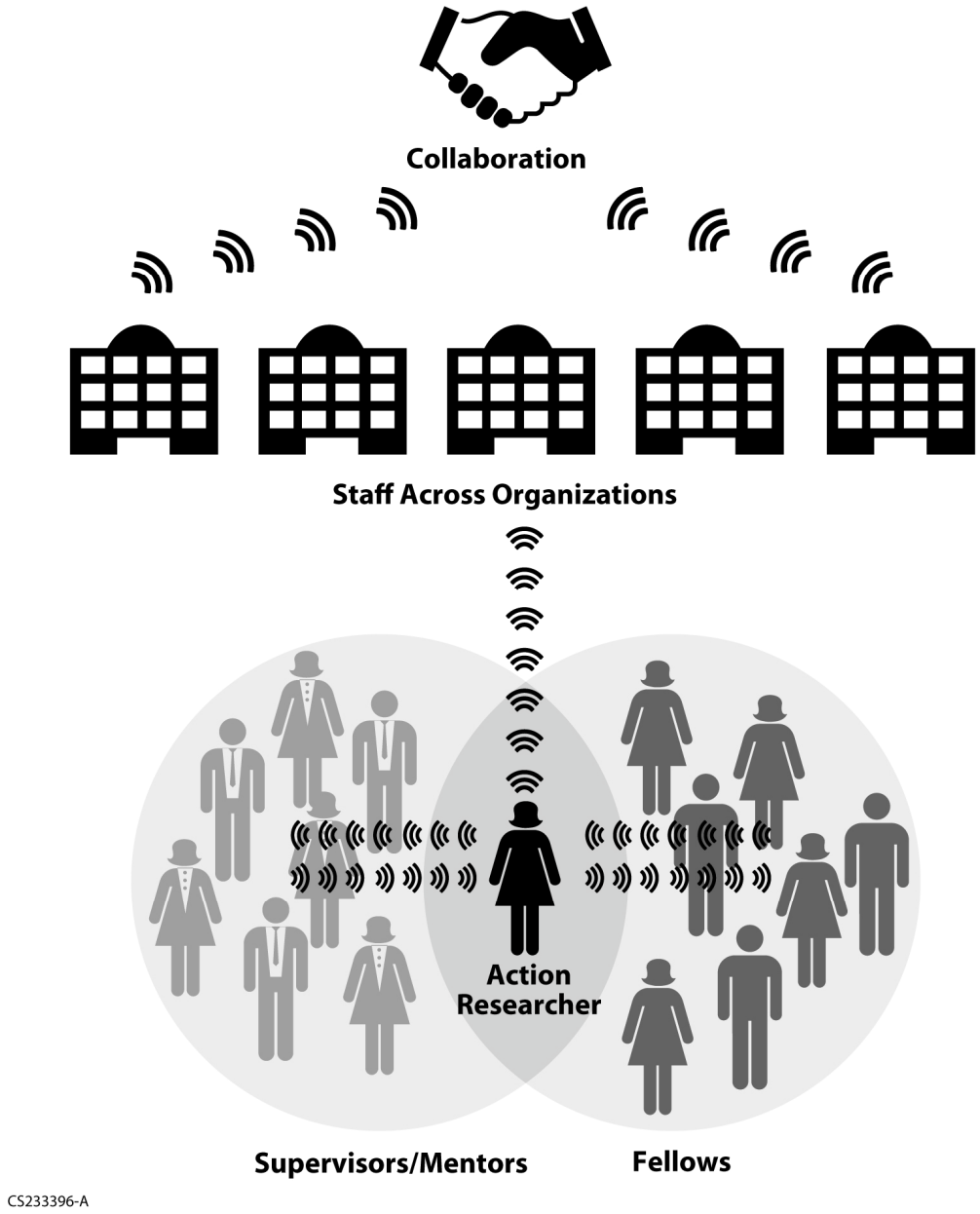

Figure 7. Dynamic interactions - two

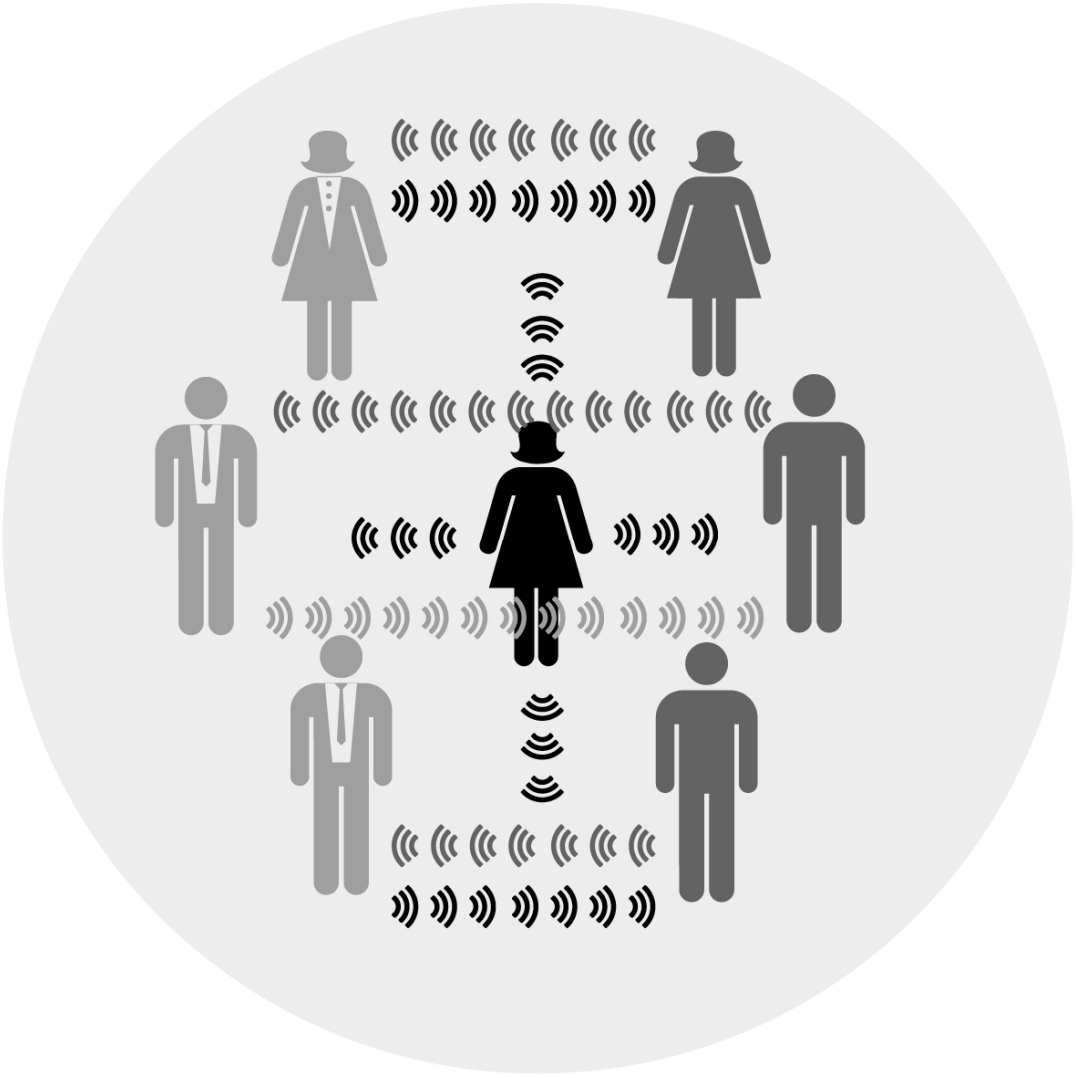

Figure 8. Dynamic interactions - three

Adding to the list of adaptive challenges

During the second meeting, I facilitated a dialogue on the adaptive challenges that the AR team has seen early-career scientists face. Here is the list we came up with:

1) Ownership and authority: Facing and overcoming their egos:
    a) Help them value work on behalf of the agency
2) View of second-class citizens: Facing and overcoming egos of non-scientists:

a) Help them by supporting them in reinterpretation of context (e.g., prior to a meeting, help them see that different personality types are not to be taken personally). We called these socializing skills
b) Help them by reframing: They are a small powerful group that is agile (guerilla army) vs. second-class citizens

3) Finding their voice:
   a) Help early-career scientists have a strong voice within a bureaucracy
4) Supervisor/Mentor and program disagreements on what work/learning is valuable

I ended the meeting by asking the AR team to (1) observe and examine the adaptive challenges that would come up over the next two months, (2) make note of them and try out some of the experiments we talked about, or try their own. What seemed to work? What did not? and to (3) explore the book we offered titled, "Presence-Based Coaching: Cultivating Self-Generative Leaders Through Mind, Body, and Heart" written by Doug Silsbee. What was helpful?

Taking Action: Cycle 3

Emergent adaptive challenges were those that arose as the early-career scientists engaged in their action learning project of conceptualizing, designing, and implementing the first CGW economics conference. This action learning project brought out the challenge of boundary spanning, "the collaboration across professional and organizational groups and the delicate balance of multiple and at times conflicting goals" (Heifetz, et al., 2009). To design a conference that generated attendance, early-career scientists worked across the organization with groups that they would typically not come into contact with. In the context of boundary spanning, an

adaptive challenge arose that was aligned with the adaptive challenge archetype of the gap between espoused values and behavior.

Adaptive Challenge: Boundary Spanning and Politics

The first adaptive challenge that emerged in the action learning project was connected with boundary spanning and who would be the organizational sponsor for the project. The process of determining the organizational sponsor was made complex in the context of contradictions in the organizational culture. One contradiction was that the early-career scientists were told, "CGW is your oyster; take advantage of all the opportunities you have" (Program manager, group communication; January 2012). However, as early-career scientists attempted to work across organizational boundaries to solicit feedback and support from stakeholders, those who, on a surface level, behaved as allies turned out to be antagonists. For example, key individuals had initially offered support and encouragement. Later these individuals acted in un-collaborative ways by communicating to other stakeholders that early-career scientists were not following direction when in fact they were. This generated a lack of trust and increased vigilance on the part of the early-career scientists. A gap between espoused values and behavior occurs when people's or organizations' behavior is different from their stated values and beliefs. In this case, the organizational espoused value was collaboration, but the behavior was one of criticizing group work. The adaptive leadership literature sheds light on why this gap may occur in the context of boundary spanning.

In many organizations, particularly often in large professional services firms, there is a gap between the organization's espoused values and its actual behavior when senior authorities advocate collaborative behavior but reward individual performance. Operating across boundaries

to break down the silos will not be achieved just by telling people at staff meetings that they should do it. Closing the gap is a difficult adaptive challenge, because people in the organization have been successful through their patterns of behavior and will want to continue to do what earned them success, especially when they are still recognized and rewarded for doing so (Heifetz, et al., 2009, p. 79).

One lesson from implementing action learning in CGW was to identify and implement incentives for key collaborators to engage in and be rewarded for engaging in action learning. This aligns the incentives so that those who are investing their effort in helping early-career scientists develop adaptive capabilities are rewarded.

When the early-career scientists began to work on their action learning group project, they were encouraged to be collaborative. Early-career scientists presented their project plan to the supervisor action inquiry group. The supervisors strongly encouraged early-career scientists to engage with high-level leaders across the agency to gather input on the design. For example, one supervisor expressed this as engaging "the top brass" (S4, group communication; May, 2012) across the agency in order to ensure their engagement, and thus high conference attendance:

> I would start with the top brass at CGW. I think Leader A is the CGC lead on healthcare reform. Would be a good place to start. Then Leader B and Leader C and Leader D. I think those four people would be the key ones to try to seek input. And I wouldn't just present them with a fait accompli, say, "Okay. Here's the program. We'd like you to show up." Ask them for their input into the program, what they would like to see. (Bob, group communication; May, 2012)

The early-career scientists followed the supervisors' advice, which included finding connectors, such as alumni of the fellowship who are networked, and who can introduce early-career scientists to the high level leaders. As the early-career scientists started to engage with prior alums of the QSFP (the scientific early-career scientist program) who would understand the concept of the conference and help provide input as well as connect them to the top brass, an important adaptive challenge emerged—the challenge of working across organizational boundaries from the position of being an early-career scientist in a bureaucracy. According to organizational theorist Gareth Morgan (2006), "organizations that are designed and operated as if they were machines are now usually called bureaucracies" (p. 13). Like machines, the organizational structure in a bureaucracy is set up "to operate as precisely as possible through patterns of authority, for example, in terms of job responsibilities and the right to give orders and to exact obedience" (p. 21). In CGW, the job responsibility of the early-career scientist, in theory, is to learn and contribute to the organizational unit that they are assigned to. To the authority figures in the system, the early-career scientist is considered a follower. The implications of this set-up in a bureaucracy, where there are clear lines of authority and responsibility, is that the authority figure is the leader and the early-career scientist is the follower. In the context of this adaptive challenge, the early-career scientists, with the support they received in the action inquiry sessions, began to practice adaptive leadership. Early-career scientists challenged the expectations of their role in the system by enacting their leadership, where leadership consisted of mobilizing people and resources to implement their action learning project. Heifetz and colleagues (2009) describe the dynamic that emerges when one enacts adaptive leadership: "When you exercise adaptive leadership, your authorizers will push back…you are challenging the status quo…pointing out contradictions between what people *say*

they value and what they *actually* value" (p. 26). Among early-career scientists, ambiguity arises in the gap between stakeholders' espoused values and their behavior, and this ambiguity is manifested as uncertainty with how to move forward. Managing the ambiguity in adaptive challenges involves maintaining an "experimental mind: you try things out, see what happens, and make changes accordingly" (p. 36). In the next early-career scientist action inquiry session, I proposed that we take time to reflect on the learning from this adaptive challenge and encourage early-career scientists to invoke their experimental mindset. In reviewing the literature on action learning as a vehicle for leadership development, engaging the early-career scientists in the process through inquiry and reflection (O'Neil & Marsick, 2007) helped facilitate learning from experience. For example, the action inquiry sessions with early-career scientists helped them to become more aware and work through the adaptive challenges, for example, hearing multiple perspectives and reframing their strategies to move the project forward.

Evaluating Action: Cycle 3

I held two final meetings to evaluate the entire action research experience with my AR team and the group of early-career scientists. During these meetings I gathered perspectives on the entire leadership development process, learning, and recommendations for improvement.

This concludes the detailed description of the three AR cycles in this study. The detail describes all of the careful action on behalf of multiple people that took place to create a community of inquiry to explore an unexplored phenomenon. The first cycle involved framing the relevance of leadership development. This process of framing involved listening to multiple stakeholders, and was the beginning of creating a sense of cohesion and community among both the AR team and the early-career scientists. A key outcome of AR Cycle 1 was the need to

reframe leadership to adaptive challenge in order to engage the groups. The second cycle involved a deep exploration of the adaptive challenges faced by early-career scientists. In sharing the data on adaptive challenges that emerged from case-based learning, we discovered that supervisors and mentors also face adaptive challenges in creating learning conditions for early-career scientists. With a poignant awareness of the adaptive challenges faced by both groups, we entered AR Cycle 3.

The real test of the third-person (impacts on the system) data is whether anything changed in the organizational system. AR Cycle 3 itself serves as the data that show the impact, because in this cycle the early-career scientists took on and completed a remarkable leadership project that challenged them and the organizational system in creating pathways for collaboration, communication, and impact. The early-career scientists conceptualized and designed the first ever CGW Scientific Conference. The objective of the conference was to promote interactions between scientists of various disciplines and highlight how scientific research impacts health by informing policy decisions. Two hundred forty individuals (205 internal and 35 external) registered for the conference via an on-line registration site and approximately 200 individuals attended the conference. Attendance was 300% greater than they had targeted and attendees ranged from people at all levels of the organization. The Forum consisted of a keynote address, presentation of the Scientific Research Award, a panel discussion, breakout presentations, and poster presentations. The Forum was opened by the most senior scientific authority in the organization. The following were some of the testimonials offered:

I was at the opening talk on Friday. Thought it was a fabulous talk. (E)ntire program was great. (T)alk was relevant for almost everyone interested in where health care is going". (Senior Advisor to the Director, CGW; October 2012)

Great scientific conference last week! (Scientist, CGW; October 2012)

Kudos to the second year of early-career scientists, who did a fabulous job organizing the first-ever CGW Scientific Conference this past Friday. We had a great turnout with over 200 people in attendance. We heard inspiring talks in the morning and informative technical presentations in the afternoon". (Senior-Career Scientist, CGW; October, 2012)

You should have one of these meetings every year or every other year. This is very nice. Key note speaker, October 2012)

Organizing a conference is a complicated project. What makes this project remarkable is the context in which the conference was implemented and by whom. A project of this scope and complexity had never been completed by a group of early-career scientists at CGW.

As with any journey of challenge and new learning, there were obstacles to ensuring that this AR study survived and thrived. I think it is important to be brutally honest about these challenges so that we can be aware that they exist. When we meet them, we can be less surprised and garner our inner and outer resources to face them. In the next chapter, I outline the key obstacles I faced, especially in ensuring that this study continued after the contracting phase.\

The Dark Forces: Stakeholder Management

At the outset of this chapter, I described the process of implementing the AR study. The objective of this section is to describe the stakeholder management issues that arose in the course of AR implementation. I separate them here from the core AR story to highlight them as what gets in the way of good learning and development. In Cycle 1, I encountered a key stakeholder who attempted to completely stop this research. In Cycle 2, I encountered stakeholders who served as obstructors in a different way. They served as gatekeepers for others with an interest in leadership development and tried to indicate that this research should be done somewhere else. Finally, I encountered stakeholders who inspired an environment of fear because of the inherent uncertainty involved in exploring the phenomenon of leadership among early-career scientists. There was no way to predict what would happen and, in this context, the fearful stakeholders increased their efforts. I outline the stakeholder management issues chronologically by AR cycle below.

Cycle 1: The Obstructors

In AR Cycle 1, the politics of my action research began to emerge.

Not all experiences of engaging with supervisors were positive. In late September 2011, after I had sent the invitation to supervisors and mentors to learn more about the possibility of engaging as an action research team, one particular supervisor, Leonard Weinstein, reacted unprofessionally and began engaging in actions to obstruct my action research. For example, in response to the e-mail invitation, Leonard communicated to all of the supervisors indicating that he thought the action research effort was a waste of time. I emailed him and asked if he had five minutes the following week, because I would like to hear more about his perspective. He

responded favorably, and even sent me a Microsoft Outlook invitation scheduling the meeting. At the outset of the meeting, Leonard made a sexist remark. I was so shocked that I did not know what to do: I just ignored it and went on to state the purpose of the meeting: for me to hear more about Leonard's point of view on leadership development of early-career scientists. The meeting did not go well. Leonard made disparaging remarks about colleges of education and my methodology. For example, he said that colleges of education were not rigorous enough, and he referred to the action inquiry groups as "bullshit groups." When I tried to advocate for myself, Leonard interrupted me and made other disparaging remarks that tended to focus on his privileging of the positivist scientific methodology over the constructivist qualitative approach that I was taking.

After the meeting, at the advice of my major professor, I began to take a systems approach to seek advice on how to address Leonard's unprofessional remarks. I spoke with my mentor within my organization, a counselor for employees, a trusted colleague, and an Ed.D cohort friend. I decided to file my complaint anonymously so that it would be documented in the system, and in case recurrence I could refer to a pattern. My experience in making a complaint was very stressful. Even as I write this formally in this report months after the incident, I still feel my throat tighten. I requested that the complaint be anonymous, and that neither Leonard nor anyone else be notified. As I indicated, I just wanted the incident documented in case of recurrence. However, the employee relations counselor did not listen to me, but spent about five minutes frantically outlining all the ways in which Leonard would be engaged and notified. I was surprised at how little capacity she had to actually engage in a conversation about a difficult event. There was little listening, empathy, or helpful advice. I felt uncomfortable that the complaint would be communicated to Leonard, so I withdrew the complaint.

A second way that I informed the system of what had occurred was by talking with my supervisor. He was empathetic and made a note of the event. I also called Leonard three days after the incident and gave him feedback on why his behavior had been unprofessional. I requested that, if we were to continue to work together, he treat me professionally. Leonard reacted with anger and aggression. For the subsequent two months he began to engage in actions to obstruct my research by raising doubts among my network of stakeholders and among the participants in my action research. Leonard, who supervises and mentors several early-career scientists, used the following strategies to attempt to: (1) raise doubts in the mind of the Associate Director of Science, who approves research in the division where Leonard works, suggesting that my research was causing an undue burden on supervisors, (2), convince the program director that supervisors could stop my research, (3), instill fear in the early-career scientist he supervises so that they would not attend my action inquiry sessions, and (4) convene meetings with his allies to raise further doubts about my methodology. My approach was to engage in various conversations with stakeholders at multiple levels in the hierarchy of my organization to clarify the intention and value of my research. In this way I hoped these stakeholders would convert them into my allies in the event Leonard tried to raise doubts among them. Additionally, I refused to attend any meetings that Leonard attempted to convene. I provided advice to my supervisor about how to respond to Leonard's attempts to pressure my supervisor to attend meetings. In the end these meetings were canceled because it became clear that they served no genuine purpose. Over time, Leonard's attempts to obstruct my research decreased in frequency and ultimately stopped.

From this experience I learned about the mutability of stakeholder support. Two years earlier, when I began to engage supervisors and mentors in the idea of doing action research,

Leonard had expressed support and even enthusiasm. Then when he heard that I would be engaging early-career scientists about their experience of the fellowship, he reacted very aggressively. While it was challenging to work with the intensity of his reaction, I slowly began to learn how to see his reactions as data. His negative reaction signified that my action research was already having an impact; it was already opening up conversations about the fellowship that had never taken place before and that Leonard might find threatening. The action research methodology of engaging stakeholders in co-inquiry and co-action is a threat to those who like the way the system currently operates.

Ryan also began to exhibit behaviors that undermined my action research work. In the middle of the second action inquiry session, he came into the room and asked me to address some non-urgent budget-related questions. My official role in the unit is managing the finances of the branch; however, at the time I was facilitating an action inquiry session that Ryan had agreed would be part of the early-career scientists' competency-based curriculum, and it was inconsiderate of him to interrupt my work. I followed up with him after the meeting to ask why he had felt it necessary to pull me out in the middle of a session. His response was "Nothing is sacred" (Ryan, personal Communication, August, 2011), and that next time I should suggest to him that "this can wait" (Ryan, personal Communication; August, 2011).

Additionally, in AR Cycle 1, Ryan began to pressure me about the outcomes and metrics of the action research. He wanted positivist, quantitative outcomes for a qualitative action research study. He suggested that I come up with metrics on leadership development and track whether they were being developed. "See if they get it," he said, adding that it was "critical to get best practices" and "keep a tally of time." In tandem with this, he began to ask for my time in other areas where I had no interest or expertise, such as getting involved in technical workshops.

The pressure to produce impacts and outcomes before the study could generate outcomes, and inserting activities that were irrelevant, was a force that could have caused me to buckle under the stress. My approach was to educate Ryan on the process and outcomes of action research, and to point to the outcomes that were already emerging.

Cycle 2: The Gatekeepers

During Cycle 2, there was a reorganization of the business units within my site, resulting in the creation of two divisions: the Division of Scientific Fellowships and the Division of Leadership and Innovation. The implication of this reorganization was that there was a new director of the Division of Scientific Fellowships, Josh. After some casual conversations with Josh, it was clear that he came from the perspective that leadership is synonymous with positional authority. Therefore, I had my work cut out for me in keeping this action research alive in a new context where the leadership did not see it as relevant.

A key stakeholder management issue, therefore, was to engage in recontracting with Josh as the new Director of the Division of Scientific Fellowships. I met with him formally and informally on various occasions to share the findings of prior leadership trainings, the challenges of developing leadership capability among early-career scientists, and the ideas that my action research team and I had generated as a result of inquiry among early-career scientists and supervisors. Josh and his deputy, Derek Smith, raised concerns that, in my role as a deputy, it might not be appropriate for me to explore educational topics such as leadership. “This seems like an Educator [formal title of a type of position in the Division] would do this. Do you have the expertise to do this?” (Derek, personal communication, September 2011). Additionally, since the division he was running is focused on developing scientists, he thought it was not relevant for

my unit to be exploring leadership. “How are these leadership skills unique to early-career scientists?” (Derek, personal communication; September, 2011). I responded by writing these words on the dry-erase board: “Leadership development among early-career scientists: Practical, relevant, cost-effective, grounded in practical issues, scientific method, continuous improvement.” I then went on to explore each element by explaining the process of action research. Josh responded by twice saying only that: “the time spent on leadership development is a concern” (Josh, personal communication; September, 2011). I responded by saying that we were in the middle of a paradox: Interview data showed that supervisors were demanding that early-career scientists have leadership capabilities while, at the same time, early-career scientists indicated that they did not think leadership development was relevant. Therefore, this AR would explore the nature of this issue so that we could address the issues that both he and his deputy were raising. Josh seemed a little more satisfied with my explanation, but then recommended that I meet with Amy, the Director of the Division of Leadership and Innovation, to determine whether we could adopt their leadership training wholesale instead of the program having to come up with our own approach.

On September 13, 2011, Ryan, program Chief, and I met with Amy for one hour. The intention of the meeting was to communicate the program’s strategic challenge of developing leadership and to inquire into the Division of Leadership and Innovation’s approach. My strategy was to describe the most frequent development challenge the fellowship program was grappling with and ask for her input. I shared that the most frequent challenge was not in the early-career scientists’ technical competence but in their ability to adapt to the culture of the CGW in order to make a contribution. I went on to say that the symptoms of this challenge manifested as challenges of interpersonal communication, conflicts with supervisors, and subsequent

deterioration of work quality and impact. I described the leadership workshops that we had piloted with early-career scientists and the ongoing challenge of making leadership training relevant for early-career scientists. I asked Amy how she would approach our observed capability gap and whether her division had trainings that we might consider.

Amy responded by articulating her view of leadership. She explained how this view had resulted in changes to the way leadership was being developed in the programs that she oversees, and suggesting that those interested in leadership development gather to share experiences. For example, Amy spoke of leadership as a "state of mind," and said that leadership is about "moving a situation forward" (Amy, personal communication; September, 2011). She reflected that "people get intimidated by the word 'leadership'" and that for this reason she had eliminated leadership as a competency domain and instead established it as a foundational proficiency so that it was embedded in all learning. She expressed her desire to "demystify leadership" and said that early-career scientists in her program would present a leadership case study to a panel of experts as part of their leadership training.

Amy did not offer a fully developed leadership training that we could adopt wholesale, because such a program or training module did not exist. We ended the conversation by articulating a mutual desire to learn from the approaches each other was using to develop leadership among early-career scientists.

Managing stakeholder issues alongside learning and implementing AR in one's own organization requires considerable time and energy. It was easy to lose heart when I had contracted with one leadership team and then, due to changes in staffing, I had to recontract with people who were not so open to the notion that early-career scientists would benefit from leadership development.

Cycle 2: The Fearful Ones

On January 25, 2012, a week after the case-based learning session with the early-career scientists, Ryan raised a key stakeholder issue, namely his concern about being left out of the loop in the action inquiry sessions:

> If an early-career scientist brings up an issue [in the action inquiry sessions] and does not bring it up to us, and Cindy [his boss] finds out, we are in deep doo-doo...I don't want to hear her asking why we did not engage her. (Ryan, personal communication, January, 2012)

As Chief of the program, Ryan is an important stakeholder in the AR meetings. He attended the first meeting, but missed the second meeting. I set up a meeting to brief him on the meeting he had missed where I presented the adaptive challenges early-career scientists faced. We met on March 11, 2012, and at the end of the conversation he raised concerns regarding the value of having Barbara, the CDAI expert, at the action inquiry sessions. I indicated that she served in an important facilitative role by helping to raise questions that would enable the groups to make meaning of the adaptive challenges and develop strategies for moving through them. As someone internal to the organization, it was difficult at times for me to give voice to the unspeakable. Barbara could do that as an external subject matter expert, and this was critical for moving forward, especially with the action learning project.

In reflecting on these obstacles or dark forces, what stands out most is the importance of having multiple allies at different levels of the system. For example, the way I navigated each obstacle was by asking for help from people that I knew cared for me as a person, cared for this type of work, and had enough experience in the organizational system to offer suggestions for what to do next.

Looking back, there is nothing external that could have prepared me for navigating these stakeholder issues. For example, reading another article or participating in another conflict resolution workshop would not have helped significantly. What helped most was my first-person practice of meditation and contemplation, which helped to increase my inner confidence, bravery, and humility in the face of these obstacles. Confidence, bravery, and humility were what enabled me to ask for help, to reach out and engage others within and external to the organizational system. I could not have navigated these obstacles without help of my second-person practice of engaging with others, such as my major professor, my coach, and other supporters in the organizational system. Reaching out for help gave me strength, perspective, and a sense that I was not alone in these challenges.

This completes the Chapter 4 in describing the story and outcomes of the action research cycles in this study. In the next chapter, I present the findings from analysis of the data generated though the action research cycles.

CHAPTER 5

ANALYSIS, DISCUSSION, FINDINGS

In this chapter I present the findings of this AR study. After two years of engaging with two AR teams in the iterative cycles of constructing, planning action, taking action, and evaluating findings as they emerged, the following findings offer insights into the research questions.

The purpose of this study was to explore how to develop leadership among a group of early-career scientists, not usually deemed to be leaders, in the context of a large hierarchical organization. In the first AR cycle, we (my two AR teams and I), learned that it is best to frame leadership from the perspective of adaptive challenge. In practice, that enabled exploration of the phenomena of leadership from perspectives beyond only associating leadership as positional authority. Early-career scientists began to see that they do face adaptive challenges that require leadership capabilities (e.g., self-awareness, skillful communication, systems perspectives). In the second AR cycle, in the context of this new view of what leadership means, we discovered that not only do early-career scientists face adaptive challenges, but their supervisors and mentors do as well. In the third AR cycle, we more deeply explored adaptive challenges by engaging in a real-time adaptive challenge. The early-career scientists took on a remarkable leadership project that challenged them on individual, group, and organizational system levels. Through these three AR cycles, unique adaptive challenges arose that offered insights into the adaptive challenges that early-career scientists face, the way in which CDAI theory methods supported the early-career through the challenges, and what can be said about creating cultures of learning and leadership.

In the next three chapters, I present the findings of this action research study. I organize the findings by the following research questions:

(1) What are the leadership challenges that early-career scientists face in the transition to an unfamiliar, multiprofessional, and multidisciplinary applied context?

(2) How does a Collaborative Developmental Action Inquiry (CDAI) method work in practice to identify leadership challenges and develop leadership capabilities? And,

(3) What can be learned about how CDAI methods can create a culture of learning and leadership at the individual, group, and organizational system levels?

For Research Question 1, there were two levels of analysis: within work unit and across organizational boundaries. "Within work unit" refers to the organizational unit that the early-career scientist was assigned to work in for his or her two-year fellowship experience. Within the work unit context, unique adaptive challenges arose. "Across organizational boundaries" refers to the context in which early-career scientists implemented their action learning project. This context involved the early-career scientists working together across organizational boundaries, and this was something that had never been done in the history of all CGW crosscutting scientific fellowship programs. Within this context, unique adaptive challenges arose. Each context represents a level of analysis; therefore, this chapter is organized into two sections. Section 1 describes the adaptive challenges that arose for early-career scientists within their organizational unit. The learning practice of case-based learning, as described earlier, was the methodology used, in which the early-career scientists wrote, presented, and described their adaptive challenges within their work unit. Furthermore, as described earlier, early-career scientists reflected, learned from their peers, and revised their actions in the case-based learning practice. Section 2 describes the adaptive challenges that arose in the context of working across

organizational boundaries in the action learning project. The intent of a collaborative leadership-action learning project was to explore the adaptive challenges and develop capabilities at more complex levels.

Learning One: "Not Enough Support" for Learning and Leadership

Across both levels of analysis, within the work unit and across organizational boundaries, a key learning emerged regarding the adaptive challenges that early-career scientists faced. I begin this chapter with one of the quotes from an early-career scientist as a way to frame the key learning across both levels of analysis: "Not enough support" (Shawn, action inquiry session; November 2012). What I learned was that the adaptive challenges that early-career scientists faced, whether within their work unit or across organizational boundaries, were those that involved not feeling supported enough. I describe what emerged from the data analysis, beginning with the first level of analysis below. The analytical approach used, as described in earlier chapters, is the Constant Comparative method. This method involved identifying patterns in the data to generate categories and themes.

Adaptive Challenges Within the Work Unit

Eight adaptive challenges emerged from the data in response to Research Question 1. The types of challenges that posed the greatest conundrums for the early-career scientists were adaptive in nature and required different kinds of learning beyond the technical and expert knowledge they already possessed. What follows are the distinct adaptive challenges that the early-career scientists encountered. I offer a more detailed description of Adaptive Challenge 1, described below, because it was the most complex adaptive challenge that emerged within the

work unit. There were adaptive challenges with greater dynamic complexity that emerged in working across organizational boundaries that I describe in the next section.

Adaptive challenge 1: Interpersonal dynamics with supervisor (Karen). The adaptive challenge *interpersonal dynamics with supervisor* that Karen faced was one the most complex, because it consisted of multiple interrelated, and in some ways unpredictable, elements. The cluster of adaptive challenges all occurred within the context of working with her supervisor, Lauren. The cluster consisted of the adaptive challenge of finding freedom to work effectively within the unexpected constraints that Karen encountered with her supervisor.

The first element of Karen's adaptive challenge emerged as a technical problem. Karen had just begun her post-doctoral program and did not have access to the statistical computing software that she preferred using: "A frustrating aspect of my work right now is that I do not have the statistical computing software that I am familiar with" (Karen, case write-up; January 2011).

Within a short time span, the technical problem emerged as an adaptive challenge. Multiple external pressures arose from Karen's new work context, including delays in receiving the dataset for analysis, and the lengthy review process CGW requires before submitting abstracts. However, the most important pressure was the interpersonal dynamic with her supervisor, Lauren. This was the moment that the technical problem of learning the new software became adaptive. When Karen and her supervisor Lauren met to review the results of an analysis, more issues arose. It became clear that they had different preferences, levels of knowledge, and personality styles. As Karen indicated in her adaptive challenge case write-up:

> My supervisor and I were frustrated at the end of the meeting…we clearly have different preferences for data analysis…we were speaking literally two different

> programming languages in addition to coming from two very different academic disciplines, not to mention having two different personalities! (Karen, case write-up; January, 2012)

Karen preferred to get the majority of her work done alone and then engage her supervisor later. She indicated that she needed more freedom to be productive: "I feel I am most productive when I have some leeway and some scope for creativity, and that's not the way that this supervisor operates" (Karen, action inquiry session; January, 2012). Therefore, she was challenged with how to work with a supervisor who wanted to meet often, offered frequent and very detailed feedback, and wanted regular updates. Karen tried to set limits with her supervisor in order to create some space for herself; however, that strategy only worked temporarily. Soon, Karen began to experience an environment of greater micromanagement that included more meetings, controlling language, and extreme oversight with email communications. This vigilant work environment affected Karen's morale and she felt she could not be effective.

Karen's adaptive challenge was how to collaborate with a supervisor who had different preferences, perspectives, and work styles. Initially, Karen faced the technical problem of receiving the software tool on time and learning it within a compressed timeframe in order to generate the analysis. However, once she had received the software tool, the challenge persisted, which is a good sign that this was an adaptive challenge. As Heifetz and colleagues (2009) indicate, if the challenge still persists after the technical solution is applied, then it is likely an adaptive challenge. Once the adaptive challenge emerged, Karen could not rely on her usual way of working. The harder she tried to push against the micromanagement style of her supervisor, the more her supervisor increased her response.

Within this adaptive challenge, the new learning for Karen was how to relax some of the requirements of her learning and work style that were no longer possible in her new work context (e.g., working alone and then collaborating later, not receiving so much feedback on her writing, being left alone to do her work). This element of letting go or adapting some of the requirements of her preferred work style is part of the challenge of becoming adaptive, as the literature on adaptive challenges indicates: "adaptive work demands three very tough human tasks: figuring out what to conserve from past practices, figuring out what to discard from past practices, and inventing new ways that build from the best of the past" (Heifetz, et al., 2009). In Karen's case, her adaptive challenge involved a shift to new commitments: from working alone to a willingness to work more collaboratively; from taking edits personally to seeing edits as constructive criticism; and from only advocating what she needed to inquiring with her supervisor about what she needed in order for both of them to work better together. Each of these tough human tasks required that Karen change her ways. These challenges resemble the Competing Commitment archetype. Competing commitments, or hidden commitments (Heifetz, et al., 2009), refer to challenges where there is a conflict between commitments. Karen would be committed to collaboration and also committed to working alone. She would need to make a decision about which work style to favor, either the one that had worked for her in graduate school, or one that involved more openness and understanding of the organizational norms and supervisory habits that she was bumping up against.

The challenge with competing commitments is that we often are not aware that both commitments are influencing our actions; for example, Karen was favoring a particular work style that was not effective in a new work context. As Kegan and Lahey (2009) indicate, often we are not aware of the hidden commitments that hold us captive and compete with our stated

goals. Furthermore, being adaptive involves taking a systems perspective (Senge, 2006) and considering why, in Karen's case, her supervisor was so vigilant. Initially Karen took the situation personally, as she indicated: "I do like to have my own freedom, so to her, that's clearly an insult to her" (Karen, group communication, January 19, 2012). In the last section of this chapter, I present data that shows how Karen, through engaging in the action inquiry sessions, was able to see her competing commitments and take a broader view of the situation to include her supervisor's perspective. For example, from the supervisor's perspective, "It is sad that she [the early-career scientist] is so smart but just does not get it…whatever I say, she challenges" (Lauren, personal communication; May, 2012).

This situation is complex and contradictory, because each person in the relationship has expressed that they want the relationship to work, but their actions are not always aligned with their commitments. The adaptive challenge, in this case, involves becoming more aware of the competing commitments, and closing the gap between the intention to be more collaborative and the actions that go against that intention. This involves gaining greater awareness of the root causes of why that gap exists (Heifetz, et al., 2009; Kegan & Lahey, 2009; Senge, 2006). With greater awareness and shifting to actions that close the gap, Karen learned to work more collaboratively in her new work context and shift to making an important decision to leave that context altogether, which was in line with her values.

Adaptive challenge 2: Leading a manuscript writing Group (Tom). In this adaptive challenge, *leading a manuscript writing group,* the underlying challenge resembles Karen's, where another early-career scientist, Tom, was challenged to shift from working alone to working in more collaborative ways. The case below illustrates this finding.

Tom was asked by his supervisor to lead a collaborative manuscript writing process with stakeholders within and outside CGW. Instead, Tom attempted to conduct the analysis on his own, which was difficult because he did not have some of the needed standard coding that one of the analysts on his team had. As he indicated:

> I personally wanted to do the data analysis myself so I could get it done in a timely manner and not have to wait as I did for the previous data. The only problem with this is that the analysis needed to be done the same way as it was previously done, to ensure that the methods would be consistent throughout the manuscript. (Case write-up, January, 2012)

The adaptive challenge for Tom was how to shift his style of working from the habit of getting analysis done on his own to working more collaboratively. We often think that the solution is to do something ourselves, especially when that is how we are trained to think. However, Tom was now a member of a team and a system with a completely new approach to working and accomplishing tasks. In this case, Tom's adaptive challenge was how to work more collaboratively. This would involve letting go of his tendency to do all the work himself, and step out of his comfort zone. As Heifetz and colleagues (2009) indicate, the practice of adaptive leadership involves managing oneself through the "individual disequilibrium" (p. 28) that comes with adaptive change. This disequilibrium, for Tom, was a period of discomfort or a "period of disturbance" as he "sift[ed] through what is essential and what is expendable" (p. 28). One recommendation that his peers offered in the case-based learning session was for Tom to speak up and alert his supervisor about the breakdowns in meeting project milestones. Skillful communication is a leadership capability and, according to Torbert and colleagues (2004), "speaking is the primary and most influential medium of action" (p. 27). As described in earlier

chapters, one of the tools introduced to help early-career scientists improve their communication was the Four Parts of Speech Tool (Torbert, 2004). His peers also suggested that Tom engage his team in more mutual ways to inquire into how they could work together to get the analysis done. Together, these two adaptations would require that Tom take up his leadership in the group, while respecting the political dynamics of working with an external partner from a position of being an early-career scientist with little authority power.

Adaptive challenge 3: Taking up authentic leadership voice (Heather). This adaptive challenge, *taking up authentic leadership voice*, was similar to Tom's, in that Heather's challenge was how to take up her leadership in a situation where a colleague was, knowingly or unknowingly, sabotaging her. The case below illustrates this finding.

Heather was asked to lead a project team; however, she encountered a more senior team member who usurped Heather's leadership role. Her colleague's sense of seniority was unwelcomed to both Heather and others on her team. As Heather indicated at the time: "[My colleague] has positioned her role on the team as that of a more 'senior' member, despite my team lead making very clear that there is no hierarchy within the team and stressing that the team structure is flat, has rubbed some team members the wrong way."

This indicates that there are few different values at play in terms of how one gets to take up their leadership, namely role and impact. For example, during conference calls with the project team, Heather's colleague would take over the call and leave Heather feeling as if she was not leading. As Heather explained in her case-write up:

> [My colleague] continuously tells me that I am in charge of the projects that they have handed over to me; however, she does not always make me feel like I am,

> this conference call example being a case in point. (Heather, case write-up; January, 2012)

Heather described her adaptive challenge as: "I think my challenge now is to figure out how to 'manage' my colleague when we work together and I am in charge of a project; I have to figure out how to assert my 'authority'" (case write-up, January, 2012). According to the practice of adaptive leadership, instead of "asserting authority," as Heather indicated, she might have mindfully experimented with the edges of her scope of authority, for example, "raising a difficult issue during a meeting" (Heifetz, et al., 2009, p. 283). During the case-based learning session, Heather experimented with different ways that she might skillfully raise the issue to her colleague of feeling sabotaged. What emerged in this case was that Heather's adaptive challenge involved learning how to take up her authentic leadership voice, which involved learning to engage her colleague before the conference calls so that there was clarity in roles. In the absence of clear leadership, Heather's colleague had been improvising and sabotaging Heather on the calls. As Heather indicated:

> I found the call to be unproductive. We went away with nothing new and we could have obtained the same results via email; the result of the call was exactly the opposite of what I had suggested in the email. (Heather, case write-up; January, 2012)

My experience of engaging in the case-based learning session with Heather was that her adaptive challenge was to take up her leadership in a way that was respectful. She seemed concerned that she did not need to "prove anything" (Heather, personal conversation, January 2012), and that her approach was to let her colleague do what she did (take over the calls), knowing that it was not her colleague's intention to do that. This is an example of the challenge

of shifting from being an individual contributor to working with others who may not be willing to share leadership, even in informal ways.

Adaptive challenge 4: Collaborating across disciplines (Shawn). This adaptive challenge is *collaborating across disciplines.* The case below illustrates this finding.

Shawn faced the adaptive challenge of selling a project idea to a subject matter expert (SME) from an academic discipline different from Shawn's who had the formal authority to accept or reject the project. Shawn approached the SME to collaborate on a project where Shawn was willing to do most of the work. Shawn just needed the SME's stamp of approval in order to move forward. However, the SME declined the project idea, indicating that most people had a tendency to shift the burden of the project to the SME, and he did not have the time for additional projects. As Shawn indicated:

> The SME said that he didn't want to devote the time to it. I pointed out that I'd done the heavy lifting on analysis and write-up and everything possible to minimize the burden on him. He said people always say that, but it ends up costing him time to make sure things are done correctly, and he didn't want to commit that sort of time. (Shawn, case write-up; January, 2012)

The mistake that Shawn made was that he actually engaged others and completed most of the project without engaging the SME. In fact, one of the concerns that Shawn raised in his case write-up was that:

> I feel like I've come out of this with a somewhat tarnished reputation. My co-authors are less likely to sign on with me again and the SME thinks I spent my

time on a trivial (to him) project. How can I repair this? (Shawn, case write-up; January, 2012)

Instead of inquiring and working with others on the process for getting a project approved, Shawn assembled a team, did most of the work, submitted the paper to CGW clearance for editorial review, and then found out that he needed the SME's sign off. My experience in engaging with Shawn was that his adaptive challenge was reading the signals around him before acting. Part of the process of adaptive leadership is reading the signals, and this involves "observing events and patterns around you" (Heifetz, et al., 2009, p. 32). Additionally, in the action inquiry sessions, Shawn seemed unwilling to explore this challenge more deeply, and considered the case-based learning "making mountains out of molehills" (Shawn, action inquiry session; January 2012). There was a sense that, on a deeper level, Shawn's adaptive challenge was working with others and asking for help even when he thought he could do something better on his own. What occurred in this case example and in the action learning project (explored later in this chapter) was that, by not engaging others, Shawn faced numerous obstacles. When those challenges were raised, the challenge I observed was that Shawn was uncomfortable with making mistakes, failure, and learning from those failures. This required him to face the adaptive challenge of being seen as fallible and vulnerable. As Heifetz and colleagues (2004) indicate, "adaptive challenges are difficult because their solutions require people to change their ways" and involve "figuring out what to discard from past practices" (p. 69). This may be even more challenging if our past successes were based on those practices that are no longer helpful in a new context. The CDAI method was developed to raise awareness around practices that no longer work for us by inquiring with others. For example, the Four Parts of Speech, introduced in the action inquiry sessions, involve the important step of inquiring with

others to assess whether our framing, actions, and intentions are aligned with those of others with whom we are collaborating (Torbert, 2004). Inquiring, and the feedback we obtain from our inquiries, gives us important data regarding whether our work practices are generating the outcomes we are intending.

Adaptive challenge 5: Getting stuck between supervisor and mentor (Peter). This adaptive challenge is *getting stuck between supervisor and mentor.* The case below illustrates this finding.

Peter had a supervisor who was interested in the practicality of his projects for the organizational unit's mission. Peter had a vocal mentor who was concerned with the potential the projects added to the scientific discipline. His supervisor and his mentor disagreed on the scope of Peter's main project. They were both very busy and did not make time to resolve their disagreement; thus, Peter was caught between a rock and hard place. Interestingly, according to program policy, the mentor did not have the authoritative role that he was exerting on Peter. The mentor's role was to offer advice, not to assign scope and direction on projects.

The unavailability of the supervisor to meet with the mentor to clearly demarcate the lines of authority for the benefit of the early-career scientist an obstacle to effectively managing the conflict. As Peter indicated about trying to bring his supervisor and mentor together to resolve the conflict, "I've been trying to get them together, but my difficulty has been that both of them are super busy. So the project is just lingering on. It's not coming to a completion" (Peter, action inquiry session; January 2012). Additionally, the mentor, who was not formally authorized to assign work, was over-stepping his bounds by directing the work of the early-career scientist. The supervisor exemplified a hidden commitment when he deferred to the mentor, but caused greater confusion by also disagreeing with the mentor. Peter was left feeling

disappointed with his progress on his performance requirements, which were key project accomplishments that he had to achieve within two years in order to graduate from the fellowship. Peter expressed disappointment when he said, "I was even hoping I would be able to finish it [the project that is stalled] and submit it as a performance requirement…" (Peter, action inquiry session; January, 2012). This example is an adaptive challenge, because the goal of working together collaboratively cannot be reached as if it were a technical solution. As Heifetz and colleagues (2009, p. 283) indicate:

> …the most common leadership failure stems from trying to apply technical solutions to adaptive challenges….Understandably, people gravitate toward technical solutions, especially those that have worked in the past, because they reduce the uncertainty and are easier to apply. (p. 70)

Time passed and Peter became anxious about his ability to move this project forward. From Peter's perspective, his adaptive challenge was to manage the dynamics of the supervisor and mentor who did not agree. These dynamics emerged out of different values and objectives: "My challenge is to be able to bring my mentor and supervisor on the same page and to have a manageable project because I have other projects to attend to" (Peter, case write-up; January, 2012). However, that was not Peter's role as an early-career scientist. His adaptive challenge was to recognize the limits of his role and create conditions so that his supervisor and mentor could resolve their disagreement. This required that Peter speak up about the conflicting information that his supervisor and mentor were raising without overdramatizing the situation. One of the adaptive challenge archetypes described in earlier chapters is Speaking the Unspeakable (Heifetz, et al., 2009). This refers to giving voice to the important content of our own inner conversation to make people aware of a challenge that others may be trying to ignore. In this

case, Peter, in some ways, needed to speak up about the contradictory information he was getting or offer his perspective in order to increase the chances of an adaptive solution.

Adaptive challenge 6: Getting stuck between disciplines (Richard). This adaptive challenge is *getting stuck between disciplines.* The case below illustrates this finding.

Richard's mentor assigned him to work a complex project involving two organizational units from distinct disciplines. The formal leaders of the organizational units had strong disagreements on the methodological approach for accomplishing the project's objectives. Richard was concerned that engaging in a project with disagreements about methods would be a recipe for disaster and had "great reservations" (Richard, case write-up; January, 2012) because "our group had previously experienced similar circumstances that put our group under severe criticism from the top management at CGW" (Richard, case write-up; January, 2012). Richard was concerned and frustrated that these political dynamics had already wasted one month of project time when he could have been moving other projects forward. He was not sure where this project was leading, if anywhere.

Richard's adaptive challenge was comprised of two elements. The first was how to see even this messy project as valuable for his career learning, even though its outcome might not be a traditionally valued outcome such as a peer-reviewed journal publication. The uncertainty of where this project would lead was causing frustration. According to the practice of adaptive leadership, "managing the ambiguity of adaptive challenges "requires courage, tenacity, and an experimental mind-set" (Heifetz, et al., 2009, p. 36). In the case-based learning session, Richard had the opportunity to experiment with different ways to interpret the conundrum he was in. For example, instead of viewing the project as a waste of time, his peers asked whether there was a

way he could adapt the project to both meet his fellowship performance requirement and at the same time help the units struggling with the methodological issues.

The second element of Richard's adaptive challenge was how to speak up to his mentor and his supervisor in ways that simultaneously inquired into the unfolding political dynamic of the project and advocated for his stance in wishing for projects that met his performance requirements. Richard needed to communicate in a way that advocated his wish to balance short-term requests for scientific analytic assistance with progress on longer-term projects (e.g., publications). The Four Parts of Speech tool offered during the action inquiry sessions helped Richard learn to better frame his requests and inquire into others' points of view, which were the two pieces that were often missing in Richard's conversations.

Adaptive challenge 7: Speaking up for engaging projects (Jennie). This adaptive challenge is *speaking up for engaging projects*, and refers to Jennie's engaging with her supervisor to identify projects that challenged her more. The case below illustrates this finding.

Jennie's primary project was to maintain a database of scientific journal studies. She expressed her challenge as "What else could I do to encourage my colleagues to do [review articles for a database] more willingly?" (Jennie, case write-up; January, 2012). My sense in working with Jennie and her supervisor over a two-year period was that her challenge was not really about the database; rather it was how to work with her supervisor to come up with projects that challenged her more. In fact, her supervisor, Elizabeth, a member of the AR group for this study, called me after an AR meeting wanting to brainstorm ways that she could engage Jennie in work that would challenge her more. Therefore, both Jennie and Elizabeth had the same intention, but Jennie had not raised this challenge to her supervisor.

In this case, Jennie's adaptive challenge was how to speak up to connect her vision for her fellowship experience with the needs of her organizational unit, and to advocate for projects that supported her learning in meaningful ways that also contributed to her work unit. The capability to align one's vision with that of the work unit is an important leadership capability in an applied environment, as reported by managers who hire early-career scientists at CGW. According to the fundamentals of action inquiry, Jennie could "in the midst of action" (Torbert, 2004, p. 55) use the Four Parts of Speech to "re-vision" her projects with her supervisor so that they were more aligned with her intentions. It requires courage and skill to give voice to what we may think is unspeakable (Heifetz, 2004), and to pay attention to the signals regarding when our action can be timely. In the action inquiry sessions, Jennie had the chance to practice speaking the unspeakable in the context of a safe environment. She grew in her leadership capabilities as she took on a very visible aspect of the action learning leadership project.

Summary of Challenges Within the Work Unit

A key theme across the adaptive challenges that were revealed through case-based learning was the challenge of shifting from being an individual contributor to working with others. In terms of working with others in an applied context, early-career scientists encountered situations where the conditions inadequately supported them to contribute and learn in the ways they wished. For example, there were dynamics in the supervisory relationship that limited a number of early-career scientists in moving forward with their work. In other cases, colleagues served as obstacles in the leadership journey of the early-career scientist.

In the midst of these conditions, the CDAI method was implemented to help early-career scientists become more aware of their actions and the impact of those actions. For example, the

situation of shifting from working primarily alone on one's own terms to working on behalf of the organization required relaxing or opening up one's style of working to accommodate the messiness and uncertainty of working with others. This also included learning to read the signals from others in order to implement effective actions.

There was the situation of working with others who are supposed to supervise and mentor, but who are relatively new and growing in their capabilities to be effective supervisors and mentors in adaptive contexts. This involves taking a more compassionate stance and accepting the imperfections of others along with our own. There was the situation of shifting from viewing leadership as authority to seeing leadership as speaking up in how one negotiates projects in ways that accomplish both individual and organizational goals. This involves gathering one's confidence to speak up and inquire in mutual ways to explore the complexity of aligning goals, roles, and actions. In all of these situations, a key theme was the adaptive challenge of working in an applied context and not feeling well supported to navigate the process of shifting from individual to group work in a complex organizational context.

This section completes the analysis and summary of findings of the adaptive challenges within the work unit. In the next section, I describe the adaptive challenges that arose in working across organizational boundaries in the context of an action learning project.

Adaptive Challenges Across Organizational Boundaries

In the previous section, I described findings from the first level of analysis of adaptive challenges. There were seven unique adaptive challenges that early-career scientists experienced in the day-to-day life of their work unit. In this section, I describe findings from the second level of analysis. As described earlier, the second level of analysis focuses on the adaptive challenges that emerged when the early-career scientists engaged with others across organizational boundaries in an unprecedented leadership action learning project. The project was conceptualizing and implementing the first ever CGW Scientific Conference. The early-career scientists wanted the conference to attract professionals from across disciplines. The scope of the project was large and complex because designing the conference required early-career scientists to engage with high-level leaders across organizational boundaries, to coordinate actions among groups not accustomed to working collaboratively, and to do that from the position of an entry-level temporary employee in the organization.

The adaptive challenge that emerged from an analysis of the findings related to working across organizational boundaries was also "not enough support." However, in this context there was not enough high-level support needed to authorize other stakeholders to support the early-career scientists in their project. The high-level organizational support was brokered by program staff; however, in practice the support did not come through in visible ways. Therefore, it appeared as if it did not exist. Without this high-level organizational sponsorship, the early-career scientists encountered a number of tactics among multiple players in the system that threatened to prevent the creative leadership idea from being implemented. The tactics were (1) internal rivalry and formality, (2) tension between authority and responsibility, (3) defamation,

(4) communication in a culture of fear, (6) communicating constraints and freedoms, and (7) and risk/reward ambiguity.

In what follows, I summarize this cross-organizational adaptive challenge and its tactics, followed by a discussion and conclusion.

Adaptive Challenge 8: Not Enough Organizational Support

Tactic 1: Internal rivalry and formality. The adaptive challenge that the group of early-career scientists faced when they engaged in their action learning project was *not enough organizational support,* which meant not having sufficient high-level organizational sponsorship in practice. A tactic that emerged from within this adaptive challenge was internal rivalry among senior-career scientists. As the action learning project grew in scope and prominence, early-career scientists reached out to their allies for advice, support, and resources. A few senior-career scientists responded by imposing formalities that limited timely action. The case below illustrates this finding. First, the case shows that the adaptive challenge began when early-career scientists started to engage others across the organizational system. The early-career scientists inadvertently crossed into the turf of a few vocal senior-career scientists. These senior-career scientists responded by invoking formal bureaucratic policies that limited the capability of early-career scientists to work with others in timely and collaborative ways.

At the beginning of their action-learning project, which was to design and implement the conference, early-career scientists focused on the technical aspect of planning and began to work closely with Ryan, the program director, in response to his keen interest and desire to help them in the process. A key strategy used by the early-career scientists was to engage connectors who had social capital in the CGW system and, thus, could help the early-career scientists invite high-

level speakers for the conference. Here is an example of the dialogue around strategizing how high-level speakers were going to be invited. A key element of the strategy was to connect with Ingrid, a senior-career scientist:

> I think that the director of CGW may not want to be on the panel. He may want to moderate the panel…what they [high-level leaders] were suggesting is that we get the keynote, and then we go ask the director of CGW. We can go through Ingrid. Ingrid can go to [her boss]. (Shawn, action inquiry session; May, 2012)

As the early-career scientists started to engage with key connectors who would understand the concept of the conference and help provide input, as well as connect them to the top brass, a key recommendation offered was for early-career scientists to seek sponsorship from an established senior-career scientist group called the Scientific Research Group (SRG). This group is an employee group, with members primarily consisting of senior-career scientists, with the purpose of promoting scientific research. A vocal member of SRG, Sarah, advocated that the early-career scientists reach out to SRG. Additionally, Ryan, the program director, was on the Steering Committee for the SRG, and also made the same suggestion.

Of the early-career scientists, Shawn became the most active in brokering connecting across the system. He spoke of connecting with a senior-career scientist, Sarah, who offered support in developing the panel. Shawn indicated that Sarah was "very helpful" and that "she's probably one of most connected ones at CGW. And "she's a senior-career scientist" (Shawn, action inquiry session; August 2012). Initially, Sarah was an ally, but as this case shows, Sarah and her boss Ingrid soon became "vicious" and "said no to everything" (Shawn, action inquiry session; August 2012).

Internal rivalry. One important event occurred that generated the adaptive challenge, and this event was related to recommendations for collaborating with an employee group—the Senior Research Group. First, in early April 2012, just a few weeks after the early-career scientists accepted the idea of doing an action learning project, Ryan, the program chief, suggested that the early-career scientists not only seek input from SRG but also collaborate closely with them. For example, Ryan suggested to the early-career scientists that they fold an existing SRG scientific award ceremony into the scientific conference. In the past, the scientific award ceremony had received less than expected attendance. Ryan's rationale was that combining two complementary events could increase attendance for both, thereby manifesting a "win/win" for both. Ryan further suggested that SRG could pay for the cost of bringing in a speaker who could serve as a keynote for both the SRG award (the senior-career scientist event) and the scientific conference (the early-career scientist event).

At the time that Ryan suggested this, he had no idea that this innocent proposal—collaboration between the early-career and senior-career scientists—would result in an adaptive challenge. In fact, when Ryan proposed this idea to the SRG steering committee, all of the members in attendance agreed with the idea. However, one vocal member who was not in attendance was Sarah, a senior-career scientist. Sarah was the individual who had eagerly supported the early-career scientists and, in particular, took Shawn under her wing to advise him on the design of the morning and afternoon sessions for the conference. She had also, as indicated earlier, advised him to seek support from SRG. However, the moment Sarah heard Ryan's suggestion to merge the senior and early-career scientist events, she became the source of an important adaptive challenge associated with collaborating across organizational boundaries.

It appeared that Sarah had been instrumental in creating the award many years earlier, and the idea of it being folded or subsumed within an event being created by early-career scientists was the sentinel event after which numerous obstacles emerged. For example, in an email reply to the SRG steering committee (which she also copied to her allies), Sarah indicated that the award should not be combined with the scientific conference because "those of us who worked hard" (Sarah, email communication, June 2012) should establish the award. The award should be marketed as a "stand-alone event" and "we should try to keep up with this tradition." Additionally, the draft marketing materials created by the early-career scientists did not acknowledge SRG and the award, and this served as a "red flag" for her.

Not only did Sarah oppose the merging of the SRG award with the scientific conference, but she also created roadblocks and established gatekeepers, preventing early-career scientists from moving forward with conference planning. This kind of behavior is reminiscent of the adaptive challenge Gap Between Espoused Values and Behavior. The gap between espoused values and behavior occurs when people's or organizations' behavior is different from what they say they value and believe (Heifetz, et al., 2009). In this case, the espoused organizational value was collaboration, but the behavior was one of criticizing the early-career scientists' group work.

Formality. The *internal rivalry* tactic was accompanied by a multiplicity of elements. To prevent the early-career scientists from moving forward, Sarah's boss, Ingrid, introduced formality as an obstacle. She required that the early-career scientists receive the highest level of organizational approval before she would allow her staff, who were the gatekeepers, to help the early-career scientists move forward with the project. The early-career scientists were stuck between a rock and a hard place, because many of the connectors who could help them invite

high-profile speakers and panelists to the conference were also connected with Sarah and her boss, Ingrid. By establishing these limits, Sarah prevented early-career scientists from reaching out to others. This caused major delays in conference planning. This is an example of the mutability of stakeholder support or where an ally became a rival. Initially, Sarah, the connector, was supposed to help. However, in the context of this tactic, she mutated into a gatekeeper, preventing the early-career scientists from inviting prominent speakers. The "formality move" became an obstacle for the early-career scientists, the action researcher, and the staff who were supporting the early-career scientists.

In reflecting on the process of engaging the SRG, Karen, an early-career scientist, indicated that her biggest disappointment was working with the group of senior-career scientists: "That was my biggest disappointment in this whole thing, is that SRG was a total dead-end and that they were supposed to be the senior-career scientists…shouldn't they be interested in perpetuating their trade at CGW?" (Karen, action inquiry session; October, 2012). Here we see a conundrum: Why would the SRG not want to support the early-career scientists in a conference that would advance the senior-career scientists themselves? This points to an internal dynamic of rivalry and double-loop learning about the assumptions we make about senior-level people, i.e., that they will help. But, in this case, the senior-level people generated this tactic.

The *internal rivalry* tactic resulted in doubt, i.e., not knowing whom the early-career scientists could count on, given the obstacles with senior-career scientists. As Peter, an early-career scientist, indicated: "The biggest challenge was knowing who to fall back on…we went to the SRG, and they were resistant" (Peter, action inquiry session; October 2012). Peter indicated, the biggest challenge was not knowing who to count on, and this was because of the

way that allies became rivals. The SRG was supposed to be an ally group, but they raised many obstacles and were "resistant," as Peter indicates above.

In summary, the tactic of internal rivalry began with an innocent suggestion by the program director to integrate two events. A vocal senior-career scientist interpreted the integration as encroaching on her turf. She responded by marshaling her resources to prevent progress. One key tactic she introduced was formality, which caused delays, and instilled doubt and a loss of freedom for early-career scientists to engage in boundary spanning. These elements resemble the adaptive archetypes of Work Avoidance, described in Chapter Two. As Heifetz and colleagues describe, the Work Avoidance archetype refers to the notion that "people in every organization develop elaborate ways to prevent the discomfort that comes from when the prospects of change generate intolerable levels of intensity" (Heifetz, et al., 2009, p. 84). In this case, one of the tactics Sarah used was to divert attention by only focusing on the technical aspects of the challenge, such as the process for obtaining buy-in from the SRG.

Tactic 2: Limit authority but keep responsibility. As indicated above, the first tactic, *internal rivalry*, and its accompanying sub-tactics or elements of formality, resulted in loss of the freedom to engage across the organizational system to get buy-in on the conference. Yet responsibility to move the project forward remained. This characterizes the next tactic: the tension between the early-career scientists' responsibility to design and implement the conference, and the lack of authority to take the necessary actions. As Richard indicates:

> …we have the dilemmas that we are being told to be accountable to have things A to Z done in a timely manner. But we are not authorized with sufficient power to execute those things. And we are hampered by all these bureaucratic constraints

> and therefore we cannot finish all these things, including inviting speakers, in a timely manner. But we are held accountable for that by the same people that put so many constraints on us. If they allow us the freedom to invite those people quickly, the whole issue would be done now. (Richard, action inquiry session; September 2012)

In the above quote, Richard speaks of being accountable to get things done but "not having sufficient power to execute those things." This tension between authority and responsibility was also described by the leader of the early-career scientists as a "constant sort of being jerked back about who's in charge of this." From her perspective, the limits placed on the early-career scientists were "a function of us starting from a very small, very low-on-the-totem-pole group who had high aspirations" (Karen, action inquiry session; Septermber, 2012). Both Richard and Karen raise the challenge of how to move forward under significant constraints.

Tactic 3: Defamation. In Tactic 2 (*limit authority but keep responsibility),* the impact was that early-career scientists lost the authority to engage across the system, but the responsibility remained. Tactic 3, *defamation,* refers to the strategy of causing a loss in credibility. In this tactic, allies who became rivals spoke badly about early-career scientists to organization leaders, leading to a loss of trust.

As requested, the higher levels of the organizational bureaucratic chain were engaged to get the highest-level approval for the scientific conference. Cindy, Director of the Workforce Development Office, had already been engaged, but she did not deem it necessary to get the highest-level approval. This was communicated to the rivals who had imposed that formality.

However, instead of accepting that reality, Ingrid took it upon herself to reach out to Cindy and, in her email, began to raise doubts about the early-career scientists. For example, in Ingrid's email to Cindy she subtly implies that the early-career scientists are out of control: "So, the short story on the conference. I'm assuming that you're familiar with this. It's something that the early-career scientists are organizing….Right now it's not all that clear how this is being directed and/or managed" (Ingrid, email communication, July 2012). Additionally, Ingrid implied that there should be greater oversight: "I think we need to be careful….We don't want to be directing your staff's activities" (Ingrid, email communication, July 2012). This resulted in the perception that the early-career scientists were loose cannons. For example, the Scientific Fellowships Division Director sent an email to Shawn and me in response to Ingrid's defamation: "This is concerning—it seems there is a perception that our early-career scientists are loose cannons" (Josh, email communication, July 2012). Additionally, Cindy began to raise concerns, and warned Ryan that she wanted to see details of the event "to be sure we won't be embarrassed by this" (Cindy, email communication, September 2012). The impact of this defamation of the early-career scientists was a loss of trust. This loss of trust resulted in each organizational layer's tightening its control over the next layer down. For example, as the data above show, in response to defamation the second-highest organizational leader, Cindy, increased her oversight on the next organizational level down, i.e., the division director, Josh, who clamped down on Ryan and me. Josh requested that greater oversight be placed on the early-career scientists. For example, shortly after the defamation incident, I ran into Cindy at an informal event, and she began to ask hyper-detailed questions about the conference. I shared this incident with the early-career scientists with the intention of signaling the need to adapt to this new constraint:

> Cindy started grilling me on details around the conference. For example, I haven't received an invitation to the meeting with the keynote speaker yet; I don't have anything on my calendar. Do the early-career scientists have details on how they're going to host these high-level leaders that are coming in? Who is going to welcome them? Do the panelists have instructions on what each is going to say? Is there a moderator who will try to get the most out of the panel? And I'm standing there thinking, do I have to know all these details, and do they need to be known now? (Anyana Banerjee, action inquiry session; September, 2012)

These data show that the implication of defamation in a situation of little trust results in the action of increasing vigilance, which had a ripple effect down the organizational layers. The next tactic is connected to defamation and is described in the next section.

Tactic 4: Fear-based communication. In a context of increased oversight generated by defamation, the tactic of *fear-based communication* emerged. This refers to increased communication and requests for details. For example, the increased oversight tactic caused Ryan and me to increase our communications with the early-career scientists in order to obtain regular updates on the status of their action learning project. This is an example that, without awareness, the anxieties of one group of managers gets absorbed by the next layer down and is passed down to the next layer. This phenomenon was observed in that the increased oversight enacted by Cindy was passed to the early-career scientists and they experienced this as a poisonous atmosphere. As Shawn indicated: "I think Cindy was a huge obstacle. I think that she has created a poisonous atmosphere over there" (Shawn, action inquiry session; October, 2012). Additionally, "She [Cindy] made you fear that you weren't overseeing things properly" (Shawn, CDAI session #10). The notion of fear from one organizational layer trickling down to the next

is evident in this quote, which points to different sub-cultures within organizations: “From my perspective, that [a poisonous atmosphere] doesn’t happen where I am, and I’ve talked to other people that where you are is a particularly terrible place to be” (Shawn, action inquiry session; October, 2012). This raised the notion that adaptive challenges can often arise depending on the culture of the sub-unit. For example, how one leader reacts affects the next leader. Similarly, how Shawn and I reacted to the increased oversight affected how we related with the early-career scientists.

Data from this study showed that one way to adapt to increased vigilance is not to react to it but to protect others from it. For example, Shawn asked that next time we protect them from the hyper-vigilance: “I think you guys could do a better job protecting us from that atmosphere,” and “you have to recognize the pressures that are coming on you and try not to pass them on to us” (Shawn, action inquiry session, October, 2012).

These data show that, in the context of this action learning study, the project challenged not only the early-career scientists but also those who were supporting them. The *fear-based communication* tactic raised blind spots at the level of awareness of the program managers and their ability to diffuse fear and anxiety. As Heifetz and colleagues (2009) poignantly state, “leadership on adaptive challenges generates loss. Learning is often painful” (p. 16). Adaptive leadership “requires the diagnostic ability to recognize losses and the predictable defense patterns of response that operate at the individual and systemic level” (p. 16). The action learning project was an example of leadership on the adaptive challenge of closing the gap between the espoused value of wanting early-career scientists to be leaders and the actual behavior of those providing poor leadership development opportunities. The action learning project was making progress on that adaptive challenge, causing some people discomfort, as described in the data

above. There was fear and anxiety among program managers, and this resulted in increased requests for detailed communications, which generated more fear and anxiety among the early-career scientists.

The next tactic is also one that impacted program managers and raised another communication blind spot.

Tactic 5: Passive-aggressive communication. A key challenge that arose within the leadership team was communicating constraints without limiting the creative freedom and energy of the group. Specifically, Ryan, the program director, found himself challenged with why the early-career scientists were not following through with his suggestions for how to design and implement the conference. Ryan offered many suggestions, but in reality they were expectations. When those expectations were not met, Ryan became doubtful and projected that doubt onto me. This characterized the tactic of *passive-aggressive communication.* However, it was not just Ryan who experienced this challenge of how to communicate the difference between suggestion and expectation. Cindy also appeared to have this challenge, as she had expectations but did not communicate them skillfully. Instead, she started asking very detailed questions, and these questions revealed her expectations. I also experienced that challenge, as I indicate below to the early-career scientists in action inquiry session #9:

> I now look back and realize the challenge that we're having, that I'm seeing Ryan have, that I have, and that Cindy has, is that what we want to offer you is freedom, because we recognize that when you have freedom you can grow. But we work in a bureaucracy where there are constraints and standards. We want to figure out: How do we ask you to communicate back to us the details of the

> conference planning in a way that respects this need for freedom but also respect the constraints? (Anyana Banerjee, action inquiry session; September, 2012)

This quote highlights the challenges that senior managers experienced in working with the early-career scientists. From my experience of being immersed in this challenge, I can attest to the conundrum that communicating the boundaries between expectations and suggestions presented. On one hand, Ryan and I did not want to limit the creative freedom of the early-career scientists, because we knew that it was this creative freedom that was giving them the energy to complete the project. On the other hand, we were aware of the internal organizational protocols even though they were not written down. Ryan, who was working most closely with the early-career scientists, responded to this challenge by offering many "suggestions"; however, they were taken as just that—suggestions. What we needed was a different model of communication that balanced the need to communicate to the hierarchy and the need to offer freedom. Complexity Leadership Theory (Uh-bien & Marion, 2008) names the challenge that was encountered in this adaptive challenge and proposes a framework for interaction between "administrative leadership" (p. 199), or those in formal managerial roles, "adaptive leadership" (p. 199), or those engaged in the emergent and creative activity, and "enabling leadership" (p. 199), or those middle managers who communicate the activity of adaptive leadership to the administrative leadership. In this tactic, these were the high-level leaders who suddenly wanted detailed information, as described in Tactic 4 (*fear-based communication*). What was missing was good enabling leadership that could translate what was happening in the action learning project to the high-level leaders. Similarly, enabling leadership could have communicated the constraints, imposed by the

organizational system, and the freedoms necessary for adaptive outcomes to adaptive leadership. What I learned about overcoming this tactic was the need for good communication between levels of a bureaucracy in a way that supports adaptive leadership.

Tactic 6: Doubt. The early-career scientists faced the challenge of how to move forward on a project when the process and outcome were uncertain. Action learning had never been attempted with any early-career scientific program at CGW. Furthermore, this action learning project was challenging because of its scope and complexity. Therefore, there was a sense of ambiguity about how to proceed for everyone involved. In this context of ambiguity regarding the process and outcome of the action learning project, early-career scientists came across the tactic of *doubt*, consisting of the following elements: (1) lack of trust for new ideas, (2) fear of the unknown, (3) not enough support in navigating the risk/reward challenges, and (4) uncertainty about the ROI of the project.

Lack of trust for new ideas. In creating their own path for accomplishing the project, early-career scientists engaged with others to ask for input and advice. In the context of a project that had never been done before, early-career scientists came across people who were skeptical or not open to new ideas with regards to their action learning project. Having to do something new, in the context of people not being open to new ideas, was challenging. Karen, who was informally leading the project, brought up this key theme, which she described as "bleeding a brick to make it happen" (Karen, action inquiry session, October, 2012). Karen elaborated by indicating that "bleeding a brick" to her meant that the action learning leadership project "was really hard, and I think part of the problem with the hierarchy is that there's no trust for new ideas…no interest in innovation" (Karen, action inquiry session; October, 2012). Thus, one of

the challenges that early-career scientists faced in working across organizational boundaries was coming up against an organizational culture that did not welcome new and diverse ideas. In addition, there was a sense that part of the lack of trust for new ideas was grounded in a mistrust of the younger generation or of new people:

> There's not any reverence for—I'm not going to say youth. It's just like new blood in the system…there's nothing. It's always upward-looking. It's never downward-looking, and that's what the private sector does infinitely better than government, is that they value new people coming in and they value diversity of experience instead of marching up the same ladder. (Karen, action inquiry session; October, 2012)

The above quote poignantly describes the challenge from Karen's perspective, that implementing the action learning project was difficult in a context that was always "upward-looking" or did not "value new people" or "diversity of experience." Yet, without the early-career scientists, the conference—which was needed in the CGW—would never have happened. Karen raised a challenge for those creating conditions for others to lead and learn: How could CGW better welcome the "new blood in the system" and create an environment where new people felt welcomed and valued? Susan, a contractor whom the early-career scientists recruited into their team, pointed out the paradox of an organization that attracts the brightest scientists but, once they are in, shows no faith in their capabilities:

> That's what struck me about this whole process is that, CGW, we are known for what we believed to be the premier emerging scientists, but does anybody acknowledge that? I had somebody say, "You're having the early-career scientists

> plan this conference?" I'm like, "Yes," and where is the faith? (Susan, action inquiry session; October 2012)

Lack of trust for new ideas was one of the tactics within the larger adaptive challenge of *"not enough support"*. The data above demonstrated that openness to new ideas is essential in helping new people feel welcomed. Additionally, welcoming the full experience of the adult learner and having faith in their capabilities is another element of openness, as exemplified in this study.

Fear of the unknown as paralyzing. The next element of the *doubt* tactic was the fear that early-career scientists encountered among the Senior Research Group (SRG), comprised of senior-career scientists. Specifically, the fear appeared to manifest around not knowing the outcome:

> But when sort of fear of the unknown is paralyzing, which I would say that is what we saw from SRG, it was like, "We don't know what's going to happen." Well, none of us knew what was going to happen, and we all took a chance on it and put a lot of work into it. Some of us staked our reputations with some very high-level people on it. (Karen, action inquiry session #10)

The fear of not knowing the outcome apparently "paralyzed" the SRG. From Karen's perspective, the early-career scientists did not let fear of an unknown outcome stop them. They were willing to "stake their reputations with some very high-level people on it." The possible source of this strength and solidarity is explored in the next section.

The fear of the unknown was particularly evident with this project that had never been done. As Peter indicated, "it's not something that happens every year where people already know what to

expect" (Peter, action inquiry session, October, 2012), especially in the context of early-career scientists doing something new:

> But it's just a bunch of—Who are you guys?—who just have come together and say they want to do something this big, so obviously people become skeptical. Is it going to succeed? There's nothing to show that it's going to work. (Peter, action inquiry session; October 2012)

While the fear of the unknown was a challenge for the early-career scientists, they were able to overcome that obstacle, as further explored in the next section addressing research question 2.

Not enough support in navigating the risk/reward challenges. In working across organizational boundaries, early-career scientists came across some unsupportive colleagues. In action inquiry session #9, the early-career scientists reflected on how unsupportive some of the senior-career scientists had been of some of their adaptive strategies that turned out to be successes. One strategy was to engage in target marketing of the conference. To do this, early-career scientists presented to target groups. Karen reflects on how Ingrid, a key ally who mutated into an antagonist, discouraged this strategy: "Remember how Ingrid told you that no one was going to show up [to the conference]? Didn't she come up to you after your really excellent presentation and say this was a waste of your time essentially?" (Action inquiry session #10). Shawn responded, "She did," and Peter added "We had people discourage us a lot." Karen confirmed that "[We had people discourage us a lot], every step of the way." Additionally, the SRG, and a vocal member of the AR team, Bob, discouraged the group from inviting a non-scientist as a keynote speaker. However, an adaptive strategy that the group implemented was to go against the grain of tradition and invite a speaker who could appeal to a broader audience.

This was an example of double-loop learning (Argyris & Schon, 1974; Torbert, 2004), because it questioned and changed the underlying conventional strategy of only inviting scientists to be speakers at CGW conferences. As Karen indicated, "I think that is why we got the attendance we did, but SRG [and Bob] hemmed and hawed." However, the early-career scientist were able to face and overcome this skepticism.

Collaborating in the context of skepticism was challenging for both the early-career scientists and those who supported them. As described earlier, Susan was a contractor assigned to help the early-career scientists with the logistics of the conference planning. From her perspective, as someone more integrated into the CGW system, her biggest challenge was the way key members of CGW showed skepticism towards the early-career scientists, "I was so embarrassed at the way the CGW was acting towards this whole project. We are making such a bad impression. I was embarrassed on behalf of CGW" (Susan, action inquiry session, October, 2012).

Another early-career scientist, in reflecting on his learning, pointed out the gap between the espoused value of collaboration and an obstacle to collaboration, which is that there is little support for the complexity that collaboration brings:

> My experience of doing my particular part for the presentation is that people speak the need, but in reality, the system goes against everything we do. You're supposed to be collaborative, but the more you collaborate, the pressure you have is then multiplied. The more you collaborate, the more clearance you need. My presentation had to be cleared by four national centers. I honestly don't know why. (Richard, action inquiry session, October, 2012)

A key point is that the greater the collaboration, the more the system asks for without support: "I do not quarrel with the clearance system, so to speak. But the system itself does not work to support you to go through the systems" (Richard, action inquiry session, October, 2012).

The action research team was invoked to support the early-career scientists; however, when the early-career scientists reached out to a very well-connected member, he did not provide any support. As Shawn reflected: "I think that he allocated the time for us in that meeting, and that was it" (Shawn, action inquiry session; October 2012). This raised the challenge that the organizational system was not set up to help early-career scientists know how to follow through. Early-career scientists faced obstacles in which there were no clear paths for how to accomplish their work. Additionally, the key rivals who generated obstacles responded in technical ways to the adaptive challenges. For example, they resorted to formal procedural logistics (a technical solution) instead of grappling with the challenge of how to create pathways for leadership development through action learning (an adaptive challenge). Approaching an adaptive challenge as if it required a technical solution is an example of a work avoidance tactic of diverting attention away from the adaptive challenge (Heifetz, et al., 2009), as explained earlier. It is also an example of a single-loop learning response to an adaptive challenge (Argyris & Schon, 1974; Torbert, 2004).

Uncertainty about the ROI of the project. This action learning project was the first time in the 15-year history of this scientific post-doctoral program in which early-career scientists engaged in a collaborative project. One of the challenges faced was uncertainty about how much to support it, since the benefits of the project did not immediately or directly accrue to any one organizational unit.

Here is an example of this challenge, where a supervisor questioned Richard's time on the action learning project because of the uncertain return on investment (ROI) directly accrued to that supervisor:

> From my supervisor's point of view it's like whether I should trade my early-career scientists' time right now for some unknown benefit in the future which may benefit scientists at CGW as a whole, but certainly it does not benefit my branch. My supervisor likes the [action learning] program. She hopes that it will happen again, but on the condition that, "You will not affect my early-career scientists' time, work, duty," and so on. Because the less I do, actually, the more she has to pick up herself. So how will we help our boss, our supervisors, handle this? It's interesting, I think. (Richard, action inquiry session, October, 2012)

This points to the adaptive challenge archetype known as the Gap Between Espoused Values and Behavior (Heifetz, et al., 2009), where the CGW tagline is collaboration, but not only are there no pathways for collaboration, there do not appear to be incentives for collaboration. Incentives and reward systems more commonly recognize individual performance but not cross-collaborations.

The *doubt* tactic was one of the most multi-faceted tactics that emerged. It contained the elements of (1) lack of trust for new ideas, (2) fear of the unknown, (3) not enough support in navigating the risk/reward challenges, and (4) uncertainty about the ROI of the project. In the next section, I summarize the key learning and offer a model to depict it.

Summary of Learning One

Analysis of the findings for Research Question 1 showed that early-career scientists faced unique adaptive challenges, both within their work unit and when they engaged in a group leadership action learning project that involved working across organizational boundaries. In the context of working across organizational boundaries, what I discovered, paradoxically, is that in the vision to accomplish a leadership project the biggest obstacle was inadequate leadership among the highest organizational levels. As Ryan reflected, "the biggest challenge was top leadership unwilling to embrace the project" (Ryan, personal conversation; March, 2013). When Ryan elaborated, he agreed with my summary that top leadership supported the project in theory but not in practice. Thus, we have the archetype of the Gap Between Espoused Values and Behavior (Heifetz, et al., 2009). The adaptive challenge involves closing the gap between the values and behavior. However, that is especially difficult given that someone high enough in the organization can keep the gap going for their benefit. In this case, the gap was not supporting the leadership from the lower levels of the organization. According to the early-career scientists engaged in leading the project and those in middle management who supported them, "top leadership did not know how to integrate good ideas from the bottom…they saw something new and immediately said 'terrible'" (Karen, personal conversation; March, 2013). Additionally, top leadership felt "threatened" and "they cannibalized on a good idea instead of rejoicing in the success of the team" (Ryan, personal conversation; March, 2013). When the project grew in prominence, top leadership tried to block early-career scientists because they wanted to be "in control" (Shawn, personal conversation,; March, 2013). Overall, the adaptive challenge early-career scientists faced was "not enough support," or not enough top leadership support in practice. This adaptive challenge and its accompanying tactics (e.g., formality, defamation,

fearful communication) threatened the creative idea that emerged among the early-career scientists.

To illustrate this adaptive challenge and its various tactics, I developed a model (Figure 9).

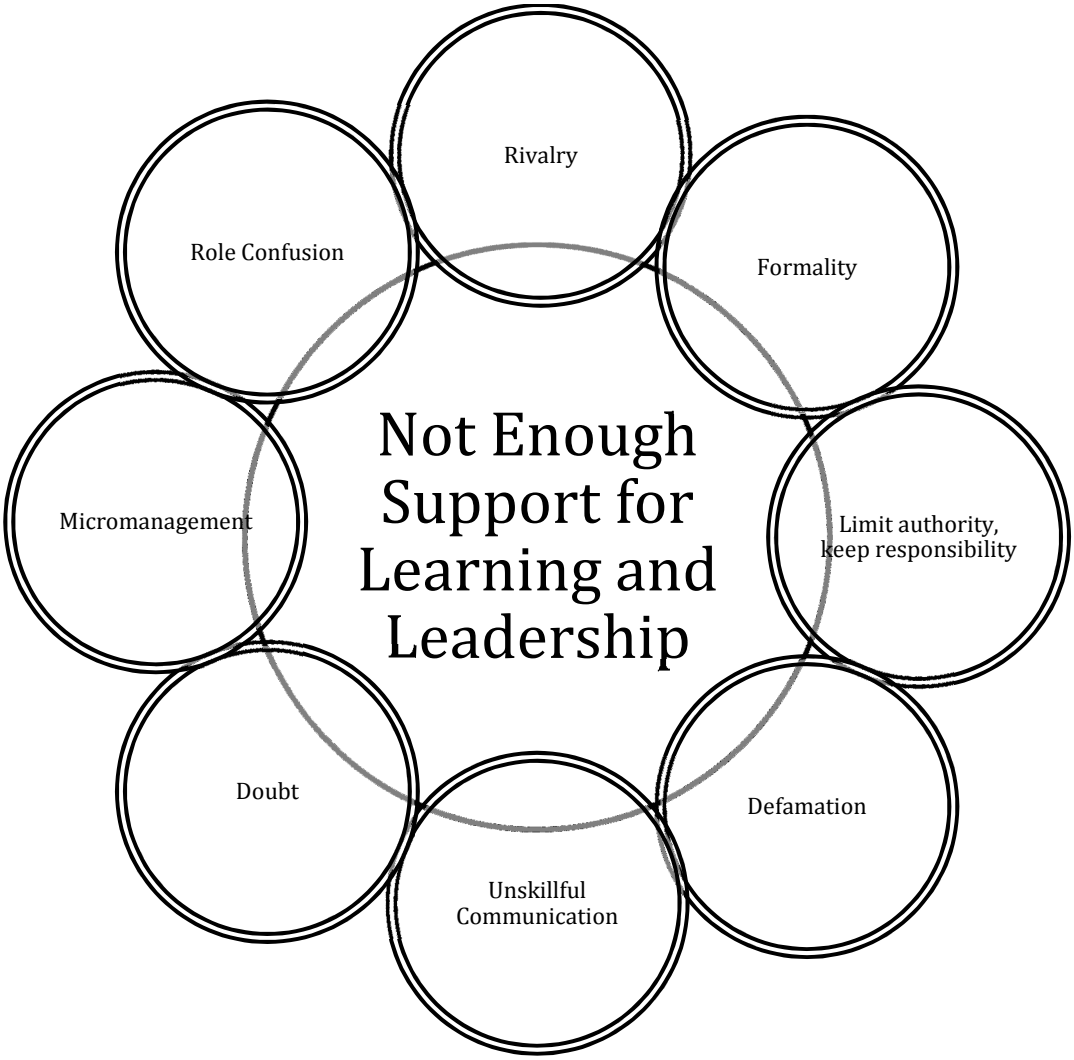

Figure 9. Learning one

The above model shows that the key adaptive challenge that early-career scientists faced in working within and across organizational units was *not enough support*. This adaptive challenge consisted of many unique facets and tactics, as described above. However, the early-career scientists' creative idea survived and was implemented. What were the conditions that enabled the leadership and creativity of the early-career scientists to emerge and survive? For the purposes of this research, and in addressing Research Question 2, I will focus on the conditions of the CDAI space (action inquiry space) that enabled leadership to emerge and survive.

This section completes the analysis and summary of findings of the adaptive challenges within and across organizational boundaries. In the next section, I share findings from an analysis of data that shed light on how the CDAI method helped early-career scientists overcome the adaptive challenge of "*not enough support" for learning and leadership*. In doing so, I address Research Question 2, which focuses on how CDAI theory and practice supported early-career scientists in identifying their leadership challenges and developing their leadership capabilities.

Learning Two: Flexible and Adaptive Learning Space

In the previous section, I described findings for research question one: What are the adaptive challenges that early-career scientists face? What emerged from an analysis of two levels of adaptive challenges is that early-career scientists faced the adaptive challenge of not getting enough support for their learning and leadership. In the context of an action learning project, this adaptive challenge manifested as not being able to get high enough level organizational sponsorship for their leadership innovation. They got the support in theory, but in practice the support did not come through. The impact was that the early-career scientists and

their action learning project was attacked by various tactics such as formality, communication constraints, and others.

The second research question in this study was focused on how the CDAI approach worked in practice to help early-career scientists develop their leadership capabilities. The learning that emerged was that the CDAI method helped to create a flexible and adaptive learning space where early-career scientists received the support and encouragement that they needed to navigate their adaptive challenges. Navigating the adaptive challenges meant that early-career scientists engaged in double- (changes in strategy) and triple-loop learning (changes in intention/vision). The reframing of their strategies and intentions enabled early-career scientists to "take up [their] power" (Karen, personal conversation; March, 2013) and take actions aligned with their intentions and values.

After in-depth analysis of the action inquiry sessions, as well as group and individual interview data, what stood out for me was that the action inquiry space was a flexible and adaptive micro-space that met the early-career scientists where they needed it.

In particular, what early-career scientists needed was support and encouragement in the face of adaptive challenges. CDAI theory and methods manifested in this adaptive space in the following ways: (1) connection, (2) making meaning of their adaptive challenges, (3) allowing creativity to emerge, (4) developing strategy, and (5) staying focused.

Being close to the process, it was remarkable to me how the fragile creativity that emerged from within the action inquiry learning space survived and succeeded in being implemented. Based on my analysis, I conclude that the only way the creativity survived the adaptive challenges was due to the symbolic protection that the action inquiry space offered. Protection manifested on two levels: outer and inner protection. Outer protection was the sense

of safety from connecting as a cohesive team. Inner protection refers to the protection from a strong and flexible mind that is able to make more complex meaning of situations. In what follows, I describe the findings of how action inquiry space emerged as a flexible and adaptive space for learning and leadership. I describe how this space was shaped and reshaped as it adapted in order to enable innovation to emerge, develop, and be protected.

Adaptation 1: Action Inquiry Space Created a Sense of Connection and Belonging

When early-career scientists began their post-doctoral fellowship experience, they were assigned to work in locations across the CGW organizational system. When they did gather together, it was to receive technical classroom-based training that typically did not engage them in getting to know one another or their work. The action inquiry space offered an important alternative – a space where early-career scientists could connect, feel a sense of belonging, and learn from each other. Peter offered a poignant summary of the element of connection and belonging that the action inquiry groups offered:

> The good thing about this whole process was bringing us together as early-career scientists was one positive thing. The second thing was getting the chance to learn from each other. And then the third thing was that it gives you a sense of belonging. It's nice. You got thrown into your division or your department or whatever, and without this, a time to see yourself as only you, who is engaging with other people and knowing what is going on with them, makes you feel like you're part of a team, and *you actually mean something*. (Peter, interview; November 2012)

In a large and complex organization such as CGW, it is easy for early-career scientists, who are in one of the minority disciplines, to feel insignificant. This is a theme that came up in

one of the action research meetings and Elizabeth noted this issue as an adaptive challenge (Elizabeth, AR meeting #3). The action inquiry space offered a powerful alternative to the typical ambiance of disconnection. The action inquiry space formed a micro-culture where "you actually mean something", as Peter summarized above.

In an atmosphere of connection and belonging, early-career scientists could learn together. The unanimous sentiment was that the action learning project was a good learning experience. Peter gave voice to that sentiment:

> I think that this whole experience was an important experience, especially coming into a fellowship that has a core model. I found it an opportunity to engage with each other, to learn from each other (Peter, interview; November 2012).

Learning and a sense of accomplishment were jointly experienced, and this generated a sense of pride in doing something together as a group:

> ..and to do something in common that we can look back at our fellowship time and say that, apart from the individual things, that we were able to achieve, this is something that we did together as a group. So I think that, to me, it was a good learning experience of a teamwork activity that you can go back and say that I learned something out of this experience. (Peter, interview; November 2012)

Peter's comment is emblematic of the great sense of accomplishment the early-career scientists were able to experience within a short time after completing the action learning project. The accomplishment was derived from working together on a project that was challenging and had impact. This type of experience is not characteristic of the experiences at CGW. For example, Jennie, an early-career scientist, had been in the CGW system for a year before joining the fellowship program, and took part in the action inquiry sessions. She indicated that before the

action inquiry sessions she felt "alone" (Jennie interview, November 2012). After the sessions she felt "I have glue, classmates to share things." The "glue" that Jennie spoke about was a sense of belonging and connection that was generated as a function of the action inquiry space. This sense of connection, and wishing to keep this feeling, was what motivated her to step up and express her leadership in the action learning project. As she indicated:

> I wanted to meld with the group and I want to do something together, to feel that connection with each other. I feel that's very valuable and I guess that's the reason [why I took a leadership role in the group]. (Jennie, interview; November 2012)

CDAI is a method for creating and sustaining a community of inquiry within a dynamic system so that these interactions produce meaningful and timely acts by individuals, groups, and the system itself (Torbert, et al., 2010). It turned out that this element of CDAI, creating a sense of connection and community, was one of the most important elements of the action inquiry space that enabled early-career scientists to navigate through their challenges.

Karen also expressed appreciation at being able to gather and connect with her peers. What was most helpful was "to be able to get together with the early-career scientists, have you guys facilitate" (Karen interview, November 2012). Karen elaborated on what she meant by gathering with peers. She brought up the notion that, for early-career scientists who are working in sites where there are no other early-career scientists, it feels as if they are operating as islands without connection to others:

> I think another thing is that we're all operating as sort of little islands, and some of us are a little bit isolated in our respective divisions, because we don't have other early-career scientists around. And so I think that these (action inquiry

> sessions) are very valuable. If you're creating a cohort, this kind of experience creates a cohort. Sitting in a method session doesn't do that. (Karen, action inquiry session #4)

As Karen indicated above, the action inquiry sessions were "very valuable" because they were a way for early-career scientists to gather together, and this contributed to a feeling of being in a cohort program, which is what the fellowship program purports to be. The technical training sessions that comprise the majority of the early-career scientists' curriculum do not create a cohort experience. This data piece shines light on the paradox described in earlier chapters—that the overemphasis on technical training has other impacts, including an exacerbation of a sense of disconnection. The action inquiry sessions emerged as an antidote to this feeling of disconnection.

The notion of operating like islands, and that the action inquiry sessions helped connect and create cohesion among early-career-scientists, is an important finding. In the context of feeling connected as a cohort, the group was able to take on an action learning project of a scope and complexity that had never been accomplished by any early-career scientist group at CGW. To put this finding into context, each year over 400 early-career scientists graduate from fellowship programs at CGW. However, this study represents the first time early-career scientists engaged in a group leadership project with impacts beyond their organizational unit. There was something about the action inquiry space that enabled this sense of connection and cohesion. According to the Stages of Team Development (Tuckman & Jensen, 1977), a group becomes a team after they have traversed a series of stages. The action learning project was a context in which early-career scientists could go through those stages in the collaborative space of action inquiry. The action inquiry space was marked by skillful facilitation of meaning making and

action inquiry. Meaning making, as described in earlier chapters, refers to how we make meaning of our experience. Action inquiry refers to practices of inquiring and reflection that can be considered actions in that they aid in the revision of meaning making (Steckler & Torbert, 2010; Torbert, 2004; Torbert, et al., 2010).

Early-career scientists who were not able to attend the action inquiry sessions offered unique perspectives on what they felt they lost, and thus, outlined the missed value or opportunity. For example, Heather did not attend 60% and Tom did not attend 30% of the action inquiry sessions due to their work travel schedules. In reflecting on what they missed they first offered remarks on what business as usual is and how the action inquiry space offered an important alternative. What normally takes place is little opportunity to interact with other early-career scientists: [we] normally we don't see each other… We might call each other or e-mail for something, but on a day-to-day basis, we don't really get a chance to spend time together" (Heather, interview; November 2012). Similarly, Tom indicated that "we don't really come together…have regular meetings or trainings really, after the first few months" (Tom, interview; November 2012). In contrast to what normally occurs, the action inquiry sessions gathered early-career scientists on a monthly basis. Heather expressed that she missed the "bonding" and the importance of those connections:

> [What I missed was] getting to know each other and dedicate time to sit with each other…the bonding of the group was important, I think. Because if we stay or if we leave, regardless of where we go this is our class, so you want to have those connections (Heather, interview; November 2012).

Tom reflected a similar theme around the value of connection and "getting to know each other" that the action inquiry sessions offered:

> The thing I liked the most about all of the sessions was that it gave us a chance to come together and meet and get to know each other here…to get to meet like once a month or so, to actually see how's it going there, and to hear…stories and how people are doing in their offices is nice (Tom, interview; November 2012).

Tom elaborated that, in the action inquiry space, he became more aware of the type of research his peers were engaged in. This enabled him to engage in collaborative dialogue after the session: "If they brought a paper where there were challenges…. [I would] talk to them afterwards during lunch… And it's nice to see what others are actually doing, because otherwise we might not get that perspective" (Tom, interview; November 2012)

Both those who attended the action inquiry and those that missed 30-60% of the sessions expressed that they valued the opportunity to get to know each other, bond as a group, and feel like they belonged.

Adaptation 2: Action inquiry Space Helped Make Meaning of Adaptive Challenges

As early-career scientists became immersed in their new work context, they began to face adaptive challenges. In the midst of their emerging adaptive challenges, the action inquiry sessions shifted to offering support for reflection, making meaning, and developing skillful action from within the adaptive challenge. For example, Karen had experienced the challenges of being micromanaged. She felt "stifled" and that she was in a "vise grip" (Karen, case presentation, January 2011). For Karen, the action inquiry sessions were a "decompression valve":

> I think it acts as sort of a decompression valve, to be able to talk about things. It puts a context around the experiences that we're having, and it helps us sort of

> say, okay, I was unreasonable in this situation, and this is something that I should advocate for. (Karen, action inquiry session #4, January 2012)

In Karen's analogy of a decompression valve, the action inquiry sessions offered her a sense of emotional release because they offered her a way to "put a context around experiences" for making meaning of the challenges. There are three components of an action logic or how we make meaning. How we cope with the challenge is one dimension (Cook-Greuter, 2004; Cook-Greuter & Soulen, 2007). That the action inquiry space offered Karen respite from her frustration is an indication that the action inquiry space may have contributed to shifts in meaning making by helping Karen cope with her challenge in more effective ways.

Heather, who missed 60% of the action inquiry sessions, indicated that what she missed most was gaining greater self-awareness and peer learning.

> For me, [I missed] a lot of theoretical content…also learning about my peers and where other people are…I think that's important for me to just get a sense of where I am and where do I want to go? How do I want to develop? Who do I want to be? What kind of leader do I want to be? So I think I missed out on some of that in the group, because I think it's useful. (Heather, interview; November 2012)

Heather's aspiration to better understand "where I am?" "where do I want to go?" and "how do I develop" reflects much of the work around the meaning making aspect of the action inquiry sessions. This is learning around how to create better alignment between our goals/intention and our actions. Creating this alignment or first-person integrity and second-person mutuality are the intentions of CDAI practices.

All of the early career scientists reported that the case-based learning method was helpful and/or interesting. The case-based learning approach was an effective tool for the practical

exploration of adaptive challenges because the method involved writing about one's own adaptive challenge. As Tom indicated, "I think of moving on to the more applied stuff really helped me" (Tom, individual interview; November 2012). The shift from framing leadership theoretically to exploring leadership in this personal way was helpful. For example, Tom appreciated the shift to the more personal exploration of individual experiences:

> …moving towards the case-based, I think that was very helpful, to kind of hear other people's experiences and how to deal with certain issues that are being beat on us in our different scenarios…. it's interesting how everybody's in the same fellowship, but the experience for everybody in their certain offices is so different. It's interesting to hear all the different perspectives (Tom, interview; November 2012).

The case-based learning approach was an effective tool for making meaning in that it offered a context to hear different perspectives.

The most valuable aspect of the action inquiry space, according to Karen, was receiving multiple perspectives and talking openly about challenges. For Karen, this enabled her to make meaning of her challenge:

> Well, if we can frame it as like the biggest benefit, it was just the multiple perspectives. Because I think particularly when someone is unhappy, vision gets very myopic and everything seems bigger and more important and more fixed and concrete than it actually is. And so being able to talk openly in the groups was really beneficial, and there's such a diversity of viewpoints and different strengths that everybody brought to the table. (Karen interview, November 2012)

Karen also seemed to be able to get perspective by putting herself in her supervisor's shoes, which was a suggestion that one of her peers offered, in the action inquiry sessions. As

Karen reflected, interrupting a pattern of behavior was a new learning: "Thank you very much for all the comments. I think it's all very helpful. Sort of thinking about how to interrupt behavior and what is the cause of the behavior" (Karen, action inquiry session #4, January 2012). Karen learned the strategy to interrupt, via inquiry, her supervisor's pattern of overemphasis on abstracts versus papers. Inquiry is the key leverage tool for raising our awareness to enable skillful action that is aligned with the territories of our experience (Torbert, 2004). Meaning making is necessarily related to adaptation, because how we make meaning affects how we act (Cook-Greuter, 2004), and revisions in meaning making are related to successful adaptation (Cook-Greuter, 2004; Drago-Severson, 2009; Heifetz, et al., 2009; Kegan, 1982). CDAI outlines various ways of making meaning or creating action logics (Torbert, 2004).

Later, the action learning project helped Karen see that she was a good communicator and a good team player—a feeling she did not have when working with her supervisor. As such, "the whole experience was sort of a lifeline for me" (Karen interview, November 2012). These are examples of how the action inquiry sessions helped Karen raise her awareness and consider revising the way she was interpreting the situation so that she could respond in more effective and timely ways. Karen acknowledged this kind of support as a "lifeline."

For Jennie, the learning resources offered at the action inquiry sessions, such as the outer, inner, and secret challenges introduced her to "different ways of thinking" (Jennie, action inquiry session, April 26, 2012) and represented "tools we could possibly use in the process of action" (Jennie, action inquiry session, April 26, 2012). For other early-career scientists, shifts in meaning making occurred in the context of the action inquiry sessions, especially through the case-based learning intervention. An important capability in being an adaptive learner is to be able to interpret situations in increasingly complex ways (Drago-Severson, 2009; Heifetz, et al.,

2009). This ability comes from being open and noticing that there are different perspectives and thus different ways of acting and being in situations that may be more aligned with our intentions. The action inquiry sessions and their emphasis on inquiring together, or collaborative inquiry (Bray, et al., 2000; Heron, 1985), enabled these multiple perspectives to emerge.

Adaptation 3: Action Inquiry Space Helped Creative Ideas to Emerge

Once the early-career scientists felt connected and supported in their adaptive challenges, the action inquiry space shifted to being a space where the new ideas could emerge. This refers to exploring the idea of a leadership action learning project. In this space, the early-career scientists were open to the idea of taking on a group leadership project with scope and impact at the first-, second-, and third-person levels. Early-careers scientists were given the freedom to decide what kind of group leadership project they wanted to engage in. Allowing early-career scientists the creative freedom to generate new ideas and decide how to implement their ideas as creatively as possible, within the constraints of the organizational rules and norm, was what was most helpful about this emergent adaptation of the action inquiry space:

"What was most helpful about the [action inquiry space] was having a broad overlay, or just sort of a goal identified, and then being able to define within our group how we were going to get there" (Karen interview, November 2012). What was most helpful to Karen about the action inquiry space, in comparison to her work unit space, was having some structure, such as a goal, but also allowing the early-career scientists creative license for how to achieve that goal, as she indicated:

> I like the idea of people being able to choose the project that they engage in...it inspires ownership and a lot of hard work that isn't necessarily self-forthcoming,

> or there wouldn't necessarily be so much creativity if something was prescribed in advance. (Karen interview, November 2012)

Richard, in his individual interview, echoed the same sentiment that allowing the early-career scientists to explore something new and innovative contributed to his learning: "the whole experience of developing something new, doing something that nobody has done before in the CGW, probably this is really the experience for the good learning for early-career scientists" (Richard, interview; November 2012). Richard made an insightful point that the learning came from doing something new: "I think to let early-career scientists develop something that is really their own is really the idea… this is more important than whether or not the conference becomes a regular event" Richard, interview; November 2012). This insight was expressed in the group interview and confirms that early-career scientists want to learn in adaptive situations. They want the uncertainty that generates a creative edge. The recognition that relevant and important learning came from a non-technical situation and the request that this type of learning context continue represents a remarkable impact in this study. The impact signifies the beginning of a shift from not seeing leadership as relevant to acknowledging and calling for leadership learning in adaptive situations.

The action inquiry space enabled the group to experiment in a caring holding environment where they could make mistakes. This was very different from Karen's work unit, where her supervisor created an environment of fear around mistakes. As Karen indicated:

> [When something was not prescribed in advance] that also meant that we ran into a lot of roadblocks, and fell over a few times. But it's also important for people to make mistakes. I think that was something that was really notably lacking in my

> supervisory situations that there was such a fear of…making a wrong step, that meant that everything had to be prescribed. (Karen interview, November 2012)

Richard, in his individual interview, raised the same notion that Karen raised in her individual interview about the fear of making mistakes:

> I think that every institution has a particular way of doing things, and where people have adapt to a particular way of working. [The institution] will be suspicious of anything new. I think especially for a bureaucracy, people are afraid of innovation not because they don't like it, not because they are conservative, but because they are afraid of making mistakes. And therefore, they are afraid of losing their jobs. (Richard, interview; November 2012)

In a culture of being fearful of making mistakes, it is challenging to try out anything new, as Richard notes, which, from his perspective, is distinct from other cultures:

> I mean, unlike in academia where people are cherished for their innovations, because if you do not innovate, if you do not publish something new, you lose your job. Here you won't lose your job by doing something new, but you lose your job by making mistakes. (Richard, interview; November 2012)

In a culture of being fearful of making mistakes, an important element of the action inquiry space, as Karen suggests, was an ambiance of learning from experimentation, making mistakes, and not "over-prescribing." Otherwise, "Nothing new comes up. You only end up doing things in the way that you know how to do them" (Karen interview, November 2012). One of the patterns of ignorance that Heifetz and colleagues (2009) encountered in exploring adaptive challenges is attempting to problem-solve adaptive challenges as if they were technical. The implication is that the challenge reemerges because the root adaptive issue was never addressed.

One of the strategies for working through adaptive challenges is to take on an "experimental mind-set" (p. 36) where you observe, inquire, try things out, see what occurs, and make adaptations.

The action inquiry space offered support for creative ideas to emerge by giving early-career scientists freedom to choose their own project (within constraints) in an ambiance of experimentation where they could make mistakes.

And it's also nice, like, that's kind of how the whole inquiry sessions kind of went too, like morphing into like a group project. I think that's really helpful to focus on a group project, some sort of collaborative work together, because, you're going to be doing a lot of group work [at CGW].

Once the early-career scientists committed to engaging in an action learning project, the action inquiry space shifted to helping early-career scientists with project management, which included help with decision-making and strategy.

Adaptation 4: Action Inquiry Space Helped with Strategy

The action inquiry space adapted to help early-career scientists make significant strides in their action learning project. The space offered them a place to brainstorm, make decisions, and receive encouragement. The forward momentum in project planning and execution as a result of the action inquiry sessions was evident based on feedback from those who worked with the early-career scientists. For example, after a gap in the action inquiry sessions, a senior-career scientist who was part of the AR team told me during an AR meeting: "Congratulations. Whatever you did [referring to holding an action inquiry session] last week worked. There was a flurry of activity after it, emails started flying" (Bob, AR meeting, September 2012). It appeared

that, in this incident, action occurred after the action inquiry sessions, indicating that the sessions were an important intervention point for action.

The action inquiry sessions and the way they mobilized early-career scientists towards timely action was also expressed by the early-career scientists themselves. The action inquiry space was helpful for brainstorming various approaches to navigating both the technical details of the conference and the adaptive challenges**.** For example, Peter indicated that the action inquiry sessions dedicated to the action learning project planning were helpful because they gave the early-career scientists a space "to brainstorm and not jump on each other." (Peter, action inquiry session #10)

When adaptive challenges arose during the action learning project, the action inquiry space was a space where early-career scientists could request specific learning resources and tools in a "just-in-time" manner to help them with the challenge at hand. For example, as the team started to engage in more complex decision-making, the leader of the team, Karen, requested decision-making resources. I offered theory on decision-making models at the beginning of the next action inquiry session to raise awareness of how early-career scientists could look at and even adjust their own behavior before engaging in the decision-making dialogue that followed the presentation. As Karen indicated:

> I like the format where we learned about the various [decision-making] models and then each of us could sort of identify our own failings and successes in it before we start to talk, and I think that really does moderate behavior. (Karen, action inquiry session, April 26, 2012)

In this way, the action inquiry sessions were supremely agile, in that they brought content around leadership development (e.g., Stages of Team Development, Decision-making,

Communication, Systems Thinking) to the early-career scientists in ways that were practical, and met them where they were in timely ways. A key element that enabled this type of flexible, emergent goodness of fit (Drago-Severson, 2009; Kegan, 1982) design was that I had a point of contact within the team who responded to my inquiries around what the group was grappling with and what they needed. For example, a couple of weeks before an action inquiry session, I contacted the whole group asking what they needed, and Karen was the one who offered input each time. Second, it was helpful to have an external subject matter expert who was experienced in action inquiry. The subject matter expert and I ensured a balance of theory and practice. As Shawn reflected in his feedback on the decision-making action inquiry session, "the practical approach is appreciated" (Shawn, written feedback, April 26, 2012). The biggest challenge in designing leadership development for early-career scientists has been to make it practical. An emergent design within the context of an action learning project that challenged the group on the individual, group, and system levels finally made leadership development practical.

Adaptation 5: Action Inquiry Space Helped the Group Stay Focused

Another element of the action inquiry space that early-career scientists found helpful in developing their leadership was having a facilitator and a subject matter expert who offered the group ways to take different perspectives and make it through complicated discussions. The facilitator helped the group through when they got stuck in the "groan zone" (Kaner, 2007, p. 21). This is a place where teams often get stuck and cannot move forward in dialogues: "[It was helpful] the very few times that we were spinning our wheels, you guys came in and sort of characterized what was going on and then we redirected. Having facilitators for complicated discussions is good" (Karen, action inquiry session, April 26, 2012). Another important element

of the facilitation was the positionality of the facilitator and the subject matter expert, who had some authority but were also external to the system and could offer an impartial perspective.. This created an adaptive learning environment where voice could be given to the unspeakable (Heifetz, et al., 2009). As Shawn offered in his feedback, "it's a luxury to have impartial arbitrators with authority" (Shawn, actin inquiry session, April 26, 2012).

Shawn added that the action inquiry session helped the early-career scientists move forward in ways that they could not have done using the methods that they had been using for their group work, namely email and phone calls: "We got a lot done that couldn't have been done without this time...that could not have been done over the phone or email" (Shawn, action inquiry session, April 26, 2012). Karen concurred: "Yeah, there were a lot of emails going back and forth about a lot of things, so being able to just sort of talk through everything [was helpful]" (Karen, action inquiry session #7, April 26, 2012). There was unanimous agreement that the action inquiry sessions were helpful for group project strategizing and planning because of the collaborative element. Peter gave voice to this finding:

> I think that we move forward a lot when we meet. I mean, there are only five of us here now. And I feel like this launches us ahead. I think there are a lot of side conversations that happen and people like to do their own thing and share what you know between you. And this [the action inquiry I session] is the opportunity to get together and move forward. (Peter, action inquiry session, April 26, 2012)

The action inquiry sessions helped create cohesion within the group of early-career scientists such that they transformed, over the course of the year, from being a group to being a team. As Peter stated, "we spoke about how to be a team, not a group" (Peter, action inquiry

session, April 26, 2012), or as Karen put it, “we work well together” (Karen, action inquiry session, April 26, 2012).

Summary of Learning Two

CDAI theory and methods helped early-career scientists to develop their leadership capabilities and navigate their adaptive challenges by creating a space that was flexible and adaptive for (1) connection, (2) making meaning of their adaptive challenges, (3) allowing creativity to emerge, (4) developing strategy, and (5) staying focused. All of these elements, that characterized the action inquiry sessions, supported and encouraged the early-career scientists through their adaptive challenges. These elements resemble the adaptive learning process that entails observing events, looking for patterns, and developing interventions or taking action (Heifetz, et al., 2009).

I suggest that the action inquiry space manifested as “protection” on outer and inner levels that, together, offered both support in the early-career scientists’ learning and encouragement to grow in their meaning making.

On an outer level, protection manifested as the monthly action inquiry sessions. The meeting space and the manner of meeting were informal and ordinary, yet firmly grounded in the intricate, dynamic, and complex CDAI theory and practice. This simple way of meeting created a cohesive community of inquiry. Early-career scientists derived a sense of belonging, and indicated that the action inquiry I sessions were what contributed to the sense of learning together and exploring leadership challenges with the intent to take skillful action. This learning space served as a place where early-career scientists could find respite and make meaning. Within this learning space, early-career scientists were able to give birth to the creative ideas of a

leadership project. Importantly, the action inquiry space enabled early-career scientists to stay focused when the adaptive challenge tactics began to cause confusion.

On an inner level, CDAI offered the best kind of protection by helping early-career scientists change their own minds and their own meaning making about their adaptive challenges. By changing their own minds, they began to take a different perspective on the challenge such that it did not have the power over them that it did before the CDAI sessions. For example, they revised their meaning making so that they could reframe an "attack" in a new way that did not seem so threatening. This impacted their responses to the "attacker." In this way, their best protection was the shifts they made in their own mind. They changed themselves instead of having to change their external conditions. They were able to make these revisions through the practices offered within the action inquiry space. For example, case-based learning supported the early-career scientists to raise their challenges and receive guidance from the collective intelligence of the group. The facilitator raised questions, made connections between comments raised, and offered perspective that helped the early-career scientists make meaning of their challenges. This, in essence, was "taking up our power," where power manifested as the ways in which their revised meaning making, in concert with tools for skillful communication, enabled them to take revised action in line with their values.

I have developed a model that depicts this learning (Figure 10).

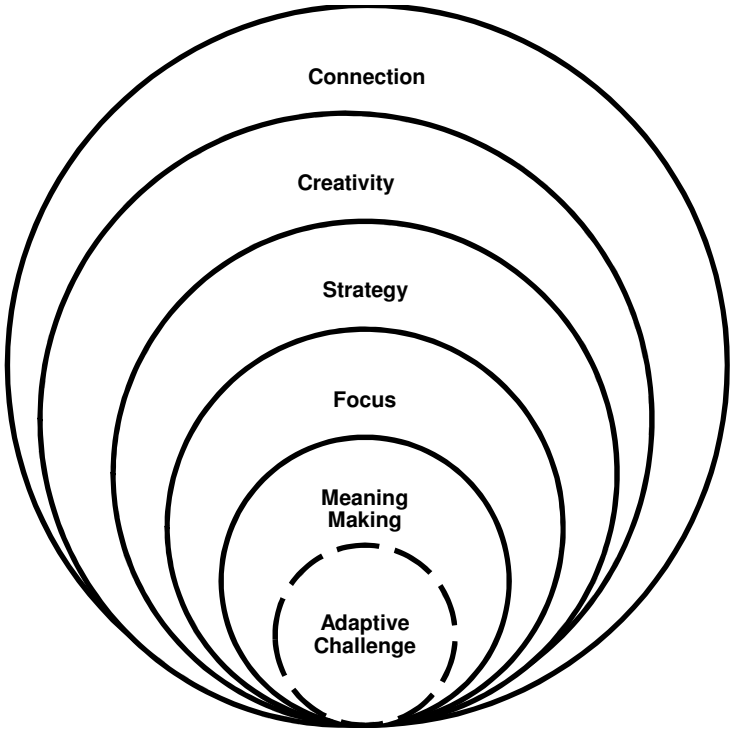

Figure 10. Learning two

The above model shows that action inquiry space adapted to create (1) a space of connection, and this represented **outer protection** from the doubt and discouragement the early-career scientists faced in their adaptive challenges. The action inquiry space also enabled (2) creativity to emerge, (3) early-career scientists to strategize on their action learning project, and (4) stay focused.

The action inquiry space also offered a more powerful level of protection at the level of the mind, that is, **inner protection** through helping early-career scientists (5) make meaning or reinterpret their challenges and face them in skillful and timely ways.

This section completes the analysis and summary of findings of the ways in which CDAI theory and methods helped early-career scientists to navigate their adaptive challenges. In the

next section, I share findings from an analysis of data that shed light on how CDAI methods and theory helped to create a micro-space of learning and leadership. In doing so, I address Research Question 3, which focused on what can be said about CDAI in creating a culture of learning and leadership.

Learning Three: Micro-Culture for Learning and Leadership

> "This was a precious learning experience. I feel like I learned a lot, I grew a lot by doing these things. I tackled a lot of things that I thought impossible, but then I still did it" (Jennie, Early-career scientist, November 2012)

In the first section of Chapter 5, I described the key adaptive challenge of "Not Enough Support" for learning and leadership. In the second section, I described how the action inquiry space was an adaptive and flexible space for leadership to emerge. In this section, I discuss the findings that emerged for Research Question 3: What can be learned about how the CDAI method can create a culture of learning and leadership at the individual, group, and system levels?

What I learned is that the CDAI method brought forth a transformative micro-culture of learning and leadership in the organizational system. *Micro-culture* refers to a structure within an organization for learning and development in mutually transformative ways. *Sustainable* means transformative, in that both the early-career scientists and the system learned new ways of being and taking up their leadership acumen when the time was ripe. For example, early-career scientists learned new ways to navigate through their adaptive challenges by reframing their perspectives, observing the dynamics of their new work culture, and inquiring and engaging with others on the basis of a common understanding of the work.

Culture of Learning—Individual

CDAI transformed the way that early-career scientists learned through their adaptive challenges, from single-, to double-, and even triple-loop learning. Before CDAI, there was no space where early-career scientists could raise their challenges. Furthermore, there was no space for even engaging single-loop learning (learning to change at the behavioral level, such as working harder, speaking more diplomatically). With CDAI and its emphasis on meaning making (Drago-Severson, 2009; Kegan, 1982; Torbert, 2004), early-career scientists began to demonstrate shifts from single- to double-loop learning (Argyris, 1976; Argyris & Schon, 1974), and even triple-loop learning. I describe the most poignant examples of learning in what follows.

Even though Tom only attended 70% of the sessions, he experienced a double-loop shift in the way he worked with others by evolving to a new strategy. Initially, Tom reported that he preferred to do all the work on his own even when leading the manuscript writing team. With the support of the action inquiry sessions, Tom's awareness of other ways to lead and engage his colleagues began to expand as he heard different perspectives: I think the case-based studies were really helpful, to kind of hear different scenarios that come up with different assignments and how they go about working through different challenges and opportunities (Tom, interview; November 2012). With the support of case-based learning and action learning, Tom began to try out new strategies for working with others:

> Over the past year I have improved my team working, like being able to work on a team and contributing. I try to determine if there's a certain project, who that I work with would be good, and like to use their strengths to help move things along, and not do too much myself (Tom, interview; November 2012)

Tom made an important shift from a single-loop linear approach of working harder individually to a double-loop strategic shift in leveraging other people's strengths. Tom reported that he started to shift from being an individual contributor to working collaboratively with others. Tom is an example of how action inquiry with others helped to overcome the challenge of shifting from being an individual worker to a collaborative and adaptive leader. The inability to make this shift was one of the key problems that arose across adaptive challenges within the organizational unit.

Karen started off with single-loop behavioral adjustments in response to her micromanaging supervisor. She tried to advocate for more space and freedom, and when that did not work, she brought up her adaptive challenge at the action inquiry sessions. The action inquiry sessions were most helpful for Karen because they allowed her to "speak up about it from a systems perspective" (Karen, personal conversation, 3/21/2013). Karen spoke openly and honestly about her adaptive challenges. As she did, she began to demonstrate an openness and vulnerability to her situation. Despite her attempts to make changes in her behavior in response to her micromanaging supervisor, she began to observe that "change is painful" (Karen, CDAI session #4):

> I think that the question of back off or move forward…I feel like I've tried a little bit of each, but perhaps it hasn't been consistent enough, and one of the things that stood out in the Heifetz book was that sort of change is painful, and you have to do things that are outside of your comfort zone. So I think I've probably stayed within the bounds of what's comfortable in terms of either backing off or moving forward and it hasn't worked. So I think that doing one of those more consistently and in recognition of what her needs are. (Karen, action inquiry session #4)

When Karen spoke of "back off" or "move forward," she was referring to her single-loop behavioral change in response to her supervisor. A poignant reframe occurred as she reflected in action and recognized that she had been staying within the bounds of what was comfortable, and that had not produced the outcomes she wished. She then began to make a shift in perspective and worldview. This is an example of double-loop learning in the context of the action inquiry sessions. Karen began to learn to be open to different perspectives about what could be occurring, and instead of intensifying a behavioral change (e.g., working harder, advocating more), she changed her strategy. The action inquiry sessions offered her double-loop feedback that allowed her to make a fundamental shift in her strategy. She started to view her supervisor and herself as part of a system and noticed that perhaps her supervisor could be reacting out of her own fear and not purposely trying to limit Karen.

One year later, in a triple-loop reflective moment, Karen indicated that what had enabled her to adapt to her situation was to apply a notion she had learned in the action inquiry session, namely the notion of "taking up my power" (Karen, personal conversation, 3/21/2013). She decided to leave her work unit because: "I could succumb to this [micromanagement] and do what she wanted, which would mean letting go of what I value or find a way to get out" (Karen, personal conversation, 3/21/2013). Karen "took up her power" and made the decision to leave her work unit based on her values. In triple-loop learning, what is cultivated is a "quality of awareness" (Torbert, 2004, p. 20) that can recognize a disharmony in one's values. For Karen, speaking up about her challenges in the action inquiry sessions and getting feedback on different perspectives from her peers and facilitator helped to raise her awareness. This "triple-loop" awareness helped her sense the incongruity between her vision of herself as a worthwhile person

and the way that the micromanagement was making her feel—"invalid." As she indicated, "Who I am is not invalid because of the situation I am in" (Karen, action inquiry session #4).

Similarly, Richard expressed hints of triple-loop learning in re-visioning himself and his career path as a result of the action learning experience. In response to the question of what he had learned, he said that the whole experience enabled him: "to discover myself in the process, to find out whether or not I fit into this environment or not; this is very important to me" (Richard interview, November 15, 2012).

One of the unique features of action inquiry is that it suggests that change happens when our action logic, or the way we make meaning, transforms (double-loop learning) or aligns (triple-loop learning) across four territories of experience in the moment (Torbert, et al., 2010). Specifically, triple-loop learning occurs when we awaken our awareness to see the "incongruities" (p. 5) across all four territories of experience. According to Torbert and colleagues (2004), the four territories of experience consist of the first (outside events, results, observed behavioral consequences), second (our own sensed performance), third (action logic, strategies, meaning making), and fourth territory (vision, intention, presencing, awareness that can see/sense the incongruities among the other territories). The leverage point for noticing incongruities across the four territories is inquiry (Torbert, et al., 2010). For example, through inquiry into our own actions, we may notice that our ineffective performance (second territory) is not consistent with our integrity (fourth territory). In noticing this misalignment, we can make single- (behavioral), double- (strategy), or triple-loop (vision) changes. Each of the incidents described above is evidence of deeper orders of change (double and triple) in the context of the action inquiry sessions. Karen sensed a misalignment between her first territory (the outside

events of her micromanaging supervisor) and her second territory (her own sensed performance). After engaging in inquiry in the action inquiry sessions and in her own personal action inquiry consisting of reflection, she decided to engage in a triple-loop change—she changed her vision of where she wanted to succeed.

Triple-loop learning also occurred for Richard when he "discovered himself" which, in working with him, I interpret to mean he learned about the impacts of his way of communicating, his work culture, and his approach to work, where he valued "academic freedom." He discovered that these were not in alignment with his vision of speaking the truth; therefore, he decided to make a triple-loop change and leave the CGW system. Speaking the truth is the antithesis of the adaptive challenge archetype, Speaking the Unspeakable (Heifetz, et al., 2009). In this way, the action inquiry sessions helped Richard overcome his adaptive challenge marked by challenging communication with his supervisor: "I think the thing I've learned here that I could take away, including as I said, the individual communication skills. I need to continue to improve, and that's probably a lifelong process" (Richard, individual interview; November 2012).

Karen exhibited double-loop learning as shifts in her strategy when engaging with her supervisor. In response to the question, "What was your most important learning?" Karen indicated that it was learning to take perspective:

> Well, if we can frame it as like the biggest benefit, it was just the multiple perspectives. Because I think particularly when someone is unhappy, vision gets very myopic and everything seems bigger and more important and more fixed and concrete than it actually is. And so being able to talk openly in the groups was really beneficial, and there's such a diversity of viewpoints and different strengths that everybody brought to the table. (Karen; interview, November 2012)

This is an example of double-loop learning because it refers to taking on a different strategy. A powerful moment emerged in the interview when Karen shared a deep insight grounded in wisdom and compassion regarding a possible reason why her supervisor had been such a micromanager. Karen's learning was shifting from thinking that her supervisor, Lauren, wanted Karen to fail to seeing what underlay her supervisor's actions, that maybe it was her supervisor's fear and anxiety that was driving her to be a micromanager:

> I do have you to thank for this idea of "it's fearful." It's fear and anxiety that makes people impose their ideas on others, so that's another major take-away from this, is not to see—people aren't inherently—and I know that my supervisor didn't want me to fail, but all of her actions, which I came to see as based in anxiety, were geared toward, ironically, having me fail, because I couldn't sort of do things in the way that…I wanted to, to be successful. (Karen interview, November 2012)

One of the advantages of doing action research in one's own organization was that I was present, as part of day-to-day business, to see the ripple effects of this action research study. For example, in a rare moment of spontaneous data triangulation, Karen's insight above—which had resonated with my suggested perspective shift—was confirmed three months later when Karen's supervisor, Lauren, informally shared her reflections with me. Lauren shared that she had been reflecting and realized that she had been micromanaging Karen because of her fear of failure. As a new supervisor, she was scared of failing Karen, of failing her own supervisor, and of failing herself. Lauren's response was to try to control and direct everything (Lauren, personal communication, February 2013). This is an example of systems upon systems impacting each other.

A remarkable learning from the action inquiry sessions was that taking perspective gave early-career scientists more data to base their conclusions on. In many cases, this opened them up to new and more effective ways of interpreting their adaptive challenges from a place of compassion. The immediate impacts were felt in a sense of freedom from struggle. As Karen indicated, in response to what changed when she realized that her supervisor could be micromanaging her due to fear, she did not feel so irritated by the structures that her supervisor imposed on her to gain control and predictability:

> I didn't feel so irritated by them. It was more like, "Oh, okay, I can be flexible in a way that you're showing me you can't be." And so it made me feel better about the situation. I felt that I could come off well in that situation by rising above the pettiness of the anxiety that was causing those actions on the supervisor's part. (Karen interview, November 2012)

This is an example of the inner protection offered by the action inquiry space vis-à-vis helping early-career scientists make meaning of their challenges. When Karen made new meaning of her challenge, her irritation diminished, and she was able to do this without a change in her external situation.

Peter expressed a double-loop shift to a new strategy in facing adaptive challenges from not being aware that it is possible to adapt to now seeing every situation through a new perspective of adaptive strategies: "I would say that before this (action inquiry groups), I would not take an adaptive measure, but after this, almost every situation I see myself in I think in terms of adaptive strategies" (Peter, interview; November 2012). Peter elaborated that his new learning involved opening up his awareness to what is important for other people and engaging them in conversations:

> I try to see what the other parties, what is key for them, and how to use all those things, framing your question and framing all those things that we talked about, so that I'll be able to adapt to a given situation to be effective (Peter, interview; November 2012)

What Peter referred to above as "framing your question" is the Four Parts of Speech tool that begins with framing one's conversation with others. The facilitator and CDAI subject matter expert repeatedly modeled this tool during the action inquiry sessions. Peter learned that by framing his conversations with others he could engage them in more mutual ways and discover "what is key for them". For Peter, this was an important part of his learning in being more adaptive - which is essentially taking on a systems perspective of observing and inquiring into the different stakeholders in a system. This awareness of a system enables one to take on a more skillful action (Heifetz, Grashow, & Linsky, 2009; Senge, 2006).

The adaptive learning early-career scientists experienced is applicable not only to CGW but to other contexts involving different organizational cultures:

> Because everywhere, I mean in CGW if we stay here, we've learned a lot about culture. If we should leave this place go to a different culture, at least one helps you to put things in perspective in that way. So I'd say they were good sessions. (Peter, interview; November 2012)

Different organizational cultures working in in applied contexts face challenges that require learning together to understand the problem and, in the learning with others, develop solutions. Learning to adapt and evolve within those cultures is an important capability.

The above analysis outlines multiple incidents of double- and triple-loop learning that occurred in the context of the action inquiry sessions. The shifts in strategy and alignment of intention and action enabled early-career scientists to become more adaptive from within the challenges they faced

Culture of Leadership—Group

CDAI methods transformed the way the early-career scientists saw themselves as leaders—from seeing leadership as irrelevant, to taking up their leadership acumen when the time was ripe. This was evident in the action learning project, where the early-career scientists took on a leadership project of scope and complexity never taken on by any previous CGW scientific fellowship program.

For Jennie, the action learning project gave her an opportunity to adapt her work style to meet the needs of the group. She shifted from a single-loop behavioral style of running every detail of her work by the team and following every rule invoked by the formality tactic to a double-loop change in her strategy. She felt the single-loop approach was "too inefficient" (Jennie interview, November 2012). Instead, she evolved to taking up her leadership on her piece by trusting herself to fulfill the group's vision in concert with asking for feedback from the group. Going from single-loop linear thinking to double-loop adaptations in strategy for the benefit of the group required that Jennie engage actively across the organizational system. In doing so, she learned the complex capability of knowing when to break rules:

> You need to find a balance. You cannot strictly follow all the rules all the time, because if you do that, you cannot do anything. But still, you need to find a way to not obey the rules but still get your things done. I needed to be a little bit flexible. (Jennie interview, November 2012)

In learning how to practice her adaptive capabilities of **observing** the events and patterns around her, **interpreting** what she was observing, and **designing** interventions (Heifetz, et al., 2009), Jennie learned to take up her leadership, and this made her feel as if she had "more power" (Jennie interview, November 2012). For example, Jennie observed that one of the senior-career scientists, who had initially been an ally, was now constantly listing reasons why elements of the action learning project would not work. Jennie noticed that: "She's more…inflexible, and she's the kind of person who wants to follow all the rules, who is kind of afraid to offend other people or other authorities" (Jennie interview, November 2012. This is an example of a remarkable shift in learning for Jennie who, in my experience of working with her, was initially paralyzed by the restrictions this rival was imposing. However, over time Jennie was guided not just by the limiting single-loop feedback from a hierarchical superior; rather, she observed this person's behavior and was, instead, led by double-loop transforming feedback where she learned to work with her team "to weigh all the opinions and then make the final decision" (Jennie interview, November 2012). This adaptive move is an example of how the early-career scientists learned to navigate the adaptive challenges of implementing a leadership project in the context of internal rivalry. Furthermore, in comparison to her work unit, where Jennie primarily worked alone, the action learning leadership project gave her the opportunity to understand the "bureaucratic structure of CGW" and "know the whole system and how to make things work, or who to seek help from to make things happen" (Jennie interview, November 2012).

In working with others within her team and across the system, Jennie had the "precious learning experience" of doing things across the CGW system that she had once thought "impossible" (Jennie interview, November 2012). In this way, the action learning project gave

Jennie the chance to take up her leadership, become more aware of the culture of CGW, and practice communication—all with the impact of deeper levels of learning.

Peter also expressed learning about the culture of CGW through the action inquiry sessions and action learning project (the whole year experience):

> I understand the CGW culture a lot better now than when we started, and how to adapt to it…Because that challenge [the challenge of leadership development through action inquiry groups] helped people to put a lot more things into perspective. To see the whole (Peter, individual interview; November 2012).

The way in which the action inquiry sessions were adapted to meet the learning and leadership needs of the early-career scientists helped the group "see the whole" of what it means to work in an applied environment – which importantly includes naming and working through adaptive challenges in complex organizational context and culture.

For Karen, the leadership action learning project helped her realize that she was essentially good at what she did. In her work assignment, she had felt unsuccessful, given the micro-management environment she was in. However, in the action inquiry space she saw that she could be successful:

> I think that I sort of came to do the conference as an experiment in, "Okay, I see what I don't like about how I'm being managed. Is it possible for things to come out right when we do something that's completely the opposite of that?" And the conference gave us an opportunity to do that, which was sort of have people identify what they want to do, do their own thing, divide the work, come back together as necessary, and produce a product. So it was really gratifying to have that experiment be running while I was experiencing something that to me felt

> very negative. To be able to see or to prove that things could be done differently and be very successful was nice. (Karen interview, November 2012)

This is an example of triple-loop learning, in that Karen was able to use the project almost as a case-control study where she was both the case and the control. In this context she saw that the action inquiry space yielded better outcomes than her supervisory situation.

The shift to an action learning project enabled the early-career scientists to apply their learning on adaptive challenges to a more complex collaborative project at the organizational system level. As Peter observed - the notion of adaptation was something that the team could apply to the project:

> It's like it still brings the team back to talking about adapting, adapting. So challenges do come and you have to adapt. So we could remember that most of the time when we see that we have this challenge, come back and say that let's just adapt. If going this way is not helping us, let's adapt. Let's change it and go this way (Peter, interview; November 2012)

The key insight that Peter expressed above of stopping to reflect and change the course of work when the existing approach is not working is extremely relevant when working under complex and changing conditions (Heifetz, et al., 2009).

In reflecting on the benefit of the action learning group project, Shawn suggested PhD level scientists, like himself, are "pretty good" at the technical aspects of work and that much of the training offered in the post-doctoral program are technical: "But for people coming in with PhDs, I feel like I'm pretty good at technical aspects, and a lot of the trainings are geared toward technical aspects" (Shawn, Interview; November 2012).

Shawn suggested that the program consider removing the technical trainings to allow time for the adaptive learning in the group project:

And then this group project takes up so much time that if you eliminate all the other trainings, would you have time to do this group project? For the people that put in the most work...probably yes. And then I was thinking, oh, could you actually remove those [technical] trainings? And I was thinking, well, probably yes too. It's an even riskier strategy to eliminate all that stuff, but—to be considered (Shawn Lloyd, Interview; November 2012).

Shawn was one of the most skeptical early-career scientists in the group at the outset. For him to suggest that the technical training be removed in lieu of more relevant adaptive learning is testament of the transformative nature of joining action inquiry and action learning methodologies. Furthermore, it is an example of how the action learning project offered an opportunity to learn capabilities that are typically not offered in academic programs that emphasize informational learning versus transformational learning (Drago-Severson, 2009).

Richard also expressed a transformative shift in the view of adaptive learning: "I think it was a great experiment. Although as you understand, not everyone, including me sometimes, had a little bit of skepticism about the whole thing" (Richard, interview; November 2012). Richard remembered that he had expressed skepticism at the beginning but engaging the action inquiry sessions and action learning project shifted his view, as he indicated: When we got to the whole experience of working together with other early-career scientists especially for the conference, I think this was very valuable" (Richard, interview; November 2012).

Heather, due to her absence, was not intricately involved in the action learning project. When she attended the outcome of the project, which was the conference, her reaction was one of pride in the work completed by her peers. As she indicated, "It was good. I'm like...you guys

did a really great job. I was proud of them, because it was really good" (Heather, Interview; November 2012). Even for someone that was not involved in the action inquiry groups, Heather could see the impacts the early-career scientists had by working together in the action learning project. Similarly, Tom, who had not been as engaged in the project as others said "I thought it was really nice to kind of see the finished product that everybody was working on for so long. It turned out really great" (Tom, Interview; November 2012).

As the above analysis demonstrates, CDAI methods, combined with the group action learning project, created a context for early-career scientists to enact their leadership on behalf of themselves, their team, and the organizational system. Their action learning project, of designing the first ever CGW scientific conference, was successfully implemented, and attendance was 400% more than they expected. The conference received visibility at the highest levels of the organizational system, including that of the director of CGW. In this way, CDAI methods transformed the way the early-career scientists saw themselves as leaders, from seeing leadership as irrelevant to taking up their leadership acumen in timely ways.

Culture of Learning and Leadership—System

CDAI methods created a unique micro-culture for learning and leadership at the system level. The system level refers to the organizational unit, the Quantitative Science Fellowship Program (QSFP) that recruits, develops, and places the next generation of scientists at CGW. For example, based on the impacts of CDAI at the system level, there is now a demand for the CDAI approach to be used for the development of leadership among early-career scientists, and the program director has already requested that CDAI methods be the methodology for ongoing leadership development of early-career scientists. In a recent email to me, he asked with

conviction, “When are we starting the action inquiry groups for the next cohort of early-career scientists?” (Ryan, email communication, 3/20/2013). A key impact of the action learning project was raising the visibility of early-career scientists in a large hierarchical system, where they “did not have a voice” (Elizabeth, AR meeting #3). Supervisors are now asking when the next action learning project will be scheduled: “When are the early-career scientists going to do another conference?” (Supervisor communication to Ryan, February 2013). Additionally, Shawn, the early-career scientist who was one of the leaders of the action learning project, indicated that the next cohort of early-career scientists, in seeing the impacts at the system level, are asking to do an action learning project. As Shawn indicates, “I did get some feedback from first-year early-career scientists that they wanted to put on another conference. I told them that they did not know what they were getting into, but they persisted. So there is interest for the next project” (Shawn, email communication, 3/20/2012). Based on the observed outcomes at the individual and group level, the system (the particular work unit) is re-shaping to accommodate a new way of learning and leading.

Part of creating a new culture of leadership is the heightened awareness of what it means to be a leader in the context of being a scientist. Karen embodied this heightened awareness in the distinctions she subsequently made:

> Thinking about the value of this [the action inquiry sessions] in the context of the fellowship, if there’s an exclusive emphasis on technical skills, you’ll end up with people who are very technically competent. If the entire emphasis is to make leaders out of the early-career scientists and the scientific cohort here, this is moving in that direction, more so than repeated methods sections that don’t give

> early-career scientists a chance to talk about the experiences and frustrations they're having. (Karen, Case-based learning; January 19, 2012)

Karen highlights the distinction between the "technically competent" and "leaders." She indicates that "this," that is, the action inquiry sessions, is going in the right direction of developing leadership among the early-career scientists. The awareness that there is a difference between technically competent and making progress on adaptive challenges is an important finding in this study. The integration of the action inquiry sessions into the ongoing leadership development of early-career scientists at CGW indicates that there is a good possibility that, over time, this greater awareness of the relevance of leadership in being a good scientist will be part of the culture within the organizational system.

Beyond the individual and group learning impacts outlined above, there were also third-person impacts (Torbert, 2004) at the organizational level: (1) increased collaborative opportunities, and (2) increased visibility of the program, and (3) learning for the system on how to better create a learning and leadership environment. For example, the conference raised awareness of the program among external CGW stakeholders, and generated interest in collaborative long-term engagements. A high-profile scientific-disciplined professor from a local Ivy League university attended the conference, and was encouraged by its joining of theory and practice. This inspired her to begin dialogues with Ryan regarding a collaboration between her university and the program for a revised, more practical PhD in science. Additionally, one of the conference panel speakers was inspired by the event and initiated a collaboration with a CGW office to host an early-career scientist next year. This kind of inter-entity collaboration is unprecedented. Another impact is that at least two doctoral candidates who attended the CGW

conference now want to apply to the post-doctoral program. High-level leaders from CGW showed up as well, signaling to others that this was an important event.

The experience of the action inquiry groups and engaging the action research team offered learning to the organization on the challenges early-career scientists face and what conditions enable them to adapt and evolve beyond those challenges. Richard, expresses this learning for the system:

> I do believe that there are logical lessons that can be learned [from the action inquiry groups] not only for the early-career scientists, but also for the CGW as an institution. If we really want to keep people here, especially people with a strong scientific background, we need to figure out exactly how they can, not only train them, but also how to accommodate them as individuals, as equal peers, and as somebody who could be innovative within the bounds of the institutions (Richard, interview; November 2012)

By creating learning conditions where early-career scientists can feel acknowledged for whom they are and their creativity is an essential way to retain staff.

In reflecting on the impact the action learning project has had on the system, Shawn indicates that there is "so much inertia" that people now assume that action learning is now an inherent aspect of the system:

> there's so much inertia here that I think people see this conference has happened. Oh, this conference has always happened. So that's a measure of success that, oh, this thing has happened; this thing will always happen. But nobody appreciates that it's a risk because it went off so well (Shawn, interview; November 2012).

The action learning project outcome was so successful that people now assume it will always happen, as Shawn expressed. The imprint that this project had has created a groove or a pathway for the next action learning project.

Action inquiry and action learning also helped to develop a sustainable team culture: "This is all about teamwork, teamwork. It helps you to develop a team culture that lasts (Peter, interview, November 2012)". Additionally, the project was something that was tangible enough for early-career scientists to look back at as an outcome of action inquiry and action learning: "everybody can look back to the conference as the main thing that happened during this process, which without that, maybe they would think that [the process] was more negative than positive" (Peter, interview, November 2012).

As the above analysis demonstrates, combining action inquiry and action learning methodologies enabled three levels of impact: shifts in learning at the individual level, group learning, and a demand for this learning sub-culture, made possible by the action inquiry methods, to continue at the system level.

Summary of Learning Three

What I learned is that CDAI methods developed a *learning and leadership micro-culture* by creating a flexible and adaptive space where deeper levels of learning (double- and triple-loop learning) could take place at an individual level. On a group level, within this micro-culture group leadership emerged. CDAI methods helped to adapt the space to offer learning resources, such as decision-making tools, that met the early-career scientists right where they were. In this way, the action inquiry space continued to support and encourage, but now on a group level. The group leadership that emerged had impacts across the organizational system. These impacts

generated the tangible evidence that organizational sponsors and other relevant stakeholders needed in order to support that this micro-culture continue.

To demonstrate how CDAI has helped to begin to make shifts in the culture of learning and leadership, I developed a model (Figure 11):

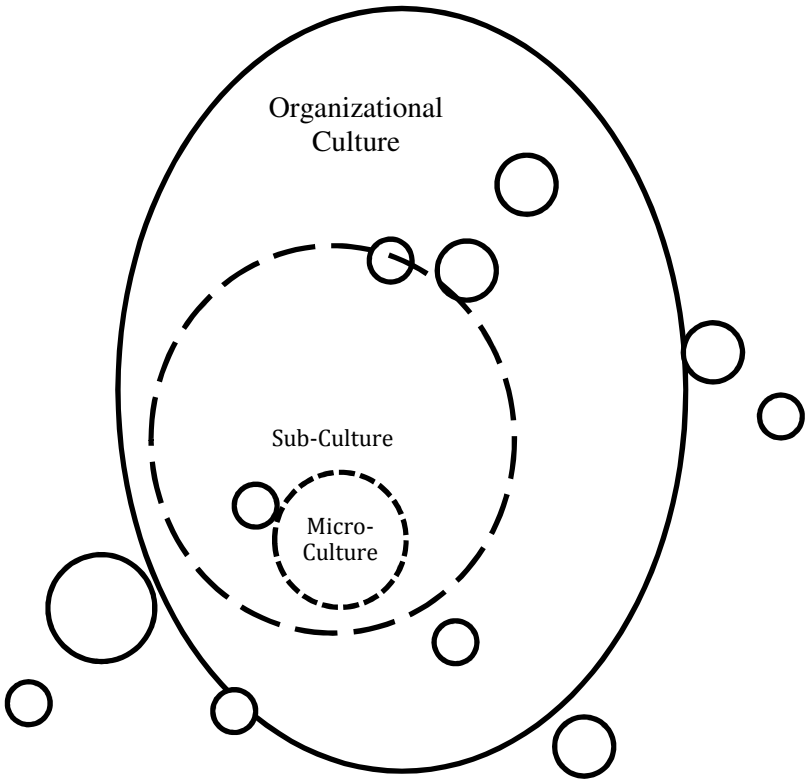

Figure 11. Learning three

The above model demonstrates how CDAI methods created a micro-culture of innovation within the organization, where adaptive learning and leadership can now occur. This micro-

culture is having an impact on the early-career scientists' sub-culture within the CGW organizational culture.

This section completes the analysis and summary of findings of the ways in which CDAI theory and methods have initiated a micro-space of learning and leadership at the individual, group, and system levels. In the next chapter (Chapter 6), I conclude this study by offering implications of the learning claims made in Chapter 5.

CHAPTER 6

IMPLICATIONS AND CONCLUSIONS

Introduction

It is the beginning of spring in Atlanta, Georgia. The dogwood trees are blooming with their bright white flowers, and the azaleas adorn the streets with colors of pink, purple, and red. The sun shines brighter and longer over the days. It is a new season, and I am reminded of the reality that in order to have Spring we must have Winter. And in order to have Winter we must have Fall. Each season creates the conditions for the other to emerge, and this highlights my motivation for conducting this research. In order to grow the next-generation scientist, we need to create the conditions for the development of a "well-rounded" scientist, one who is not only technically adept, but is also poised to meet adaptive challenges. We cannot solve adaptive challenges with technical, linear thinking. We cannot develop scientists who are only technically smart and who, because of their technical credentials (e.g., a PhD or MD), are put in positions of leadership. The moment they enter the dynamic and messy complexity of working with others, they generate the adaptive challenge archetypes that Heifetz and colleagues (2009) have seen as patterns of ignorance in dealing with adaptive challenges. We cannot have staff working in applied fields, marked by adaptive challenges, who are only able to solve challenges technically. Organizations operating in applied fields, such as health fields, need not only their leaders in positions of authority to be adaptive leaders, but also people at all levels of an organization. When all levels of an organization are engaged in learning, then the organization is poised to be a learning organization (Senge, 2006; Watkins & Marsick, 1993, 1996). Then the organization, its

leaders, and staff can mobilize each other to solve adaptive challenges in mutually beneficial ways. However, first an organization must be brutally honest about the adaptive challenges it faces (Collins, 2001).

The focus of my study was to first inquire into the types of adaptive challenges that a group of early-career scientists faced, and then to apply learning approaches that supported and challenged them to grow their capabilities for skillful and timely action. From my experience working in the applied scientific context of this study, I noticed that the Achilles heel of this technically-oriented organization grappling with adaptive challenges (Heifetz, et al., 2009; Koh, 2009), was something other than technical acumen. My hunch was that, because the challenges in many applied fields are adaptive (Koh, 2009), practitioners in technical fields must also have capabilities to navigate the complexity of adaptive challenges. The challenge I was faced within this study was that the group of scientists, and many who supported their development, did not understand the value of leadership development; therefore, they had little to no interest in engaging in learning about their personal leadership challenges. Yet the data showed that the most frequent challenges these scientists faced were not rooted in technical problems. Rather, the most frequent challenges had to do with their ability to lead themselves – to adapt and contribute to their new work culture. However, as I reflect on the outcomes of this study, I see that the participants did more than just adapt to the conditions of the organizational culture. They went beyond being able to operate in the culture to actually changing how the organizational system viewed these emerging scientific leaders. Had they adapted to the conditions, they would merely be operating efficiently within the constraints of that system. What I learned is that the CDAI methodology functioned as a sacred space that enabled these growing scientists to transform beyond the systemic constraints they encountered.

As I pause to reflect on the adaptive challenges we face at the individual, group, and system levels, I am humbled by the scope and complexity of these challenges. We live in a time with overwhelming challenges—the global financial crisis, the health care crisis, recurring wars, increasing percentages of obesity, addictions, gang violence—to name a few. We live in a global system that is not generating the outcomes we wish for. If the system we are in, whether it be our family, community, or work, is not generating the outcome (Senge, 2006) we wish for, we must change. This change often involves deep feelings of loss (Heifetz, et al., 2009), and leadership involves creating the conditions where people can navigate the pain of loss to come out on the other side of change—a new way of being, a new way of working, and new systemic outcomes that are sustainable, just, and genuine.

How do we even begin to tackle challenges at that level of complexity? We need to start with the root cause. In applied fields such as the health field, the challenges are adaptive (Koh, 2009). One of the common mistakes in working through adaptive challenges is trying to resolve them as if they were technical (Heifetz, et al., 2009). This case study is an example of an adaptive challenge in an applied field, whereby the program was increasing its technical training when the underlying challenge was adaptive in nature. We (my AR teams and I) started by using CDAI theory and practice to guide our inquiries into the outcomes the system was generating. We framed our inquiries as: "What are the challenges that early-career scientists face?" This question, supported by an environment of careful inquiry and brave experimentation, led us on a remarkable journey, where the group of early-career scientists transformed from being skeptical about leadership development to fully engaging in an unprecedented leadership challenge that left an imprint on the system—an imprint of change and the grooves for more to come.

In what follows, I discuss the implications of this study for theory and practice. I begin the chapter by reminding the reader of the three key findings that emerged in this study. I then outline the claims I make based on these findings and their implications for theory and practice. Along the way, I make the reader aware of my biases and the limitations of my research. I conclude this chapter with a reflection on the impact this research has had on me.

Purpose of the Study and Research Questions

The purpose of my study was to develop leadership capabilities among a group of early-career scientists working in an applied context. I believed that this group, due to their incredible technical skills and their transition to an applied environment, would offer the most challenging context for exploring how to develop adaptive leadership capabilities. Furthermore, I believed that what I learned from working with this group and their mentors and supervisors (two AR teams) might generate insights for how to develop the capabilities needed to meet the challenges we face in our work, families, communities, and larger global systems. The assumption behind this inquiry was that this study could help solve the paradox of how to develop adaptive capabilities in a context where those who are faced with adaptive challenges are either closed to such learning or there are no incentives for such learning. As I explained at the outset of this document, a paradox was at the heart of my inquiries. The challenges were adaptive, but the emphasis and interest were on technical training. I was interested in how facilitators of adult learning could better support the development of adults at all levels in an organization or system to learn how to work with adaptive challenges instead of struggling under them. What I discovered is that early-career scientists faced unique adaptive challenges, and that the CDAI method helped to create a space for naming and exploring those challenges. Over time, naming

and exploring the challenges with a methodology that focused on meaning making not only developed adaptive capabilities, but also generated a willingness to take on more complex adaptive challenges. This study takes the notion of "adapt" to the next level of "evolve." Early-career scientists engaged in deeper levels of learning (e.g., double-and triple-loop learning) to adapt, then evolve, beyond the constraints they faced.

The following were my three research questions.

My Research Questions

(1) What are the leadership challenges that early-career scientists face in the transition to an unfamiliar, multiprofessional, and multidisciplinary applied context?

(2) How does a Collaborative Developmental Action Inquiry (CDAI) method work in practice to identify leadership challenges and develop leadership capabilities?

(3) What can be learned about how CDAI methods create a culture of learning and leadership at the individual, group, and organizational system levels?

What Surprised Me

Prior to discussing the implications of my findings, I return to the assumptions I had at the beginning of this research. Through a Constructivism lens, I had assumed that adults actively interpret or make meaning of their realities (Kegan, 1982). Constructivism is an adult learning theory indicating that we learn by how we make sense or construct meaning of our experience (Merriam, Caffarella, & Baumgartner, 2007). I also assumed that adults can develop the way they make meaning if they are provided with the supports and challenges that are developmentally appropriate (Drago-Severson, 2009; Kegan, 1982). Additionally, I believed that adults who make meaning in increasingly complex ways are more effective in leading (Rooke &

Torbert, 2005) themselves, engaging in leadership with others, and having positive and sustainable impacts on an organizational system. I entered this research expecting that if my AR teams and I could create developmentally appropriate conditions for the early-career scientists to make meaning of their adaptive challenges, we could transform the way that they enacted their leadership in positive and sustainable ways. At the same time, I was surprised by the extent to which leadership emerged within the group of early-career scientists—they led a project that had the visibility of the highest level of the organization. I was also surprised by how the fragile creativity that emerged from within the group survived attacks from an organizational system not primed to support early-career scientists. I was astonished to find out that the action inquiry space was what helped create protection for creativity to emerge, dwell, and thrive.

I assumed that the CDAI theory and method would be valuable when adapted to the local context. However, it was impossible to predict who would benefit from the CDAI method and its practices. For example, I thought that those who seemed least interested would likely drop out of the study. However, the action inquiry space met people where they were in magical and unpredictable ways, such that those who seemed least interested eventually and quietly emerged as leaders by the end of the study.

In my personal case, while I was aware that implementing this complex project would be challenging, I was surprised by how much this research was a mirror for me, both of my struggles and my leadership capabilities. Working so closely with the early-career scientists and the action research team, I noticed moments when the participants and I mirrored each other in our struggles. When I experienced challenges in finding meaning in an organizational culture that is quick to judge and slow to acknowledge, it was uncanny to see that same sentiment expressed in the group. To rouse courage and generate flexibility of mind in the midst of doubt

and uncertainty became a collective experience and learning. As I reflect, on the numerous actions I took on a daily basis to enable this research to survive and flourish, I saw my own leadership capabilities grow and bloom. I worked through scary, messy, and perplexing dark forces and I have come out on the other side smiling at them.

Summary of Findings

Learning Claim One: "Not Enough Support"

Adaptive challenge: Not enough support and encouragement for learning and leadership. The first learning claim that I made was in response to the first research question: What are the leadership challenges that early-career scientists face in the transition to an unfamiliar, multiprofessional, and multidisciplinary applied context? What I learned was that each of the seven early-career scientists described unique situations, but there was a pattern that connected them. This was that, in their attempt to move forward and do their best learning and work, they faced a pattern of *Not Enough Support for Learning and Leadership*. The external conditions of their work were not supportive or encouraging enough to help them meet their vision of being good learners and good emerging scientists. The unsupportive conditions manifested as inadequate skillful supervision or mentorship. What early-career scientists needed was supervision and mentorship that went beyond vigilant oversight and unresponsive shadow presence. Additionally, the unsupportive external conditions also manifested as colleagues who did not know how to take up their leadership to support the early-career scientists in their path toward contributing and leading.

When the early-career scientists worked across organizational boundaries, they encountered multiple, confusing, and unpredictable obstacles. However, what they all had in common was the same archetypal element—the challenge of lack of support and encouragement.

To overcome or make progress on the adaptive challenge of *Not Enough Support for Learning and Leadership*, early-career scientists learned their way into creating that support for themselves. This involved creating internal and external conditions to protect themselves from the obstacles within the adaptive challenge.

Learning Claim Two: Flexible and Adaptive Space

CDAI methods generated a flexible adaptive space for learning and leading. The second learning claim that I made was in response to the second research question: How does a Collaborative Developmental Action Inquiry (CDAI) method work in practice to identify leadership challenges and develop leadership capabilities? What I learned is that the action inquiry group space adapted in the following ways to support early-career scientists through their challenges: (1) connection, (2) making meaning of their adaptive challenges, (3) allowing creativity to emerge, (4) developing strategy, and (5) staying focused. The action inquiry space offered the good support that the early-career scientists needed to meet their adaptive challenges. The space manifested as "protection" on outer and inner levels that, together, offered both support in their learning and encouragement to grow in their meaning making.

On an outer level, protection manifested as the monthly action inquiry sessions. The meeting space and the manner of meeting were informal and ordinary, yet firmly grounded in the intricate, dynamic, and complex CDAI theory and practice. This simple way of meeting, firmly grounded in CDAI theory and practice, created a cohesive community of inquiry. Early-career scientists derived a sense of belonging, and indicated that the action inquiry sessions were what

contributed to the sense of learning together and exploring leadership challenges with the intent to take skillful action. This learning space served as a place where early-career scientists could find respite and connect. Within this learning space, early-career scientists were able to find their strength, and this enabled the innovation and creativity of the group's leadership to emerge and survive.

On an inner level, CDAI offered the ultimate kind of protection by helping early-career scientists change their own minds, that is, their own meaning making of their adaptive challenges. By changing their own minds, they began to take a different perspective on the challenge, such that it did not have the power over them that it had before the action inquiry sessions. For example, they revised their meaning making so that they could reframe the "attack" in a new way that did not seem so threatening. This impacted their responses to the "attacker." In this way, their best protection was the shifts they made in their own minds. They changed themselves instead of having to change their external conditions. They were able to make these revisions through the practices offered within the action inquiry space. For example, case-based learning supported the early-career scientists to raise their challenges and receive guidance from the collective intelligence of the group. The facilitator raised questions, made connections between comments raised, and offered perspectives that helped the early-career scientists make meaning of their challenges. This, in essence, was "taking up our power," where power manifested as the ways in which their revised meaning making, in concert with tools for skillful communication, enabled them to take new action in line with their values.

Learning Claim Three: A Micro-Culture for Learning and Leadership

CDAI developed a learning and leadership micro-culture. The third learning claim that I made was in response to the third research question: What can be learned about how CDAI

methods create a culture of learning and leadership at the individual, group, and organizational system levels? What I learned is that CDAI methods developed a *learning and leadership micros-space*—a new micro-culture of learning and leadership—by creating a flexible and adaptive micro-space where deeper levels of learning (double- and triple-loop learning) could take place at an individual level. On a group level, within this micro-culture, group leadership emerged. CDAI methods helped to adapt the space to offer learning resources, such as decision-making tools, that met the early-career scientists right where they were. In this way, the action inquiry space continued to support and encourage, but now on a group level. The group leadership that emerged had impacts across the organizational system. These impacts generated the tangible evidence that organizational sponsors and other relevant stakeholders needed to acknowledge and support this emerging micro-culture.

The action inquiry space was also created for the action research team meetings, and in this space a surprising finding emerged. Senior-career scientists also faced adaptive challenges in supporting the development of early-career scientists. The action inquiry space offered support to the senior-career scientists as well by transforming the AR meetings into a space where they could both talk about their challenges, in the same way that the early-career scientists needed that space, and offer input into how to grow adaptive capabilities for all. This finding indicates that, in a large hierarchy, there is a need for informal, well-supported spaces where adults can "speak the unspeakable" (Heifetz, et al., 2009) and receive support to revise their meaning making. In this way, CDAI supported the development of both the early-career scientists and their supervisors/mentors.

Implications

Each finding, as I have discussed in Chapter 5, and the claims that follow have important implications for leadership development among early-career scientists, and the creation of a micro-culture that supports both the early-career scientists and their supervisors/mentors. What I learned from this research is that early-career scientists do face leadership challenges, and these are best framed as adaptive challenges (Heifetz, et al., 2009). I learned that CDAI theory and method can be applied in a context of leadership development. CDAI practices helped to create the conditions to engage with single to double-loop learning (Argyris, 1976; Argyris & Schon, 1974) and even triple-loop learning (Torbert, 2004). For example, in response to feedback that he was confrontational in the way he engaged with others, Richard demonstrated single-loop learning by making small shifts in his tone of voice. This behavioral change helped him to adapt temporarily to an organizational unit that was operating out of alignment with Richard's values of academic freedom. Karen demonstrated double-loop learning by changing her strategy in communicating with her micro-managing supervisor. She began to inquire into her supervisors' needs. By maintaining an inquiring stance, Karen realized that her supervisor was acting out of fear. This gave her a new perspective and relieved her concern that her supervisor was purposefully trying to prevent Karen's success. Shawn exhibited triple-loop learning in his re-envisioned mission of his role in the team. He recognized that taking up a leadership role on behalf of the group was both a personal and collective good that was mutually transforming at the level of the team, and in the difficult engagements with stakeholders across the system. For example, in a mutually transformative vulnerable moment, Shawn gave voice to the unspeakable by revealing to me that he needed more protection from the challenges he faced.

Single-, double-, and triple-loop learning enabled early-career scientists to better navigate their adaptive challenges. I also learned that it is possible, within the constraints of a hierarchical system, to create micro-cultures where these supportive and encouraging conditions can thrive for the growth and development of staff across levels of an organization. For early-career scientists, it was an informal, safe space where they could both talk about their challenges and allow creativity to emerge. For senior-career scientists, it was a space to talk informally about their adaptive challenges in supporting the development of others. I suggest that the adaptive challenges that arose, and attention to how these micro-cultures of learning and leadership were created, have implications for the development of theory and practice. For theory, the key implication is that this case study offers a detailed account of how the complex elements of CDAI can be applied in an organizational setting. For practice, the key implication is that this study unearthed the reality that early-career scientists do face leadership challenges. As a result of this research, the program that trains early-career scientists is now reshaping the way it trains the next-generation scientist. I elaborate on both of these implications in the sections that follow.

Theory

This research deepened the understanding of how CDAI is applied in a context of learning and leadership. Specifically, this study showed how CDAI theory and methods (1) integrated developmental theory to understand how the way we make meaning affects our actions, and (2) created second-person action inquiry communities for the development of learning and leadership.

I suggest that what I am calling the *learning and leadership micro-culture* that emerged in this study, made possible by CDAI methods, relates to Torbert's (2004) "second-person action inquiry" (p. 38) or second-person initiatives to create "communities of inquiry" (p. 195). I suggest this because I noticed that the way early-career scientists interpreted their environment began to expand to recognize the dynamics of interpersonal behaviors. Some of them began to shift how they worked with others (second-person practice), especially in their use of the Four Parts of Speech approach, where they emphasized not just advocating but learning to frame, advocate, illustrate, and inquire. This is an example of how developmental integration (Cook-Greuter & Soulen, 2007; Kegan, 1982; Torbert, 2004), a key theoretical construct in CDAI, came alive in practice. The early-career scientists demonstrated more complex ways of looking at their adaptive challenges (e.g., seeing themselves and the challenge as part of a system), and then a willingness to engage the challenge from a different strategy (e.g., developing new ways of working by inquiring into the perspectives of their supervisors/peers). As such, this study deepened the understanding of how double-loop learning (e.g., change in strategy from advocating harder to inquiring into the others' perspective) and triple-loop learning (e.g., change in vision from trying to succeed in a micro-management context to leaving that context altogether) occur in practice as a result of CDAI methods. Additionally, the findings regarding deeper levels of learning made possible by CDAI methods are consistent with the theoretical construct regarding second-person research practice. This is in reference to where "the individual members and the community as a whole are guided…by double-loop transforming feedback…and triple-loop presencing and re-aligning feedback" (Steckler & Torbert, 2010, p. 106).

CDAI is a method of learning practices where participants are supported in engaging with different forms of reflection and inquiry, both individually and collaboratively. In this study, the CDAI practices implemented emphasized first-person (inquiry into our own actions in the world), second-person (inquiry into our actions with others), and third-person inquiry (inquiry into how our collective actions impact the larger organization) (Torbert, 2004). The findings illustrate the spectrum of types of learning that are facilitated from within this method of practice.

CDAI methods enabled deeper levels of learning, such as double- and triple-loop learning, to occur. Deeper levels of learning are needed to make progress on adaptive challenges (Drago-Severson, 2009; Heifetz, et al., 2009). Adaptive challenges cannot be solved with the approach we have at hand. The CDAI methods used in this study enabled double- and even triple-loop learning to occur within the Expert Action Logic over a short period of time (six months). The majority of the early-career scientists exhibited action logics at the Expert Level based on their completion and assessment of the Leadership Development Profile. This confirms the theory that, when there are developmentally appropriate supports and encouragements, deeper levels of learning can occur at earlier action logics (Drago-Severson, 2009).

This research is an example of how a complex theory was applied in a complex context. Complex in that the organizational context was unfamiliar with non-linear learning methods and there were no pathways established for implementing CDAI practice. CDAI theory is complex, and the concern that "it may be hard for future scholars to master its many interrelated constructs and applications" (Foster, 2012, p. 9) is relevant, especially in contexts that may not be familiar or have a proclivity for non-linear learning methods (Fraser & Greenhalgh, 2001). In this project,

CDAI theory and methods were successfully implemented as a function of (1) the location of implementation, and (2) the facilitation.

CDAI theory and methods were implemented in an organizational unit that was small and nimble enough to experiment with an innovative pedagogical approach. For example, because it was implemented within one unit, I did not have to go through the slow process of obtaining multiple levels of approval across the organizational system. This meant that action inquiry sessions could be scheduled at the frequency needed, for the duration needed, using program resources as needed. These conditions enabled the experimentation with CDAI theory in an applied context over a two-year period.

CDAI theory and methods were implemented with a facilitator and subject matter expert: one with expertise in the CDAI methodology, and the other with internal organizational experience. This setup enabled the action inquiry sessions to be well guided and grounded in the organizational realities faced by the emerging scientific leaders. Importantly, the facilitator and subject matter expert, in conjunction with the action research team, created an action inquiry community. For example, after each session, we reflected on our actions, their impact, and what was emerging in each session. These reflective engagements represented action inquiry into our own practice and process of implementing CDAI methods. What I learned is that implementing CDAI methods cannot be done alone, because the implementation process itself is an adaptive challenge. As Heifetz and colleagues (2009) indicate, adaptive challenges cannot be solved alone. They require the perspectives of multiple diverse stakeholders. *In creating an action inquiry community, it took an action inquiry community to guide the adaptive learning process.*

The contribution that this research makes to theory is to offer an example of how CDAI came alive in an applied setting. The key theoretical CDAI constructs of meaning making and

action inquiry were applied in this study. Data from participants showed that these constructs helped them to navigate their adaptive challenges, especially in being able to take a new perspective that enabled them to feel, act, and be in new ways that were aligned with their values.

Contributions to Practice

In today's complex world, there is a need for leadership development models that go beyond relating leadership only with positional authority (Fraser & Greenhalgh, 2001; Heifetz, et al., 2009; Uhl-Bien, Marion, & McKelvey, 2007). Leadership in the Knowledge Era must engage all levels of an organization, because administrative leaders at the top simply coordinate the complexities of action in timely ways (Uh-bien & Marion, 2008). This study offers a practical example of how leadership development, grounded in CDAI methods that emphasize action inquiry and appropriate developmental supports, can develop leadership at all levels of an organization. For example, Claim One named an adaptive challenge archetype (Heifetz, et al., 2009), *Not Enough Support for Learning and Leadership*, which was relevant for early-career scientists in the CGW context. The various ways the archetype manifested can serve as case studies for future early-career scientists in hierarchical technical contexts. This research offers a new way of framing leadership development in a context relevant for early-career scientists. A more contextualized framing defines leadership as making progress on adaptive challenges that can occur within a work unit or in working together across organizational boundaries. Heifetz proposed this framing for leaders engaging in organizational change. This definition, based on this case study, shows that adaptive leadership and adaptive learning are relevant for early-career

professionals—in this case, scientists. This new view of leadership has implications for refining leadership development competencies, as well as a new curriculum that includes action learning.

Model for Creating a Micro-Culture of Learning and Leadership

Claims Two and Three together describe how the CDAI methodology was implemented to create a micro-culture that enabled deeper levels of learning and group leadership to emerge. These claims provide insights into how organizations may wish to implement such micro-cultures of learning and leadership to make progress on adaptive challenges. For example, what emerged from this research is a strategy for leadership development that could apply to any group of professionals transitioning to an unfamiliar work context marked by adaptive challenges (e.g., ambiguity in the problem, solution, or process for how to move forward). The strategy involves an iterative six-step process: (1) Inquire into framing leadership, (2) Engage in applied learning though a non-linear method such as case-based learning, (4) Overcome internal/external obstacles, (5) Manage stakeholders, (6) Create multiple holding environments, and (7) Evolve from reflecting on past experience to learning in the midst of the challenge to become more aware and skillful leaders. I describe each of these in the following section.

(1) Inquire. The first part of creating a micro-space for learning and leadership is to inquire with relevant others into the challenges faced by the organizational unit. The outcome of this step is to frame leadership and leadership development in a context appropriate for the adaptive challenges that the particular organization faces.

(2) Engage. This phase consists of creating an action inquiry group, and exploring and experimenting with CDAI theory and methods. For example, engage in case-based learning to collectively understand and learn through the challenges faced. Once the group appears to

practice first- and second-person research practices regularly (e.g., increased integrity and mutuality), move on to the next phase, where the group can evolve from reflecting on challenges in the recent past to developing adaptive capabilities in real-time by taking on a leadership group project. The project should contain the element of learning in new situations and not simply repeating the same project, such as a conference, every year without any room for creativity. The practice and methods of action-learning are recommended (O'Neil & Marsick, 2007; Watkins & Marsick, 1993, 1996).

(3) Overcome internal/external obstacles. Expect to face internal and external obstacles. Internal obstacles are the limits of our own mind – or meaning making. Engage in first-person practices such as meditation, journaling, and contemplation to create internal conditions that support your own adaptation and evolution. External obstacles are the dark forces against positive and sustainable change. Expect that these will arise and shift from taking the force as a personal attack to seeing it as data that you and others are creating a meaningful shift. Otherwise, these obstacles would not arise. Engage your trusted allies in the system to gain perspective on the external obstacles. Trust yourself.

(4) Manage stakeholders. Remain externally open to feedback on how stakeholders in your system are shifting. For example, as turn-over happens, be ready to re-contract with new staff to ensure they understand the project and have the opportunity to offer input. Experiment with how your stakeholders like to receive information and at what frequency. For example, after your inquiry sessions, summarize the learning outcomes at a high level (paying careful attention not to divulge the identify of participants) in an email. Follow up with a short report at staff meetings and inquire with others on what questions they have.

(5) Create multiple holding environments. Create support systems to increase your capacity to navigate complexity and ambiguity. For example, hire a developmental coach to regularly help you make meaning of the personal challenges you will face as you implement this work. Identify trusted allies and nurture those relationships to create a sacred space of trust, inquiry, and encouragement.

(6) Evolve. In this phase you and your participants engage in a group action-learning project that has the possibility of stimulating double- and/or triple-loop learning at the individual and group levels to generate impact at the system level. In this phase, it is important to identify not only what level of organizational sponsorship is needed, but also to make agreements on what that level of sponsorship will do to support the project. This could include a letter or email of support that enables the action inquiry group to do its work.

During this phase, it is critical to maintain an experimental mindset and recognize that you are learning how to be adaptive in a dynamic dance with your participants. Learning through these challenges can be painful because part of this growth involves letting go of what is no longer serving the group in order to adapt and evolve beyond the constraints of the system. In order to do this, engage yourself and others in the CDAI practices that increase mutuality and a willingness to be influenced. To be intelligently vulnerable to change. This can be captured as invoking a team spirit of being influenced in the powerful space of second-person practice.

While many action research models include some of the steps outlined above, the contribution this research makes is in explicitly naming steps 4,5, and 6 in the model. The forces, stakeholders, and creating a support structure are essential for the implementation of action inquiry in concert with action learning. I have created a model to depict this iterative process (Figure 12).

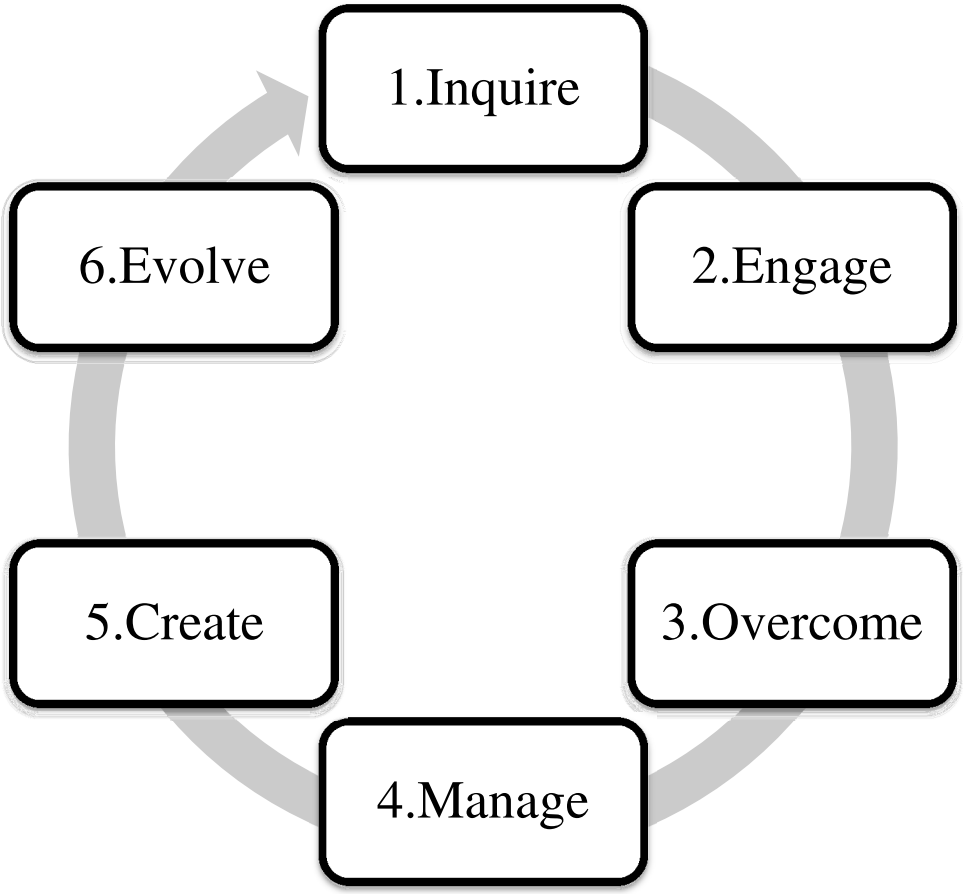

Figure 12. Model for creating a micro-culture of learning and leadership

I offer a word of caution for facilitators of adult learning. The process of implementing action inquiry groups (action inquiry sessions, as described earlier) is an adaptive challenge in and of itself. Therefore, I encourage adult learning educators to proceed using the adaptive leadership process (Heifetz, et al., 2009; Heifetz, A. Grashow, & Linsky, 2009) and to also benefit from learning how to navigate the adaptive challenges offered by the CDAI methods. For example, create a CDAI protective space, so that the embryonic idea can survive and thrive or it will be attacked, as the early-career scientists were attacked when they did not have cover. I

recommend that an informal CDAI Implementation Action Inquiry group be created, with membership comprised of stakeholders across the organization who can offer not only input for action inquiry to be integrated into leadership development approaches but, more importantly, for protection against other organizational stakeholders, including high-level leaders, who may feel threatened by the democratic and powerful nature of CDAI. One of the ways that CDAI will likely be attacked—and there is already evidence of this brewing in the CGW context—is that organizational leaders, or people with enough formal or even informal power, will attempt to diminish the credibility of CDAI by evaluating it using the social scientific paradigm of Empirical Positivism. This paradigm has been described as a "critical (but not hermeneutically self-critical), intellectual quest for predictive certainty" (Torbert, 2013, p. 6). Stakeholders from this perspective will want measurable outcomes of leadership that can be replicated and generalized across large populations. However, the intention of CDAI methods is not necessarily to predict and control phenomena; rather, the intention is to "bring inquiry into as many of our moments of action as we can" (p. 7). Therefore, CDAI methods are best evaluated on their own merit. That is, "one person at a time, as he or she practices awareness-expanding first-person action inquiry at more and more moments" (p. 7). Social change happens at the first-person level; thus, it is move valid and trustworthy to evaluate CDAI methods on what is occurring at the individual and group levels and what kind of impacts those levels are having in the organization.

Future Research

Traditional leadership theories focus on the leader as the source of knowledge. The leader is the one who has the answers. In this study, leadership manifested in two ways: (1) as the

facilitator and subject matter expert creating the conditions where the group's potential could emerge, and (2) as the leadership of the early-career scientists. However, without the holding environment (Drago-Severson, 2009; Kegan, 1982; Winnicott, 1965, 1986a, 1986b) created by the facilitator and subject matter expert using the CDAI method, the early-career scientists would not have accomplished their leadership project. The extent to which CDAI can be scaled up is a function of skilled facilitative leadership. What we were unable to explore is how to scale up CDAI methods across the organizational system with one facilitator and one subject matter expert. I recommend that future research explore how leadership development efforts grounded in CDAI can be scaled up to more units across the organizational system in timely and skillful ways.

CDAI theory and practice not only emphasize reflection in action on intentional behavior, but this approach also encourages looking at multiple levels of experience (e.g., feeling and thinking) in order to understand why we don't achieve our intended outcomes (Torbert, 1991). For example, CDAI practice emphasizes examining Four Territories of Experience (Torbert, 2004), all of which have to do with what is occurring in the present moment. The more we are present, the more information or data we have access to. From a CDAI perspective, the additional data that we are normally blind to enables us to make better decisions. *Better* refers to more mutual and inclusive as well as more timely. CDAI emphasizes the capability to be present; however, further elaboration is needed on how to develop this capability. For example, I introduced reflective journaling as a practice for increasing first-person inquiry (inquiry into our own actions in the world). However, the reflective journaling practice was not integrated well, because it was difficult to create the habit of stopping to reflect on one's own. This is important because first-person action inquiry has impacts at the second-person level (Torbert, 2004). If a

person does not become more self-aware through first-person action inquiry, they will perpetuate unhelpful habits in a second-person space. I recommend that future research explore how to implement first-person research practices, such as reflective journaling and mindfulness awareness practices, in contexts where these practices are unfamiliar, especially those operating at speeds where it is challenging to stop and engage in reflective writing or meditation on one's own. This may involve creating spaces for first-person research practice as part of the system of learning and leadership.

Limitations

In this section, I describe the limitations of this research on two levels: (1) research method limitations, and (2) practical limitations.

Research method limitations. The claims that I made are based on a single action research case study with a unique population, limited to seven early-career scientists, their supervisors and mentors, and program staff. That this study used a small sample size means that there are limits in attempting to generalize the results of this study across broad populations of adult learners. I have tried to describe the particular organizational context and process of implementation in sufficient detail. Facilitators of adult learning can assess whether the context they are exploring is similar to the context of this study and transfer or use the insights in this study to inform their practice.

To overcome these limitations, I suggest that multiple longitudinal studies with larger samples sizes be conducted. These studies would follow diverse groups of adult learners over time to track evidence and outcomes regarding the impacts of the CDAI methods. This larger sample size and multiple study approach would generate more generalizable data to bolster current research studies such as this one.

Practical limitations. There were limits in how quickly I could create conditions in a system for the CDAI theory and methods to take root. For example, there were limits in how many stakeholders within the system I could engage to support CDAI. The impact of this is that the time horizon for implementation was extended as a function of getting enough buy-in at the outset and overcoming the multiple obstacles of leadership turn-over. There were limits in

resources, such as the time and energy that one action researcher can have to simultaneously educate the local context about the CDAI methodology and at the same time learn it.

To overcome the practical limitations, I suggest that action research teams that involve practitioners, scholars, and scholar practitioners conduct a next cycle of CDAI action research in contexts similar to that of this study to help extend the implications of this research in practice. For example, insights from this study include engaging in case-based learning earlier and combining it with case studies to help early-career scientists more quickly understand what adaptive challenges are in the context of their work. By applying learning insights from this study to future empirical studies, the amount of time and energy investment may decrease in proportion to the maturation of a system that can support and nurture new adult learning pedagogical approaches.

Epilogue

I return to the story that I began with in framing my research. It was five years ago that I faced the adaptive challenge of how to help a post-doctoral program survive in the midst of skepticism and uncertainty. As an aspiring facilitator of adult learning, I was drawn to the paradox of how to improve leadership development among early-career scientists within a program attempting to survive. What I learned is that paradox can reveal a lot about human nature. Reflecting on this research journey, I see that the way I approached the paradox revealed a lot about my practice at the time. This research has taught me to inquire more. Five years ago, I tried to crack the paradox by going at it alone and head-on. How would I facilitate leadership development now if I had the understanding that this research uncovered? The group of early-career scientists taught me that the key to leadership development is to create a space for them

where leadership, in their own language, meaning, and metaphor, can be discussed. I have learned that *creating micro-cultures for learning and leadership* involves inquiring with others more. I have learned that the process of creating these spaces is an adaptive challenge and could not be solved with the capabilities I had at hand. In order to complete this research, I had to transform from trying to predict or outline what would happen to letting go into the space of emergence. It was only in this space that the creativity and leadership of the early-career scientists could emerge.

What I learned from this research is that not only did early-career scientists benefit from the action inquiry space, but their supervisors and mentors did as well. They were going through their own adaptive challenges in supporting these emerging scientific leaders. The spaces for informal dialogue enabled both groups to feel that they were being heard, to explore new thinking, and to feel safe in voicing their challenges, perplexities, and worries. What brought rigor and integrity to this space was the CDAI method of engaging people across the system to create a safe ground to give voice to the unspeakable. For example, I shared the challenges raised by the early-career scientists with my action research team, which was comprised of the supervisors and mentors of those early-career scientists. In the context of creative experimentation, the supervisor action research group did not take the challenges personally. They came up with innovative ways to address the challenges, such as raising awareness of adaptive challenges on a broader scale by developing and implementing adaptive learning training for all supervisors and mentors of early-career scientists at CGW. This training was designed and implemented, and gave further credence to the key insight that emerged for me in this study, namely that when you engage people through inquiry, they bring their whole experience to the table, and this offers the diversity of perspectives needed to solve adaptive

challenges. However, inquiry takes courage, and can be seen as a subversive activity (Coghlan & Brannick, 2010). This leads me to my next learning—how to garner the courage to move forward.

There were many times in this research journey where I felt that the rug had been pulled from underneath me, times when I felt that I had no ground to move forward on because I was completely floating in ambiguity. What I learned is that, in those moments, I was not alone. I reached out to friends, family, colleagues, and mentors for help. They did not give me the "answer," but they gave me perspective, in broader, more inclusive and permeable perspectives from which I found the wisdom and courage to move forward. This is precisely what navigating adaptive challenges entails—joining head, heart, and soul with others in order to let go of what no longer serves us, to keep what does, and to develop new capabilities to adapt and evolve. Like the rich fluidity of the seasons, where each creates the conditions for the other to emerge we, as a human family, create the conditions for each other to evolve. What I learned from this research is that this—creating conditions for others to evolve—is leadership.

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APPENDIX A: IRB APPROVAL

PROJECT NUMBER: 2012-10039-0
TITLE OF STUDY: Development of Leadership Capacity among Early-Career Scientists
PRINCIPAL INVESTIGATOR: Dr. Aliki Nicolaides

Dear Dr. Nicolaides,

0The University of Georgia Institutional Review Board (IRB) has reviewed and approved your above-titled proposal through the exempt (administrative) review procedure authorized by 45 CFR 46.101(b)(2) - Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, /unless:/(i). the information obtained is recorded in such a manner that human participants can be identified, directly or through identifiers linked to the participants; /and/(ii). any disclosure of the human participants' responses outside the research could reasonably place the participants at risk of criminal or civil liability or be damaging to the participants' financial standing, employability, or reputation.

Your approval packet will be sent by mail. Please remember that any changes to this research proposal can only be initiated after review and approval by the IRB (except when necessary to eliminate apparent immediate hazards to the research participant). Any adverse events or unanticipated problems must be reported to the IRB immediately. The principal investigator is also responsible for maintaining all applicable protocol records (regardless of media type) for at least three (3) years after completion of the study (i.e., copy of approved protocol, raw data, amendments, correspondence, and other pertinent documents). You are requested to notify the Human Subjects Office if your study is completed or terminated.

Good luck with your study, and please feel free to contact us if you have any questions. Please use the IRB number and title in all communications regarding this study.

Regards,

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