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•	•		
•	•		
		<i>Leonard J. Barchak</i>	1
		An End to Ideology	
		<i>William Stephenson</i>	13
		Theory and Methodology for Esthetics	
		<i>Daun R. Anderson</i>	33
		Female Executives in Biotechnology: A Contextual Approach to Understanding Their Work Environments	
		<i>Russell C. Hurd</i>	58
		<i>Steven R. Brown</i>	
		The Future of the Q Methodology Movement	
		<i>James C. Rhoads, Dennis F. Kinsey, Mark N. Popovich, Will Focht, Michael Stricklin, Philip Christman, and Kai-Hung Fang</i>	76
		Commentaries on "The Future of the Q Methodology Movement"	
		<i>Russell C. Hurd and Steven R. Brown</i>	93
		In Place of a Rejoinder: Embracing Factors A, B, C, and D	
		• •	
		•	
		•	
		•	
		•	
		•	

Female Executives in Biotechnology: A Contextual Approach to Understanding Their Work Environments

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Abstract: *This research study used Q methodology to uncover the perceptions and experiences of 25 women at the vice president level and above in 21 biotechnology companies in Massachusetts. Through personal interviews, web-based interviews, and Q sorts the women provided a range of views regarding their work environments. The study contributes to the literature on subjectivity and organizational behavior by revealing the participants' views of specific individual and group behaviors that facilitate career advancement for women. It extends social role and structural theories by adding to the literature on the role of context in shaping professional experiences. The women identified teamwork and integrity, politics and barriers to advancement, or expertise and opportunity as being most characteristic of their organizational cultures and environments.*

Introduction

The senior executives of an organization are the individuals at the upper echelons who play a crucial role in the formulation and implementation of strategic decisions (Hambrick and Mason 1984; Osborn, Hunt, and Jauch 2002). The senior executive team serves as a link between the organization and its environment (Hambrick 1994), and most chief executive officers (CEOs) need such a team to help them carry out the complex array of responsibilities associated with corporate leadership. While a tremendous amount of attention is directed at whether women operate at this level in distinctive ways, a Q study of the views of top female executives in biotechnology offers the potential for new understanding of the environments in which they work.

It is clear that women are not represented proportionately in senior executive ranks. The biotechnology industry, however, seems to be an outlier in some respects. Increasing numbers of women have been able to penetrate the glass ceiling to gain access to the upper echelons of their organizations. In addition, the biotechnology sector is ideally suited to concentration on the rather elusive notion of "context" given the dynamic boundary zones of a typical biotechnology firm. Context refers to the situation in which an organization operates, and it includes the external environment, the history, the

industry, the technology, and the internal culture. Turbulence, rapid change, environmental volatility, and technological sophistication characterize the context of the biotechnology industry.

Morrison, *et al* describe the glass ceiling as a barrier "to women as a group who are kept from advancing higher *because they are women*" (1987, 13). Women make up 47 percent of the workforce in the United States (Henslin 2003), and women and minorities may outnumber men by 2025 (Pfeil 2002). However, there are currently only eight female CEOs in the Fortune 500 and 17 in the Fortune 1000 (Catalyst 2003). The absence of women at the top of companies could put American businesses at a competitive disadvantage (Kanter 1994). Evidence for this comes from the fact that the value of the eight Fortune 500 companies led by women increased by 52 percent during 2003, versus a 27 percent increase in value for large companies overall in the Standard and Poors 500 index (Jones 2004). During the four-year period from 1996 to 2000, Fortune 500 companies with the highest number of senior women experienced a 35 percent higher return on equity and a 34 percent higher return to shareholders than companies with the fewest women in top management positions (Sellers, 2004). Given the nature of the biotechnology industry, then, and the underrepresentation of female senior executives in industry overall, a Q study offers the signal advantage of obtaining very rich and informative views of the context in which this study's participants worked.

The focus of this study was women in top management positions in biotechnology companies in Massachusetts. Since leadership is embedded in context (Van Velsor and McCauley 2004), an understanding of the context in which senior executive women in biotechnology work could provide valuable insight into the ways that other companies could create a more welcoming environment for women. Biotechnology is a relatively young industry that employs approximately 191,000 people in 1500 companies in the United States (*Biotechnology – a consistent record of growth* 2002), 280 of which are in Massachusetts. The industry includes companies that engage in research, development, production, and commercialization of products that use rDNA, cell fusion, and bioprocessing techniques (Eaton 1999). A new drug can take more than 12 years and more than \$800 million to move from conception to market (Parloff 2004). Researchers estimate that only 10 percent of firms will get a product to market, and only 30 percent of drugs generate returns that exceed their research and development costs (Eaton 1999). Such figures exemplify the uncertainty, risk, and the potential for rewards that characterize the industry (McGarvey 2003). Of late, the rewards have been plentiful. The NASDAQ biotechnology index rose 45 percent in 2003 (Mitchell 2004), and the American Stock Exchange Biotech index rose 70 percent during the 12 months ending in March 2004 (Weintraub 2004). Biotechnology firms raised 56 percent more money in 2003 than they did in 2002 (Mitchell 2004) and have experienced revenue growth of more than 20 percent per year for the past 2 years (Malaspina 2004).

Women in a Leadership Context in Biotechnology

Selected research on leadership style, women, and the biotechnology sector provides an effective picture of the issues and the current gaps in understanding. Key findings in recent leadership research reinforce the context sensitivity of leadership. Such a malleable version of leadership is nevertheless still subject to both constraints and preferences associated with gender.

Leadership Style

Leadership is contextual. A style that is effective in one setting may not be as effective elsewhere (Yoder 2001), which can result in both men and women adjusting their leadership style to accommodate their environment and to meet others' expectations (Antonakis, Avolio, and Sivasubramaniam 2003). Gardiner and Tiggemann (1999) found that female managers were more task- or people-oriented depending on whether they were operating in a predominantly masculine or feminine setting, respectively. Not surprisingly, men tend to be more effective in leadership roles that call for masculine behaviors, such as being dominant and competitive, and women tend to be more effective in leadership roles that call for feminine behaviors, such as being supportive and nurturing (Eagly, Karau, and Makhijani 1995). This puts women at a disadvantage, for not only do they often have to conform to a masculine view of management, but they must also adopt styles that violate gender roles for women but are acceptable to their male colleagues (Ragins, Townsend, and Mattis 1998) who associate the managerial role with men more than with women (Powell and Graves 2003). This association, however, is apparently not unique to men, given the fact that women as well as men consistently describe a good manager as someone who exhibits more masculine than feminine traits, according to studies that spanned three decades from 1976-1999 (Powell, Butterfield, and Parent 2002). Overall, male-dominated organizations in which task accomplishment is the only rewarded goal, and where hierarchy and power have more weight than egalitarianism and influence, are particularly uncongenial for women (Yoder 2001), thus reducing their chances of becoming effective leaders.

Barriers to Career Advancement

A number of theories shed light on the challenges that women face in striving for upward mobility. Social role and status characteristics theories address societal expectations of women, while structural theory addresses the role of organizational structure and context.

Social role theory

In her seminal work on social role theory, Eagly (1987) posits that society imposes different norms and behavioral expectations regarding the social roles that men and women will occupy, and these differences lead to a division of labor that gives women less social influence. Families, schools, and peers encourage women and men to develop different personality characteristics and to view occupations as appropriate for either males or females (Seymour

1999), and these perceptions eventually result in a workforce characterized by sex-linked inequality (McIlwee and Robinson 1992). Most young boys grow up thinking in terms of competency and achievement, leading to a strong career orientation. The expectation on the part of both men and women is that men will be competitive and assertive in the workplace, that their jobs will involve leading and directing, and that their career will figure prominently. Young girls, on the other hand, are socialized to place more emphasis on nurturance and sensitivity and to assume subordinate behaviors in the workplace. Both men and women expect women to be emotional and nonassertive and to value family over career. Although generally seen as posing a career barrier, the supportive and considerate behaviors associated with women are aspects of transformational leadership and may eventually serve as career enhancers (Eagly and Carli 2003). However, it is still most often the case that societal expectations discourage women from assuming leadership positions.

Status characteristics theory

According to status characteristics theory, which is one aspect of expectation states theory, members of task-oriented groups form expectations about themselves and others based on member characteristics like sex, race, and education (Berger, Fisek, Norman, and Zelditch 1977). A diffuse status characteristic is one that is associated with expectations regarding competence (Lucas 2003). As such, sex is a diffuse characteristic because being male tends to confer higher status than being female, and group members generally assume that individuals with higher status will be more competent in their jobs. In keeping with this assumption, men get more respect and honor than women, and men's higher status gives them more opportunities to contribute to group tasks (Carli and Eagly 2001). This leads to an increase in men's self-confidence and assertiveness, which in turn results in their getting more positive feedback and gaining more influence over group members (Powell and Graves 2003). The more influence that men have, the more likely they are to be chosen for leadership positions than women, whose contributions are often ignored or rejected by group members. Others' opinions can become key determinants of career success, for the people who reach the top levels of management are the ones whom others see as leaders. The frequent evaluation of women as being less effective leaders than men, along with the fact that women are often held to higher performance standards than men, contribute to their difficulty in moving up the corporate ladder (Lucas 2003).

Structural theory

Structural theory suggests that context and organizational characteristics, rather than individual characteristics, are responsible for differences in behavior and experience (Ibarra 1993). Structural theory builds on Kanter's (1977) seminal research on women in corporations. From this perspective, women's status and occupational behavior are determined by the organizational structure in which they work rather than by their personal

characteristics (McIlwee and Robinson 1992, 14). Numerous researchers agree that structural barriers are pervasive and pose challenges to women and minority groups that (white) men do not face. These barriers are corporate practices and cultures of male-based authority that result in men rather than women being the beneficiaries of recruitment, retention, and promotion policies (Eagly and Carli 2003; Guy 1994; Maier 1999; Oakley 2000). Catalyst (1996) reinforced the legitimacy of structural theory in its conclusion that most corporations have not eliminated the structural obstacles to women's advancement into leadership roles. Two aspects of organizational structure that pose particularly formidable obstacles to women's career advancement are networks and political behavior.

There is an informal network of power relations within organizations, and exclusion from this network is a barrier to advancement (Anderson 2003; Catalyst 1999; Ibarra 1993; Jackson 2001; Kanter 1977; Morrison *et al* 1987; Ragins *et al* 1998; Vinnicombe and Singh 2003). Brass (1985) noted that women are not well integrated into the organization's dominant coalition, often referred to as the "old boy network" (Oakley 2000). Women's exclusion from these informal and influential relationships reduces their ability to acquire organizational power (Schein 1978). Networking and strong ties to influential organizational members are particularly beneficial in uncertain and loosely structured environments (Ibarra 1993; Singh, Kumra, and Vinnicombe 2002) like the biotechnology industry. Even women who reach the top often remain on the periphery of the decision-making circle. Almost half of the Fortune 1000 female vice presidents in a Catalyst (1996) study felt that exclusion from informal networks was a barrier to advancement.

In addition to exclusion from informal networks, obstacles in the form of political behavior stymie many women's upward mobility. The numerous definitions of political behavior, also known as organizational politics, include the claim that it is the nonsanctioned and active management of influence (Ferris, Frink, Gilmore, and Kacmar 1994) to obtain one's preferred outcomes through manipulation and self-serving behavior (Ammeter *et al* 2002). To operationalize the construct, one can think in terms of observable yet often covert actions, including the formation of internal or external alliances and coalitions, withholding information, agenda control, blaming others, and cooptation (lobbying key executives in an attempt to gain their support). Political behavior poses a structural barrier to women's career advancement because women are reluctant to engage in it for a number of reasons, including a distaste for politics, a lack of competence in political behavior, and a lack of confidence (Arroba and James 1988; Singh *et al* 2002). Women focus on task accomplishment, expertise, high standards, and attention to detail rather than on self-promotion and gaining visibility (Vinnicombe and Singh 2003), whereas men are self-focused and more inclined to promote their own interests (Maier 1999).

Women in Science

Women make up 36 percent of the workforce in the life sciences and almost 50 percent of the professional scientists in biotechnology firms. This is a rather astonishing figure when one considers that they account for only 28 percent of doctoral-level scientists in the biological sciences as a whole (Eaton 1999). It is especially surprising in light of the fact that estimates put women at only 12-22 percent of all scientists and engineers combined in the labor force (Mattis and Allyn 1999). Initial research into approximately 50 biotechnology companies in Massachusetts, however, revealed that at least 37 of those companies had women at the Vice President level or above, an extraordinarily high percentage compared to the Fortune 500 where women account for less than 16 percent of the top executives (McDonald, 2003). Education figures predict the future importance of women scientists in industry: from 1980-1995, the number of women students earning doctorates in science and engineering increased from 30.3 percent to 39.3 percent, whereas the percentage of men dropped from 69.7 percent to 60.7 percent (Mattis and Allyn 1999). Data from the National Research Council (1996) have helped to explain the relatively high number of women who subsequently enter the biotechnology industry. In 1993, at the bachelor's level, women represented 47 percent of biological scientists but only 32 percent of computer scientists and 30 percent of physical scientists. At the doctoral level, women accounted for 28 percent of biological scientists compared to 15 percent of computer scientists, 13 percent of chemists, 11 percent of geologists, and 6 percent of physicists in the labor force. Factors that Attract Women to the Biotechnology Industry

It is not growth alone, however, that attracts women to biotechnology. In a study of 30 men and women in four publicly traded companies in the northeast, Eaton (1999) uncovered six factors that might explain the prevalence of female scientists in this industry. Most of the factors relate to the structure of the work itself, which supports this study's emphasis on context. The exception to this is the first factor, which is the myriad difficulties that make academic settings unfavorable to female scientists such as low pay, feelings of isolation, and the low likelihood of getting tenure (Catalyst 1999). The second factor relates to the unstable nature of the biotechnology industry. It affects males and females alike, and the gender-blind nature of this instability levels the playing field for women when it comes to opportunities to succeed. The third factor is the flexibility in scheduling one's working hours due to the long-term deadlines and the ability of scientists to cover for one another without worrying about coordinated schedules. The fourth factor is the feeling of achievement and control that comes with scientific discovery due to the autonomous nature of some experiments as well as the feeling of support that one gets from colleagues (Eaton 1999). The fifth factor is the scale effect that translates into women having greater opportunities for success in an industry in which other women have already reached a critical mass. At almost 50 percent of the workforce, women are clearly no longer tokens in biotechnology. Finally, the sixth factor that could explain the relatively large

number of women in biotechnology is the possibility of gaining management skills and earning promotions due to the project management nature of the work. Ph.D. scientists in industry often begin their careers by managing one or two B.S.- or M.S.-level scientists, and given the unstable nature of the biotechnology industry, promotions might be one of the few available rewards for employees.

Impact of Context on Leadership

Despite its recent impressive performance, instability and turbulence still characterize biotechnology, an industry in which learning takes place through the constant exchange of information. The youth of most biotechnology companies usually results in a fairly organic structure, for scientists tend to focus more on research and development than on traditional management functions (Dubinskas 1988). Structure and technology as organizational variables, and industry as an environmental variable, are elements of context that are important to understanding leadership. Osborn *et al* (2002) offered a continuum of contexts ranging from stability to crisis to dynamic equilibrium to the edge of chaos; I believe that the latter best describes the biotechnology industry where risk and change are the norm. Leaders must identify and pay attention to what is most important for achieving organizational outcomes with a focus on priorities for change within the system. They must interact with diversified networks of people, for information exchange is key to sustaining the system. Organizations at the edge of chaos must adapt to and fit the environment in order to enhance organizational performance and increase the chances of success. Leadership must be collective and dynamic with an emphasis on process. As the biotechnology industry matures, companies will move from laboratory environments to commercial businesses, and this will necessitate an understanding of the contextual aspects that are the most necessary to nurture and sustain executive leadership.

Research Questions

The preceding information on women and leadership and women in science led me to formulate the following research questions which were broad enough to allow the participants to express themselves on a wide range of topics, yet narrow enough to keep them focused on the themes of women, context and the biotechnology industry. Given the information presented on barriers to career advancement and the evidence that the feminization of top management levels can result in better organizational performance, it is crucial to understand the perceptions of these women of their work environments.

To begin, I wanted to know what factors women in the study think contribute to their ability to attain and retain senior executive positions in their companies. What are the critical success factors in biotechnology companies, and how do the characteristics of the biotechnology industry affect the manner in which individuals work with one another? I was interested in hearing their views of the contextual aspects of their companies that specifically facilitated upward mobility for them and for other women, and I believed that the manner

in which employees worked with one another would play a significant role in creating the context. This line of questioning provided insight into the nature of the biotechnology industry that both helps and hinders women's career advancement.

Next, I asked the participants if they felt that it was possible to fail at a project and still maintain respect and influence. This question directly addressed the turbulent and unpredictable nature of biotechnology; only ten percent of firms will get a product to market. Expertise in myriad disciplines is necessary for success in this industry, which led to my questions about the role of individual achievement and teamwork. For projects that required teamwork, I asked about the manner in which people were assigned to teams. Was it a matter of whom you knew? Or was it more objective, revolving around what you had already accomplished? Were women excluded from teams as they have traditionally been excluded from organizational networks?

Finally, I asked the participants to describe the cultures of their companies, including core values, beliefs and behaviors that were rewarded or discouraged. I asked them how information was disseminated, again in relation to the way women are often excluded from information networks, and I wanted to know their perceptions of the importance of political savvy to career mobility and strategic decision making. All of my questions focused on the themes of women in leadership and the nature of the biotechnology industry as a context for career advancement.

Method

Stephenson first described Q methodology in 1935 in a letter to the Editor of *Nature*, and he subsequently presented an in-depth description in his book that was published in 1953. He put a great deal of emphasis on the importance of having an inquiring attitude and of making discoveries rather than simply testing one's reasoning. Q methodology has since achieved widespread application (Brown 1980; de Graaf 2001; Lipgar 1997; Maxwell 2000; McKeown 1984; O'Reilly, Chatman, and Caldwell 1991; Popovich and Popovich 2000; Rosenthal 1999; and Stephenson 1989). Perhaps of greatest relevance to this research is Slavet and Butterfield's (1999) use of Q methodology to study the glass ceiling in the financial services industry. They looked at five women above the glass ceiling and five women below it. The ten women sorted statements drawn from personal interviews that dealt with career development and barriers to advancement. The study uncovered three themes: perceptions of discrimination, desire to become a CEO, and having had mentors or role models. The women who had penetrated the glass ceiling felt that they had experienced less discrimination, and they reported a stronger desire to become a CEO, than the women below the glass ceiling. Having had a mentor or role model was less of a differentiator between the two groups.

Participants and Procedures

My participants were 25 women at the vice president level or above in 21 biotechnology companies in Massachusetts, a number sufficient to answer the

research questions of interest and to generate meaningful results (Barry and Proops 2000). The selection of these women was based on their expressed willingness to discuss their experiences as senior executive women in the biotechnology industry. The average age range of the women was 40-49 years. Eleven women held the title of Vice President, seven were Senior Vice Presidents, one was an Executive Vice President, four were Presidents, one was a COO, one was a CSO, and five were CEOs (five women held two titles). The average tenure within their company was six to eight years, while the average tenure within their position was three to five years, with nine of the women having been hired into their current position, and 16 having been promoted into their current position. Thirteen women (just over 50 percent of the participants) held a Ph.D., followed by five M.B.A.s; two with a M.S.; and one each with a V.M.D., M.D., M.P.A., B.A. and B.S. degree. As to the 21 companies, which were almost evenly divided between public and private ownership, the average age was six to ten years, and the number of employees ran the full gamut from fewer than 50 (eight companies) to more than 1,000 (three companies) with the average number falling in the 101-200 range.

In the first phase of the research, I sent my research questions in the form of open-ended web-based interview questions to 37 women whose names I had gotten from Internet searches on biotechnology companies in Massachusetts, as well as from some of the women themselves. I had contacted all of these women by telephone, email, and/or in person in 2003 and early 2004 to describe my research and its role in my dissertation. Getting their exact words was crucial because the Q sample that I created consisted of statements that the women made, not my interpretations of their opinions. Without my presence, I was able to standardize, to a certain degree, the manner in which the participants completed the interview questions since there was no risk of my making unintentional and influential comments regarding my research. The web-based interview questions appeared identical to all recipients, and they could easily answer the questions by typing in text as they would in a document or email message. By clicking "Submit," they sent their responses to me in a consistent and readable format, and they entered a user code rather than their name to protect their anonymity on the Internet. Twenty-eight women completed the interview, but scheduling conflicts resulted in only 25 of them agreeing to perform the Q sort.

Upon receipt of the women's responses to my web-based interview questions, I created a Q sample of 43 statements (see Appendix) for the second phase of my research. In keeping with the inductive nature of my research, I wanted the statements to come directly from the participants. There is no magic number for the size of the Q sample (S. R. Brown, personal communication, July 26, 2003), but it should allow for multiple viewpoints of each topic. The interview questions asked the participants for their subjective perceptions of seven broad topics: characteristics of the biotechnology industry that affect women's career advancement, success

factors, teamwork, individual achievement, political behavior, organizational culture, and information exchange. The Q sample included approximately equal numbers of statements for each of the seven areas. I felt that it captured the majority, if not all, of the opinions that the women expressed without being unnecessarily repetitive. I felt that an inductive design was appropriate, given my formulation of observations as I collected their statements (McKeown and Thomas 1988).

Q methodology involves a Q sort that requires the participants to order the statements in the Q sample according to their own experiences and understandings, thereby grounding the statements in their experience. With the exception of three women who had health issues and/or travel conflicts, I administered the Q sorts in person at each participant's company. I assigned a random number to each statement, typed each one on a card, and asked the participants to rank order them along a continuum from "most agree" (+4) to "most disagree" (-4) for a total of nine categories. I gave each participant specific instructions which were particularly important for the three participants who completed the Q sort without my being present. Table 1 shows the number of statements in each category. I followed the completed Q sorts with a final discussion that focused on the six statements that the participants put into categories +4 and -4.

Table 1: Distribution of Q Sorts

<i>Score</i>	<i>-4</i>	<i>-3</i>	<i>-2</i>	<i>-1</i>	<i>0</i>	<i>+1</i>	<i>+2</i>	<i>+3</i>	<i>+4</i>
<i>No of Statements</i>	3	4	5	6	7	6	5	4	3

I recorded the Q sorts of all participants using Schmolck and Atkinson's (2000) PQMethod. The software program calculated coefficients of correlation for every pair to uncover similarities and differences between the ways that the individuals sorted the statements. Once the matrix of correlations was produced, the Q sorts were subjected to centroid factor analysis and theoretical rotation in order to determine how many different factors existed in the Q-sort responses. The participants actually grouped themselves based on their Q sorts, and the factor analysis revealed the number of different factors. Together, centroid factor analysis and theoretical rotation allow reality to play a role in scientific inquiry (Brown and Robyn 2003).

Results

The 25 women who participated in this study made up a rather diverse group in terms of demographic characteristics such as age, title, tenure within their company and within their current position, and educational background. Three women worked at one company, two at another company, and two at a third company, for a total of 21 companies which, like the women, were quite diverse. The companies represented a range in age, size, and focus within the industry. Their lines of business covered cancer research, preclinical animal

testing, genetically engineered bacteria, antiviral drugs, nucleic acid diagnostics, protein and inflammation therapeutics, and vaccines, to name just a few. Q methodology does not seek to generalize across populations, but the factors that surface represent the way people associated with each factor think. Given the small and nonrandom group of participants, the findings of this study are suggestive only and not necessarily indicative of other populations. Centroid factor analysis and theoretical rotation derived three factors with at least two women loading significantly (greater than .40 at $p < .01$) on each factor, and these three factors accounted for 20 out of the 25 participants. The remaining five either loaded significantly on more than one factor or not significantly on any factor. Close examination of the Q-sort values associated with each factor revealed that the three factors described three distinct perspectives of the contexts in which the participants worked. The factor matrix in Table 2 shows the loadings for each Q sort on each factor, with significant loadings greater than .40 ($p < .01$) in bold, with decimals omitted.

Table 2: Factor Loadings for Each Q Sort

Q Sort	Factor		
	A	B	C
1	16	06	60
2	76	13	04
3	46	33	30
4	51	43	03
5	44	-34	-40
6	50	-34	-18
7	37	59	06
8	53	-11	-28
9	11	01	-01
10	68	-24	-06
11	08	19	02
12	70	-15	-37
13	64	-21	-05
14	54	-47	-01
15	54	-31	-21
16	71	-37	-27
17	60	05	-14
18	35	25	57
19	04	82	29
20	10	35	22
21	56	10	-03
22	70	36	-04
23	29	10	54
24	59	-09	-10
25	66	03	-19

Factor A: Teamwork and Integrity

The first factor reflected the views of 15 women, whose positions ranged from vice president to CEO. These women clearly saw teamwork and integrity as defining characteristics of the companies in which they worked. All five CEOs and all company founders loaded significantly on this factor. Table 3 shows the factor scores for the seven statements with which they most agreed, with the scores for Factors A, B, and C immediately following each statement. (See Appendix for a complete set of factor scores.) A factor score for a statement is a weighted sum of the rank orderings for that statement, representing the consensus viewpoints of the participants who ascribe strongly to the view represented in that statement.

Comments associated with this factor, made in response to the question about what it takes to succeed in her company, are that “You must be a team player as well as team builder,” and the “feeling that if the team succeeds, we all succeed.” One participant relayed her company’s reliance on outside alliances, which made it important for individuals to learn to work in teams due to the importance of “team-building across disparate functions [being] critical to success.” Along the same lines, several women described teamwork as essential because of the cross-functional nature of scientific experiments

Table 3: Factor A, Most Agree

No.	Statement	Factor		
		A	B	C
34	Teamwork is the key to success.	4	2	-1
29	The ability to work effectively in a team contributes to professional success.	4	3	-1
12	We value honesty, integrity, and trust.	4	-2	-1
10	The fast-paced nature of the biotechnology industry requires us all to adapt and respond quickly to change.	3	1	3
35	Hard work and commitment to the company are part of our corporate values.	3	-1	1
16	Good performance and results facilitate upward career mobility for women.	3	-1	-1
5	Personal integrity is a critical success factor.	3	-2	-3

and product development. Perhaps the most formal endorsement for teamwork came from the woman who stated, “In 2004, the senior management team has emphasized the importance of teamwork in our performance reviews.” As for integrity, its importance was a resounding theme among the women associated with Factor A, as illustrated by responses like “All employees are expected to act with the highest integrity,” “Honesty and integrity are highly rewarded,” and “The workplace culture of this company requires integrity in everything that we do.”

Factor B: Politics and Barriers

Factor B, on the other hand, presented a decidedly different view of context, one in which political behavior and career barriers for women were the norm. As above, Table 4 shows the factor scores for the seven statements with which the two women associated with this factor most agreed, with the scores for Factors A, B, and C immediately following each statement.

Table 4: Factor B, Most Agree

No.	Statement	Factor		
		A	B	C
9	Employees who stay on positive terms with the CEO are the ones that succeed.	-1	4	2
21	Women who fit in with the corporate culture are more likely to rise to top positions.	1	4	4
24	Political awareness facilitates career mobility.	-2	4	3
26	Tolerance for ambiguity is necessary for career success.	0	3	1
29	The ability to work effectively in a team contributes to professional success.	4	3	-1
7	In order to be respected, an employee must be highly intelligent.	-2	3	-2
38	Political savvy is important to strategic decision making.	-3	3	4

One of the two women associated with this factor put it quite bluntly in responding to the interview question about what it takes to succeed in her company: “It is entirely a male-oriented environment. Career advancement for females is fine as long as they are always in agreement, soft-spoken, and unopinionated. Performance is not a factor. Staying on positive terms with the CEO is a major factor.” In response to the question about the importance of political savvy to career mobility, this participant wrote, “It is essential to know when and to what extent you can express disagreement with the boss without compromising your future position.” The other woman supported this view in her statement: “The nature of our business requires a degree of hype and self-promotion. Most women are poor at self-promotion, but this is perhaps the most overlooked skill we need in this world that is perceived as risk-taking.”

Factor C: Expertise and Opportunity

The three women who loaded significantly on Factor C demonstrated the view that expertise and political awareness facilitated career advancement. The emphasis here was on the individual rather than the team, and unlike the two women associated with Factor B, these women’s Q sorts indicated an awareness of opportunities for upward mobility within their companies. Table 5 follows the same format as the preceding tables.

Table 5: Factor C, Most Agree

No.	Statement	Factor		
		A	B	C
21	Women who fit in with the corporate culture are more likely to rise to top positions.	1	4	4
4	Having technical skill and expertise contribute to women’s ability to attain and retain senior executive positions.	1	2	4
38	Political savvy is important to strategic decision making.	-3	3	4
24	Political awareness facilitates career mobility.	-2	4	3
1	Women at lower levels are encouraged by a CEO who is comfortable with women on the top management team.	-1	-3	3
10	The fast-paced nature of the biotechnology industry requires us all to adapt and respond quickly to change.	3	1	3
43	Women can more easily move into senior executive positions if they can have a flexible work schedule to accommodate parenting issues and/or work-life balance.	-3	-1	3

These three women held the two lowest level positions in my study – two vice presidents and one senior vice president – and they were all promoted into their current position. One stated that promotions were “based on performance rather than politics” and that women could be heard and seen if “they are very assertive.” In answer to the interview question on aspects of the biotechnology industry that help or hinder women’s career advancement, one woman posited that women are good at blending their analytical side with their ability to fit into the corporate culture, and therefore “women have a chance to shine when it comes to making decisions and ‘selling’ recommendations.” Another woman noted that while it is important to have a personality that is compatible with the CEO’s, it is just as important to be “fearless in stating your opinions [and] able to back up your ideas with data/evidence.” While acknowledging the role of teamwork, one woman observed that “attention is often focused on individual contributors because it is easier to recognize individuals.”

Areas of Consensus

The discussion of this study's results has focused thus far on the differences between the Q sorts associated with the three factors. There are, however, four statements for which the factor scores were not significantly different as shown in Table 6. Several women listed communication skills and the ability to express one's views as contributing to women's career success in their companies, and two of them stated that open communication was part of their corporate culture. A woman who noted the necessity of being able to "appropriately communicate your ideas to the right people" summarized its importance by stating that "communication is what career success is all about." The factor scores for Factors A, B, and C, respectively, follow each statement.

Table 6: Areas of Consensus Across All Factors

No.	Statement	Factor		
		A	B	C
33	Employees who possess good communication skills are more successful than those who do not.	2	2	2
40	Having a background in the biological sciences contributes to women's career advancement.	0	0	0
14	Individual achievement plays a major role as long as it is linked to corporate objectives.	0	-1	0
19	Without initiative and a "can do" attitude, an employee will not succeed.	2	1	1

Discussion

The 25 women in this research study had reached the level of vice president and above in the fast-paced industry of biotechnology, characterized by rapid growth and constant change. Their responses to my web-based interview questions produced the 43 statements in the Q sample, and the manner in which they performed the Q sorts on those statements resulted in three distinct perspectives of the specific environments in which they work. The first environment, Factor A, provided an atmosphere of teamwork, integrity, technical expertise, commitment, and encouragement and support for women who were dedicated to making their companies successful. The 15 women associated with this factor, representing 60 percent of the participants, were enthusiastic and optimistic about their future and their companies. Their Q sorts supported the perspective that good performance, not necessarily having a mentor or flexible schedules, leads to advancement within their companies. Their negative ranking of the statement on political savvy was in contrast to the literature on the pervasiveness and importance of politics in the upper echelons of organizations. They were involved in the strategic decision making

process on a regular basis, however, so they may have become so accustomed to engaging in political behavior that they no longer consciously recognized it as an influential aspect of that process.

By contrast, a much smaller group of two women perceived their companies as fostering a political environment that posed barriers to advancement for women, an environment in which information was not shared and qualified women did not enjoy upward career mobility. In keeping with the literature, the theme here was one of having to use political behavior to get ahead. These women felt that they lacked connections and were excluded from their organizations' informal networks, as evidenced by one woman's reference to information exchange occurring "in private little one-on-ones with the favored few." Respect came only through high intelligence, which presumably one had to be able to demonstrate in an atmosphere of politics and ambiguity. Political behavior becomes more pervasive as one moves up the organizational hierarchy, and the two women associated with Factor B saw such behavior as something that facilitated that move. The participant's statement that women need but lack the skill of self-promotion supports the literature on women's distaste for politics, lack of competence in political behavior, and lack of confidence (Arroba and James 1988; Singh *et al* 2002). Discussions with these two participants revealed dissatisfaction with their companies and with the progress that women in general have made, despite their own professional success. In fact, they both indicated that their success had come almost in spite of their companies. There was a clear distinction between the way these women saw men and women being treated in their company. Not only did men and women with equal human capital not progress at the same rate, but they did not even enjoy equal advantages from possessing technical skill, thus illustrating the weakness of human capital theory. These women did not see their female coworkers as beneficiaries of the relative newness of this industry in terms of there not having been enough time yet for traditional patterns of male dominance to have developed.

The third group of women saw technical skill and expertise as necessary ingredients for the attainment of senior executive positions. The three participants associated with Factor C occupied the two lowest levels in my study – vice president and senior vice president – and were all promoted into their current position, which may help to explain their optimism regarding opportunities for advancement. All three women considered individual achievement to play a very important or even critical role in their company. Evidently they believed that their individual excellence, coupled with an awareness of how to navigate the political landscape of their companies, would lead to professional success. These three women did not feel that the financial stresses of the biotechnology industry have resulted in more teamwork, given their emphasis on individual achievement. While they saw expertise as important, they did not perceive skills and experience as the sole criteria for assignment to projects that required teamwork. According to these

women, it was equally important to gain the notice of decision makers and to display individual initiative.

Despite the many differences, there were areas of consensus across the three factors regarding the importance of a biological sciences background, the role of individual achievement, initiative, and communication. There were neutral positions on the importance of a biological sciences background to career advancement, and on the role of individual achievement. The consistent and slightly more positive factor scores for initiative and a “can do” attitude seemed to reflect the benefits of having an entrepreneurial spirit and a willingness to take risks. Nine of the companies had fewer than 100 employees, so it would undoubtedly be difficult to rely on hierarchy and structure to get the work done. Finally, all three groups of women recognized the value of good communication skills to one’s career.

Possible Limitations

My educational background exposed me to the field of leadership studies and to theories that seek to explain barriers to women’s career advancement. Thus it is certainly possible that some of my own opinions surfaced and influenced the participants when I described the purpose of my research to them. Having held management positions in a number of companies, I have witnessed barriers to women’s career advancement. As to my relationship with the participants, approximately four to 15 months elapsed between the time that I met my first participant and completed my research. I spent face-to-face time with every participant as we discussed their Q sorts and their perceptions of the environments in which they worked. However, qualitative studies often last for a much longer period of time, or feature more intensive interactions, giving the researcher more opportunities to observe participants’ daily lives in the environments in which they work.

Implications for Leadership Theory

Strategic leadership theory focuses on the people on the top management team who have responsibility for an organization. The participants in my study were clearly in positions to formulate and implement strategic decisions. Osborn *et al* (2002) have offered a model of leadership that describes a continuum of four contexts ranging from stability to crisis to dynamic equilibrium to the edge of chaos; the latter seems to best describe the 21 companies in my study as they exist today. Organizations at the edge of chaos are complex and dynamic. In keeping with the importance that most of my participants placed on teamwork, leadership is collective rather than individual within the top management team. This serves women well who prefer teamwork and a participative approach. The informational aspects of leadership combine with the transformational aspects to ensure that these organizations engage in the necessary and constant exchange of information (Osborn *et al* 2002) which is essential in the rapidly changing world of biotechnology. Leaders focus more on shifting priorities than on the pursuit of consistent competitive tactics.

As the biotechnology industry matures, however, I believe that the context will bear a greater resemblance to the dynamic equilibrium model that Osborn *et al* (2002) have described. Stability will begin to take root, and there will be more emphasis on leadership from the top rather than from the whole system. Strategy will increase in importance as will the need to link performance to strategy. Leaders’ patterning of attention will shift from priorities for change to key stakeholders, many of whom will continue to be outside the organization as more biotechnology companies become public and continue to rely on alliances for funding and broader research. The top management team will have to focus on communication with organizational members in order to ensure alignment with corporate strategy and objectives. Intraorganizational networks will continue to be important sources of information, and strategic leadership will continue to play a key role in organizational direction. As the shift from the edge of chaos to dynamic equilibrium takes place, biotechnology companies will have to develop new strategies to cope with advances in products and technologies.

Contributions

These contextual changes will necessitate changes in the practice of leadership within biotechnology companies. This study contributes to leadership theory and praxis because it addressed the participants’ perceptions of the manner in which they interact with other members of the top management team as well as the manner in which their organizations facilitate strategic decision making. Leadership is embedded in context (Van Velsor and McCauley 2004). As the industry matures and the context changes, so must leadership practices change. As the business model transitions from research and development laboratories to companies that sell products and generate profits, effective leadership will become increasingly essential to survival (Grupp and Gaines-Ross 2002). One participant articulated this transition in her statement that “building bridges between science and business is particularly important.” Another participant echoed this view in her observation that “problems have arisen as people have been rewarded solely on the basis of technical excellence, and other skills such as people management have been ignored.” She also noted the historically informal exchange of information in her company as effective when her company was smaller, but not now when they are working on major projects with outside collaborators. Changes in the way that leadership is practiced will have to occur, for management within biotechnology companies “needs to become as leading edge as its science if it is to attract and retain the best people in the industry” (Larbey 2002, 303). To do so, management will have to create an environment of teamwork and integrity that encourages and supports dedicated employees who are committed to professional excellence.

Areas for Future Research

This paper would not be complete without pointing the reader in the direction of areas for future research, three of which are the subjective perceptions of male senior executives at biotechnology companies, the subjective perceptions

of women at lower levels of the hierarchy in biotechnology companies, and cross-cultural issues surrounding women and career advancement in biotechnology companies outside of the United States. Given the differences in men's and women's attitudes toward political behavior, for example, it would be enlightening to explore how men perceive its role in their work environments. It would also be interesting to conduct the same Q sorts with women below the vice president level at the same companies to see if their perceptions and experiences differ from those of senior executives. As to cross-cultural issues, there are hundreds of biotechnology companies outside of the United States. A Q methodology study of senior executive women at biotechnology companies in other countries would add to the literature on cross-cultural differences in leadership. The more that we understand obstacles to professional success that women and other minorities experience, the greater will be our chances of ensuring that everyone has an equal opportunity to realize his or her full potential.

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Appendix

Statements with factor scores for Factors A, B, and C

No.	Statement	A	B	C
1	Women at lower levels are encouraged by a CEO who is comfortable with women on the top management team.	-1	-3	3
2	Having an entrepreneurial spirit gives an employee an advantage in career advancement.	0	1	2
3	The fact that biotechnology is a new industry without career paths and networks gives women the opportunity to create their own career paths and networks.	-1	-3	-2
4	Having technical skill and expertise contributes to women's ability to attain and retain senior executive positions.	1	2	4
5	Personal integrity is a critical success factor.	3	-2	-3
6	The financial stresses of biotechnology have resulted in our employees working more cohesively and in teams.	-2	-1	-4
7	In order to be respected, an employee must be highly intelligent.	-2	3	-2
8	A lack of mentors makes it difficult for women to move up the corporate ladder.	-3	0	2
9	Employees who stay on positive terms with the CEO are the ones that succeed.	-1	4	2
10	The fast-paced nature of the biotechnology industry requires us all to adapt and respond quickly to change.	3	1	3
11	People are assigned to teams based on their skill set and experience.	1	0	-4
12	We value honesty, integrity, and trust.	4	-2	-1
13	It is possible to fail at a project and still maintain respect and influence as long as the failure is not the result of inadequate thought or poor design.	0	2	1
14	Individual achievement plays a major role as long as it is linked to corporate objectives.	0	-1	0
15	We value technical excellence.	1	2	0
16	Good performance and results facilitate upward career mobility for women.	3	-1	-1
17	The old boy network is not established in biotechnology generally, and this has favored the advancement of women in this company specifically.	-3	-4	-1
18	Information is broadly and freely disseminated.	0	-4	-2
19	Without initiative and a "can do" attitude, an employee will not succeed.	2	1	1
20	In order to succeed, an employee must accomplish goals and objectives.	2	-1	-2
21	Women who fit in with the corporate culture are more likely to rise to top positions.	1	4	4
22	Technical skill, independent of gender, is rewarded in the biotechnology industry, which helps women's career advancement in this company.	0	-3	0

23	One's influence on key decisions is directly proportional to one's achievements.	-1	-1	-3
24	Political awareness facilitates career mobility.	-2	4	3
25	Being successful means being able to multitask.	2	1	-3
26	Tolerance for ambiguity is necessary for career success.	0	3	1
27	The fact that women have more family responsibilities than men is a barrier to women's career advancement.	-4	1	0
28	The recruitment of senior male executives from the pharmaceutical industry makes it difficult for women to move into senior executive positions.	-4	0	1
29	The ability to work effectively in a team contributes to professional success.	4	3	-1
30	The presence of women who already occupy senior executive positions encourages other women to attain and retain senior executive positions.	1	-2	0
31	Employees who are able to raise money for the company are valued.	-1	1	-3
32	Senior management's discrimination against women is an obstacle to women's career advancement.	-4	-2	-4
33	Employees who possess good communication skills are more successful than those who do not.	2	2	2
34	Teamwork is the key to success.	4	2	-1
35	Hard work and commitment to the company are part of our corporate values.	3	-1	1
36	In order to have influence, an employee must have achieved significant successes.	-2	0	-1
37	Women with an appropriate education and relevant experience have been able to advance at a similar pace to their male colleagues.	1	-4	-2
38	Political savvy is important to strategic decision making.	-3	3	4
39	The high costs and risks associated with the biotechnology industry require teamwork between multiple technical and business disciplines.	2	0	1
40	Having a background in the biological sciences contributes to women's career advancement.	0	0	0
41	Working long hours is valued in the company.	-2	1	2
42	The relative youth of the biotechnology industry helps women's career advancement in this company because there is not a long tradition of male dominance.	-2	-3	0
43	Women can more easily move into senior executive positions if they can have a flexible work schedule to accommodate parenting issues and/or work-life balance.	-3	-1	3