The Effects of the Workgroup on the Development of the Roles of the Shift Leader

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Abstract: Leadership development is a large industry and has received much attention by researchers. At approximately the same time, organizational researchers have been emphasizing the need to understand the context when doing social system research. Little research has been done on the effects of the set of subordinates on the development of leader. This paper begins to look at this issue by using virtual experiments to examine the development of a context-for-Learning at a work site and the implications of that organizational level resource and the work groups involved on the personal development of leadership skills by the leader through job experiences.

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The Effects of the Workgroup on the Development of the Roles of the Shift Leader

Leaders and their skill sets have long been identified as very important for organizations. Leadership research has addressed a range of definitions (see for example: Howell & Costley, 2004/forthcoming, 2001; Yukl, 1998). Indeed, there has been an ongoing discussion between what is leadership versus what is management (Howell & Costley, 2001). While these issues can be very interesting theoretically, pragmatically, organizations are interested in people who can lead towards the future while ascertaining currently levels of performance are maintained or improved. This is particularly important given the impact of executive leadership on organizational performance (Day & Lord, 1988). It is no surprise that leadership development has been the focus of a large number of researchers. A cursory search of scholarly journals included in the ABI/Inform databank resulted in 150 identified articles. There is also a proliferation of leadership development programs. Indeed a recent “Google” search on the phrase, “Leadership Development Programs” resulted in over 25,000 identified websites. Leadership development is not a new idea but it remains one that confounds implementation efforts.

This confounding is based in part on the increased turbulence in organizations and their environments (Gilmore & Shea, 1997) and in part on the fact that leadership like many other strategic resources is socially-constructed. By socially constructed we mean that you need both leaders and followers (Howell & Costley, 2004/forthcoming, 2001; Heller & Van Til, 1982). “Followership” has received increased attention over the years (Kelly, 1988; Hollander, 1992, Mumford, Dansereau & Yammarino, 2000; Montesino, 2003). However, the effects of the particular set of followers on the leader’s own skill development has not really been addressed.

The effects of various leadership development programs have been evaluated; but, in conjunction with the above comments on the lack of focus on the inclusion of the impact of followers, the focus for this paper will be on the experiential learning that the leader engages in and not a particular leadership development program. Because of this focus, there is a need to simulate the development of another socially constructed resource to mimic the interaction of the leader and followers. The current need for both high performance and handling change indicates that having a Context-for-Learning is a valuable strategic resource to include. This resource impacts the ability of individuals in organizations to learn.

Whenever there are people involved, some of the more puzzling and hard to manage resources are the result of their interactions. Creating a context for learning is such a perplexing human system resource (Black & Boal, 1997; Black & King, 2000, 2004/forthcoming). In a human system resource, one needs to consider the nested resources and their influences to the whole systemic resource (Black & Boal, 1994). Since we are interested in the influence of the followers on the leader we will need to simultaneously consider leader-follower dynamics, individual-group dynamics, and group-individual dynamics (Kisfalvi & Pitcher, 2003) with regard to the development of the Group Context-for-Learning resource and its attendant influence on the learning of the leader.
Because of the confounding nature of the development of socially constructed resources such as the Context-for-Learning and the development of leadership skills, traditional means of experiments and case studies will not allow us to systematically evaluate potential impacts of each of these dynamics. We choose to utilize virtual experiments via computational models. This means that a computer algorithmic model (computer program) is developed based on previous published findings and then is run. Such models enable us to understand our theoretical logics in use. Because of the emergent nature of the group level competency and the social constructive nature of both the leadership phenomena and the Context-for-Learning, a model using an agent-based modeling framework will be developed.

The paper begins with a description of specific leadership skills and Context-for-Learning, relationships involved in social construction and the learning focus used. Hypotheses will be developed and presented. We discuss computational modeling and the computational model used for hypothesis testing. We discuss the virtual experimentation process and the choice of a research site for examination of a results of practicing managers. Next the results of the virtual experiments are presented. We conclude with implications for researchers and practitioners.

**Literature Reviews**

We use a computational model to run virtual experiments. Computational models are computer simulations that are developed based on previous research and which allow the examination of components in a system and the effect of changes in either the components or their relationships to each other on the emergent higher order results. Virtual experiments are the running of the simulation either across conditions or when varying model components. The computational model will represent a work group composed of one leader and a number of followers. The computer program will model the development of the Context-for-Learning by the work group. It will also include a set of specific leadership skills for the leader and will track the development of those skills from their use by the leader during the development of the Context-for-Learning. We now present the previous research used in the model development. The areas discussed are: leadership skills, Context-for-Learning, relationships among work group members and forms of learning over time.

**Leadership Skills**

There are a wide set of skills that have been associated with leadership. Given the current need for both current performance skills and innovation and growth skills (Gilmore & Shea, 1997) on the parts of leaders we choose to include a wide set of skills in this project. Such skills include those traditionally argued as needed by managers as well as those traditionally argued as needed by leaders (Howell & Costley, 2004/forthcoming, 2001). Certainly frameworks for leadership skills have been presented by a wide range of researchers (Howell & Costley, 2004/forthcoming; Yukl, 1998; Quinn, 1984). For the wide range of skills to be included in the computational model, this paper focuses on those presented by Quinn and his associates based on the competing values framework (CVF). This set of skills was chosen because it has already

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successfully been incorporated into computational models via the developed questionnaires (Black & King, 2001).

The CVF perspective summarizes four general organizational behavior research epochs and argues that they are based along two dimensions with competing ends (Quinn & Cameron, 1983; Quinn, 1984, 1988; Quinn, Sendelbach & Spreitzer, 1991; Quinn, Spreitzer & Hart, 1992; Denison, Hooijberg and Quinn, 1995; Quinn, Faerman, Thompson & McGrath, 1996, 2002). Control Value Systems compete with Flexibility Value Systems and Internal Focused Values Systems compete with External Focused Value systems. Each of these value systems require different roles with associated behaviors (Quinn, et al., 2002). These two dimensions create four quadrants: Flexibility-External, Control-External, Control-Internal, and Flexibility-Internal. There are two roles for each value system and thus a total of eight roles. The roles and behaviors are complementary within a quadrant and contrast directly (or compete for attention) with the roles and behaviors in the opposite quadrant (See the four quadrants and contrasting roles connected by solid arrows in Figure 1.) Tension exists when attempting to learn in roles associated with competing dimensions. Without intervention, the leader will learn first in the role in which he or she has the highest skill level (Quinn, et al, 2002).

Quinn developed questionnaires to assess the skill levels associated with each role and set of behaviors (Faerman, Quinn, & Thompson, 1987; Denison et al., 1995). These questionnaires were shown to have discriminant, convergent and nomological validity (Denison et al., 1995). Leaders need to not only effectively handle each role but they must be recognized by others as effectively handling the role (Bullis, 1992; Hart and Quinn, 1993; Hooijberg, 1996). Following Black and Boal (1994), we recognize the associated skills with each role as an embedded competency. The competency is required

![Figure 1: Quinn’s CVF Roles by Quadrant](image-url)
for effective role enactment so it is considered embedded in that role. The embedded competencies or skills associated with each role are presented in Table 1.

<table>
<thead>
<tr>
<th>Role</th>
<th>Embedded Competency 1</th>
<th>Embedded Competency 2</th>
<th>Embedded Competency 3</th>
<th>Embedded Competency 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovator</td>
<td>Live with change</td>
<td>Create change</td>
<td>Think creatively</td>
<td></td>
</tr>
<tr>
<td>Broker</td>
<td>Build and maintain</td>
<td>Present Ideas</td>
<td>Negotiate agreement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>power base</td>
<td></td>
<td>and commitment</td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Work productively</td>
<td>Manage time and stress</td>
<td>Foster a productive</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>work environment</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td>Design and organize</td>
<td>Delegating effectively</td>
<td>Envision where the</td>
<td>Setting goals</td>
</tr>
<tr>
<td></td>
<td>the work</td>
<td></td>
<td>organization is going</td>
<td></td>
</tr>
<tr>
<td>Coordinator</td>
<td>Manage projects</td>
<td>Manage cross-</td>
<td>Design work processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>functional teams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor</td>
<td>Manage group</td>
<td>Manage</td>
<td>Manage individual</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Performance</td>
<td>Organizational</td>
<td>performance</td>
<td></td>
</tr>
<tr>
<td>Facilitator</td>
<td>Build teams</td>
<td>Use participative</td>
<td>Manage conflict</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>decision making</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentor</td>
<td>Understanding self</td>
<td>Communicate</td>
<td>Develop your followers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and others</td>
<td>effectively</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Leaders use their skills to facilitate the performance of their work groups. Such performance will be in the necessary tasks assigned to the work group as well as the development of other critical strategic competencies. Recall that the strategic competency we use in this simulation is the Context-for-Learning.

**Context-for-Learning**

The Context-for-Learning competency was chosen because so much of our business environment and the way we carry out our work is in a constant state of change (Harrigan, 2001). To enable an organization to survive and thrive requires the employees to be continuously learning (Harrigan, 2001; Quinn, et al., 2002; Winter, 2003). Supporting such learning is the purpose of the Context-for-Learning competency. This competency can be measured at an individual level as well as at the collective level. It was first noticed in a rich case study on a learning organization that was done by Ghoshal and Bartlett (1994). In that case study, four key attributes of the work environment were
identified. Ghoshal and Bartlett described these attributes and called them: Discipline, Stretch, Trust & Support. Black and Boal (1997) operationalized these constructs with questionnaire items and developed scales for them (See Table 2). Black and Boal (1997) building from their earlier work recognizing the critical nature of the relationships among nested or embedded resources (Black & Boal, 1994) and the holistic nature of the Context-for-Learning as described by Ghoshal and Bartlett (1994) found that similar configurations of the Context-for-Learning occurred in the presence of high current performance and in the presence of high acceptance of change. They also confirmed the presence of this competency in a manufacturing environment.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Embedded Competencies</th>
<th>Crombach’s Alpha Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discipline</td>
<td>• clear performance standards</td>
<td>α = .87</td>
</tr>
<tr>
<td></td>
<td>• fast feedback</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• open communication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• management by commitment</td>
<td></td>
</tr>
<tr>
<td>Stretch</td>
<td>• shared ambition for the future across the organization</td>
<td>α = .77</td>
</tr>
<tr>
<td></td>
<td>• collective identity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• personal link between the individual’s work and the company’s priorities (hence personal meaning)</td>
<td></td>
</tr>
<tr>
<td>Trust</td>
<td>• perceived equity in decision-making (a.k.a. fair decision making)</td>
<td>α = .70</td>
</tr>
<tr>
<td></td>
<td>• involvement of people in decisions that affected their work or collective problem solving</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• individual competence</td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td>• access to organizational resources (which was presented as inter-group cooperation and coordination)</td>
<td>α = .87</td>
</tr>
<tr>
<td></td>
<td>• autonomy or the freedom to make decisions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• guidance and help including help from within groups, as well as, from management in terms of coaching and support</td>
<td></td>
</tr>
</tbody>
</table>

Recently, socially-created phenomena can be seen as the emerging result of the interactions of individuals who are operating with their own set of behavior rules (Anderson, 1999; Bergmann-Lichtenstein, 2000) and are in systems comprised of embedded systems (Mathews, White & Long, 1999). Complexity theory applications appear appropriate ways to investigate emergent collective level phenomena (Anderson, 1999). Complexity theory applications require that the relationships among the individuals involved be identified and defined. For this simulation there are the relationships among group members (Leader-Followers-Group; taken pair wise in all combinations) and the relationship across time with the individual (learning). We now describe the literature base used for each of these types of relationships.

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Relationships Among Group Members

In the past, collective level responses have been handled in a naïve fashion using simple averages across the individuals involved. However, when we examine the socially-created phenomena from the complexity theory perspective we find that the types of relationships among the individuals involved matter. In social systems, particularly work-based systems, such relationships are found in the power relationships between individuals and there have been calls to include these relationships in our research (Yukl, 1998; Pfeffer, 1992; Howell & Costley, 2001; Contu & Willmot, 2003).

In this paper, we recognize that power is embedded in the very positions of an organization, as well as, in the individuals and their competencies (French & Raven, 1959; Pfeffer, 1992; Whetten & Cameron, 1998; Howell & Costley, 2001). Several types of power have been identified as valuable for investigation and used in recent research endeavors: Legitimate or position power (Koh & Low, 1997; Elangovan & Xie, 1999), expert power (Reed, 1996; Koh & Low, 1997) and referent or person-based power like charisma (Yukl, 1998, Howell & Costley, 2001, 2004/forthcoming) which has a growing research base. This study uses the first two: the individual (expert) power and legitimate (position) power.

Learning

While people will develop the most quickly when they build on personal strengths while also addressing their weaknesses (Howell & Costley, 2004/forthcoming), much of the leader’s development occurs on the job during the regular work day (Day, 2001). Leaders, of course, are not the only ones whose learning comes via on-the-job experiences. Two types of on-the-job learning are included in this paper: experiential learning and directed learning.

Experiential Learning. Just in interacting in a daily fashion people engage in experiential learning (i.e. learning from one's own actions). Thus as people interact, they learn. Because this is a by-product of the interactions, experiential learning includes the small adjustments made to an individual’s personal perceptions of their world (i.e. it is a reflection of the collective’s influences on individuals as they create and recreate their environments (Giddens, 1977)).

However, as individuals choose to respond, they will be constrained by their current levels of knowledge (individual scale scores for embedded competencies – see Tables 1 & 2) and their own personal Context-for-Learning profiles (2nd order scales) and their workgroup’s collective Context-for-Learning (Group Context-for-Learning). Thus we expect that, for a given embedded competency, an individual will have an experiential learning curve that applies and that what the individual chooses to do will be dependent in part on their personal placement on that learning curve and their personal Context-for-Learning level. In addition to this personal enhancement or constraint, there is a group level enhancement or constraint. The Group Context-for-Learning will also impact the learning of an individual group member. This influence relationship is related to the expert influence mentioned above. Both are individual based influence relationships; however, the key here is the degree of similarity between the Group and the individual group member. If the two are similar the individual will automatically include the Group
influence. If the two are dissimilar, the individual will still be influenced by the group but not to the same extent. He or she will reject most of the group influence.

Thus, the individual's learning for his or her personal Context-for-Learning profile will be influenced by the Group Context-for-Learning, their personal Context-for-Learning and their own personal skill level for the embedded competency.

**Directed Learning.** Leaders by virtue of their positions will also directly impact their followers (Neck & Manz, 1996; Agashae & Bratton, 2001; Driver, 2002; Maurer, Pierce, Shore, 2002). This learning is contingent upon whether or not the follower actually noticed the leader’s behavior. Given that a follower has noticed the leader’s behavior, the follower will also modify his or her acceptance of the behavior by the degree to which the leader’s behavior aligns with the follower’s own perceptions of the situation.

Not all behaviors equally influence perceptions. To determine the maximum amount of influence that a leader’s behavior in the embedded competencies of the CVF roles would have on the Context-for-Learning embedded competencies, an influence matrix was constructed from the responses of a panel of nine leadership researchers from the United States. These panel members were asked to indicate on a matrix of embedded items if action in one would influence the perception in the other. For example, if they believed that a specific leader behavior (such as designing & organizing work) would influence a follower’s perception of an embedded competency for the Context-for-Learning (such as collective identity). After grouping the responses into the CVF roles and the Context-for-Learning attributes, the collective relationships between the eight roles and the four attributes were derived and the theoretical influence matrix was generated. The matrix (See Table 3) reveals the weighted percent of agreement across experts on the influence of the leader’s behaviors on the Context-for-Learning attributes.

<p>| TABLE 3 |
| Leadership Roles’ Main Competencies Influence on Context-For-Learning Competences |</p>
<table>
<thead>
<tr>
<th>Mentor</th>
<th>Innovator</th>
<th>Broker</th>
<th>Producer</th>
<th>Director</th>
<th>Coordinator</th>
<th>Monitor</th>
<th>Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discipline</td>
<td>39.29</td>
<td>04.76</td>
<td>35.72</td>
<td>34.53</td>
<td>32.14</td>
<td>30.95</td>
<td>30.95</td>
</tr>
<tr>
<td>Stretch</td>
<td>41.27</td>
<td>25.40</td>
<td>38.09</td>
<td>28.57</td>
<td>50.79</td>
<td>38.10</td>
<td>41.27</td>
</tr>
<tr>
<td>Trust</td>
<td>38.10</td>
<td>25.40</td>
<td>15.87</td>
<td>28.57</td>
<td>26.99</td>
<td>17.46</td>
<td>26.98</td>
</tr>
<tr>
<td>Support</td>
<td>47.62</td>
<td>28.57</td>
<td>31.64</td>
<td>22.70</td>
<td>33.33</td>
<td>36.51</td>
<td>23.81</td>
</tr>
</tbody>
</table>

These values were then operationalized as the percent of time the leader’s behaviors will influence the perception of the follower if the follower was paying attention to the leader in the first place. Thus, for example, a leader’s Mentor behaviors will impact the Discipline competency level 39.29% of the time.

To the above experiential learning, we add the directed learning from the leader but modified by the maximum amount of influence from Table 3 and whether or not the follower was paying attention. In this paper, leaders will not have this learning since we limit our system to one-leader and a set of followers.

**CVF Role Learning.** The leader will learn in an experiential fashion in the embedded competencies of the CVF roles but with some added caveats. Quinn and his
associated (Quinn, 1988; Quinn et al., 2002; and so forth) argued that due to the competing nature of the Internal-External and Flexibility-Control dimensions, if one learned on one side it was more difficult for them to learn on the associated competing role. Thus for the leader, to the earlier experiential learning issues, we add explicit attention to this additional learning tension. We assume that the leader will choose to take action in the areas that he or she already has the highest competency and will thus learn on that dimension and forgo learning on the competing embedded competency. Such learning is still constrained by the existing level of competence and by the leader’s personal Context-for-Learning and the workgroup’s collective Context-for-Learning.

**Hypotheses**

Recall from earlier that much of the leader’s developmental learning occurs on the job. There is one main issue that we are interested in finding out, does the work group make a difference in a leader’s development from experiential learning? An associated issue is that we wanted to test this with “real” data. Thus we will look at real workgroup-leader combinations.

The particular resource that is being modeled relates to having a context that supports learning. Given the previous detailing of the literature that informed the development of the computational model, we expect that a group with a high Group Context-for-Learning will enable all CVF leader profiles to learn in their leadership skills. Thus, Hypothesis 1 is:

**Hypothesis 1.** The skill level change for each role in the CVF profile of a leader at a work site with an associated group with a high Group Context-for-Learning will be positive.

Given that the group with a high Group-for-Learning level facilitates learning, we anticipate that effective leader profiles will learn more and faster and thus will approach the master leader shape of being balanced across all roles. Thus Hypothesis 2 is:

**Hypothesis 2.** The shape of all effective leader profiles at the site will be roughly balanced at the end of the run of the computational model when run with their associated workgroup.

Does the specific work group make a difference? Since each workgroup has a high Context-for-Learning index, we do not believe that the particular work group would make a difference in the learning of the leaders. Thus Hypothesis 3:

**Hypothesis 3.** There will be no differences in learning by an effective leader at a site in any workgroup at that site with a high Group Context-for-Learning.
To examine the above hypothesis that take into explicit account the work group within whom the leader interacts and the potential impact on the learning of the leader, we turn to computational modeling. This methodology is detailed in the next section.

Methods

The Computational Model and its Operationalization

Complex adaptive social systems have agents who work in sub-groups have relationships with each other and their groups, who import energy (learn) and mutually co-evolve with their system (Anderson, 1999). To illustrate the inclusion of these complex adaptive system elements in the base computer model we will address each one individually.

Agent Identity (Identifying the Individuals Involved in the Workgroup)

The computational model is composed of agents and their relationships with each other and with larger systemic resources. Agents are individuals involved in a workgroup and they are identified by their roles. The agents each have several embedded roles. One is whether they are a leader or a follower. Another is if they are a member of a work group. The leader role is operationalized via the CVF profile developed from the Quinn questionnaires (Quinn, et al. 1996). The follower role has no such profile. The group member role is operationalized as the attribute profile developed from the Context-for-Learning questionnaire.

Relationships between Agents (Relationships between Leader-Follower-Group)

The base computer model (Black, Oliver & King, 2004/forthcoming) also details the general relationships between the various agents. These relationships may be from individual-to-another-individual or individual-to-group or group-to-individual. The operationalization of these sets of relationships are presented next.

Individual-to-Another-Individual. There is only one specific type of relationship included in this computational model based on the earlier work of Black and her associates (Black & King, 2000, 2002; Black, Oliver & King, 2004) and that of the Leader-to-Follower. This was described earlier in the section “Directed Learning”. The leader by virtue of being in that position will have some direct impact on the aware follower. This impact influences the amount of learning that the individual does. It is operationalized by including the learning factor associated with the leader’s level of an embedded competence when calculating the amount of learning that an individual is doing during a time period. If the follower is paying attention (operationalized with a stochastic random number generator), then the contribution that the leader makes is the amount of learning possible from the leader’s skill level in an embedded competency of the CVF role modified by the theoretical influence matrix (see Table 3) (the percent for that particular CVF role-Context-for-Learning attribute). If the leader is relatively similar to the follower, the follower will equally weight the leader’s contribution with his or her own personal contribution to learning. If the leader is not similar, then the follower will use a 25/75 leader/personal weighting.
Individual-to-Group. The influences from individual-to-group level are operationalized as the weighted results of position or legitimate power (leader-to-group) and personal or expertise power (Follower-to-group) (French and Raven, 1959; Pfeffer, 1992; Whetten and Cameron, 1998; Howell and Costley, 2001). Expertise power is operationalized as the proportional contribution that the individual makes to the work group’s collective expertise (excluding the leader). These are calculated for each Context-for-Learning attribute and then the attributes are averaged together to calculate the Group Context-for-Learning. On the individual level, the attributes are averaged together to calculate the Personal Context-for-Learning.

Group-to-Individual. The rules that affect the group’s influence back onto the individual are based in the social structuration literature (Giddens, 1977). Here the work group’s influence an individual is ongoing and constant and roughly equivalent to the individual’s own preferences if the individual is relatively similar to the group (Black & King, 2000; 2002, 2004/forthcoming) (a weighting of 50/50 group/individual) but will be partially rejected if the group is relatively dissimilar to the individual (a group/individual ratio of 25/75).

Learning
The relationship rules or energy importation rules that guides the changes from one interaction to the next are the individual’s learning factors (Black & King, 2004/forthcoming) for their Context-for-Learning Profile (CFL PROFILE). These factors are based on the individual’s initial level in a particular area (discipline, stretch, trust, support) and are modified by the individual’s Personal Context-for-Learning index, the Group Context-for-Learning and any perceived leader behaviors. The Learning Factors for each individual change over time due to changes in each individual's Context-for-Learning profile. The same general pattern also applies to the leader’s CVF PROFILE. An individual’s expertise factor grows the same way that their trust factor grows since it is an embedded component of the trust factor (an item that represents the concept that one trusts that someone has the expertise to do what they say they will do).

Personal Context-for-Learning Index Learning Factor. Each individual will have his or her own Personal Context-for-Learning index which is the average across all the attributes of the Context-for-Learning for that individual at the start of a particular time period. There is a learning factor associated with that level which is based on an S-curve that goes from 0 to 1.5. At low levels (1-3) the value is fractional, at about 4 it is equivalent to 1 and at high levels (5-7) it approaches 1.5. This factor represents the amount of movement possible across a Likert-scale level associated with the questionnaires. This value is then divided by 4 to mimic the concept that one can not move up one full level within any particular time period but must take several time periods to do so. We chose 4 because that represents 4 months or one quarter of a year as a reasonable representation of movement along a Likert-scale. This is arbitrary and may be examined closer in future projects.

Group Context-for-Learning Index Learning Factor. The Group Context-for-Learning attribute levels are first calculated as described in the section “Individual-to-
Group.” These Group level constructs are then averaged together to form the Group Context-for-Learning index. The learning factor for this index value is then calculated as described in the “Personal Context-for-Learning Index Learning Factor”.

**CVF Profile Learning Factors.** The leader's CVF PROFILE Learning Factors also change due to their use on the job. The learning factor is based on the leader’s skill level and is modified by the leader’s Personal Context-for-Learning index, Group Context-for-Learning index and frequency of use.

**Leader Directed Learning Factor.** The leader is expected to take a variety of actions in daily work life which is operationalized by Quinn and his colleagues Competing Values Framework (Quinn et al, 1996). The learning factor for each one of the roles is calculated in a similar fashion to the Personal Context-for-Learning Index Learning Factor, with the input being the skill level for the leader in a particular CVF role.

These actions influence the leader’s followers in varying degrees. The details were described earlier in the section, “Individual-to-Another-Individual”. Thus the leader acts which is sometimes noticed and when noticed by a follower influences that particular follower.

**Total Learning in an Iteration.** During each iteration of the computational model, there is a recalculation of the Group Context for-Learning index based on the current levels of the Context-for-Learning profiles for individuals involved and their current expertise proportions. This impacts the actual composition of the Group Context-for-Learning. Black and King (2000, 2004/Forthcoming) used position power and expertise power to calculate a weighted score for the group level index. The percentages of each type of power vary (Black, Oliver, & King, 2004b). They vary depending upon first the skill level of the Leader (until the leader is roughly equivalent in skill between competing skill areas, the leader will do what he or she does best. Once they are roughly equivalent, the leader will choose which one to do based on the overall Group Context-for-Learning levels. If these levels are very low, the Leader will engage in the director role (Leader contribution = 75%). When the Group Context-for-Learning is very high, the leader will engage in the facilitator role (Leader contribution = 25%). These rules were also followed for this simulation and paper.

**Co-Evolution (Group and Individual Goals).**

As the group and individuals change this affects future changes through the learning factors. These factors then in turn affect the future changes in the individuals who then impact the group level resulting in co-evolution of the individual and group levels of Context-for-Learning. The Group goal is to maximize the Context-for-Learning. The only individual goal included is that the leader’s goal is to learn in the CVF roles but constrained in the ways already discussed. The leadership development then is a by-product of the leader acting in ways to attain the group goal of maximizing the Group Context-for-Learning index.
Summary

Notice that individual agents have identified characteristics for the organizational role they occupy and that relationships are defined that govern the interaction between individual agents, the agents and the collective, and the same agent across time. It is also evident from the above that past actions influence future actions and that the group is both influenced by the individual and influences the individual resulting in co-evolution. Thus the major components of a complex adaptive system are found in the simulation. Given that the logic of the base model chosen appears to conform to the organizational concepts of a complex adaptive social system, we continue with our virtual experiment.

Virtual Experiments

Virtual experiments operate much like traditional experiments. You specify conditions which are modeled through the computational model. You run the computational model mimicking the “doing the experiments” and extract the output from the computational model runs. To increase the veracity of the computational model, if it is a purely deterministic model you run it with a variety of input data sets. If the model is a stochastic model, you run the same data set multiple times. If the model combines the two, you must both vary the input data and run each variety of data multiple times.

This computational model has logical but deterministic factors and stochastic factors (the individual paying attention). Furthermore, computer models have greater veracity if they are linked to the real world. One way to do such linkage is to take input from a real world site. For this paper, we determined that the experiment would use real world information for leader skills and follower attributes (Noe, 1986). In such a case, the computation model was run 100 times for each condition. The degree of variation was low enough (nothing higher than .0001) that the average across the 100 runs could be used for analysis.

An initial step was to determine which leader profiles fit Quinn’s effective category and which did not. We then compared the leadership responses to prototypically responses derived from the work by Quinn et al. (Quinn, Faerman, Thompson & McGrath, 1996, 2002). The smallest absolute value of the average difference to a particular profile resulted in that leader being categorized as representative of that profile. To identify leaders to use, we look to see which managers had profiles that were the closest to an effective leader profile as identified by Quinn.

The data had two levels of leaders, supervisory level associated with six groups and two non-supervisory leaders not associated with only one group. For the eight site leaders participating, six fit the profile of a Master Manager the best. One was categorized as a Conceptual Producer. One ineffective profile emerged that was categorized as an Extreme Unproductive. (See Table 4).
Table 4
Results of Profile Comparisons
Absolute Value of Average Distance from Profile Roles

<table>
<thead>
<tr>
<th>Site-Leaders</th>
<th>Chaotic Adaptives</th>
<th>Abrasive Coordinator</th>
<th>Drowning Workaholic</th>
<th>Extreme Unproductives</th>
<th>Aggressive Achiever</th>
<th>Conceptual Producer</th>
<th>Peaceful Team Builder</th>
<th>Master Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leader 1</td>
<td>1.79</td>
<td>2.10</td>
<td>2.80</td>
<td>3.12</td>
<td>1.34</td>
<td>1.05</td>
<td>1.20</td>
<td><strong>0.78</strong></td>
</tr>
<tr>
<td>Leader 2</td>
<td>2.11</td>
<td>2.43</td>
<td>3.13</td>
<td>3.44</td>
<td>1.66</td>
<td>1.38</td>
<td>1.53</td>
<td><strong>1.10</strong></td>
</tr>
<tr>
<td>Leader 3</td>
<td>1.47</td>
<td>1.16</td>
<td>0.46</td>
<td><strong>0.15</strong></td>
<td>1.92</td>
<td>2.21</td>
<td>2.06</td>
<td>2.49</td>
</tr>
<tr>
<td>Leader 4</td>
<td>0.77</td>
<td>1.08</td>
<td>1.78</td>
<td>2.10</td>
<td>0.32</td>
<td><strong>0.03</strong></td>
<td>0.18</td>
<td>0.24</td>
</tr>
<tr>
<td>Leader 5</td>
<td>2.47</td>
<td>2.78</td>
<td>3.48</td>
<td>3.79</td>
<td>2.02</td>
<td>1.73</td>
<td>1.88</td>
<td><strong>1.45</strong></td>
</tr>
<tr>
<td>Leader 6</td>
<td>1.21</td>
<td>1.52</td>
<td>2.22</td>
<td>2.53</td>
<td>0.76</td>
<td>0.47</td>
<td>0.62</td>
<td><strong>0.20</strong></td>
</tr>
<tr>
<td>Middle &amp; Upper Management</td>
<td>1.64</td>
<td>1.95</td>
<td>2.65</td>
<td>2.97</td>
<td>1.19</td>
<td>0.90</td>
<td>1.05</td>
<td><strong>0.63</strong></td>
</tr>
<tr>
<td>Leader 7</td>
<td>1.78</td>
<td>2.09</td>
<td>2.79</td>
<td>3.10</td>
<td>1.33</td>
<td>1.04</td>
<td>1.19</td>
<td><strong>0.77</strong></td>
</tr>
</tbody>
</table>

Research Site
Because the Hypotheses required high Group Context-for-Learning and effective leader profiles, we looked for a research site which these conditions. We found this organization in the United States Armed Forces medical facility program. We assessed several nursing work groups at one of the military medical facilities.

Eight skilled nursing floor shifts participated in the study. Six cases of nursing supervisors and work groups had sufficient leader and follower responses to be included in this virtual experiment. The work group sizes ranged from a low of 7 followers to a high of 12 followers. The responding shifts were both day and night shifts. The shifts did not include the operating room nursing staff.

Results
The results of running the simulation were a series of radiographs. Radiographs are multidimensional graphs. In this case there are 4 axis in use. Each axis has one of the competing dimensions displayed. They look like figure 1 except the vertical and horizontal axis are not present. The evaluation for each Hypothesis is presented next.

Hypothesis 1: Leaders Learn When Leading High Groups.
Each work group at this site had a high Group Context-for-Learning (lowest level of a leader-work group was just at 5). To evaluate whether or not there was learning the radiographs for each leader-group was examined to determine that the positive learning experiences outnumbered the neutral or negative learning experiences.

A visual examination of the summary graphs of the result of 100 runs with each leader-group combination reveals that all graphs indicate had more roles with positive learning (light gray shading is outside dark gray shading) than did not. Hypothesis 1 is supported.

**Hypothesis 2: LEADERS LEADING HIGH GROUPS BECOME/STAY MASTER MANAGERS.**

This hypothesis argued that effective leader’s profiles would become more balanced overtime. Recall that all leaders with the exception of leader ANG3 were effective leaders. For this Hypothesis we examine the radiographs for shape. We look for instances of more balanced shapes after the runs (light gray shading) versus at the beginning (dark gray shading). Visual inspection of the graphs reveals that of the 5 effective profiles (#ANG1, ANG2, ANG4, ANG5, ANG6) graphs only 2 are equally or more balanced at the end of the runs (recall that these are average results across 100 runs). It is only those people who at the beginning of the experiment were closer than a total difference of 1 across all 8 roles to the master manager profile that ended up having a balanced end result. Those that were farther away ended up with a less balanced profile. Hypothesis 2 is **NOT** supported.

**Hypothesis 3: NO MATTER WHICH GROUP THE LEADER’S LEARNING IS THE SAME**
Hypothesis 3 suggested that since both the leaders and the groups were at the effective end of ranges that there would be no differences in leader learning across the workgroups at the site. Each of the five effective leader will be placed with each of the six groups. The resulting radiographs will be compared to determine visually if there are any differences between the resulting learning.

**Leader ANG1.** In examining the radiographs for Leader ANG1, it is apparent that it does not matter what group this leader is in, he or she will learn and will achieve a balanced set of skills (See Figure 3). Leader ANG1 provides support for Hypothesis 3.

**Leader ANG2.** In examining the radiographs (See Figure 4) for Leader ANG2, it is clear that Hypothesis 3 is **NOT** supported. All final learning patterns are not the same. There appear to be two patterns of learning with each half similar to each other. Or in other words only fifty percent (50%) appear to have similar learning patterns (lighter gray shaded areas). This may imply that the workgroup variations, even within a “high” Context-for-Learning category, end up influencing the leader’s development in different ways.
Leader ANG4. In examining the radiographs (See Figure 5) for Leader ANG4, it is evident that there are even more different patterns of learning than for Leader ANG2. All six learning patterns are different! One even results in a fairly balanced final profile (Group ANG6). Hypothesis 3 is **NOT** supported.

Figure 4: Hypothesis 3 for Leader ANG2

Figure 5: Hypothesis 3 for Leader ANG4
**Leader ANG5.** Reviewing Figure 6 for similarity of pattern for Leader ANG5 reveals mixed results again. Groups ANG1, ANG4, ANG5, and ANG6 have similar patterns but the other two have different patterns either from ANG1,4-6 or from each other. Hypothesis 3 is **NOT** supported.

![Figure 6: Hypothesis 3 for Leader ANG5](image)

**Leader ANG6.** Leader ANG6 like Leader ANG1 (see Figure 7) had similar patterns no matter the workgroup. Hypothesis 3 is supported.

![Figure 7: Hypothesis 3 for Leader ANG6](image)
In summarizing the results of the Leader by Leader assessment of Hypothesis 3, we find two leaders whose learning patterns across all groups support Hypothesis 3 but the remain 4 do not. There is a pattern to the support. It is those work groups which were less than 1 away from the Master Manager profile at the beginning of the virtual experiments. We conclude that Hypothesis 3 is NOT supported. This implies that unless the leader is very strong across all of the leadership skills, the specific characteristics of a work group make a difference in the leader’s experiential development.

Discussion

We opened this paper by recognizing that leadership development is important and that much of that development occurs through on-the-job experiences. We acknowledged that while there is quite a bit of literature on the impact of leaders on their work groups (followers) there is much less research on the impact of the leader’s work group (followers) on the leader’s own development. We chose to examine this issue as the strategically important resource of having a Group Context-for-Learning was being developed. We used a computational model to simulate the development of the Group Context-for-Learning that had been developed by Black and her associates (Black & King, 2000, 2001; Black, Oliver & King, 2004). We examined the CVF profiles of the Leader’s skills as suggested by Quinn and his associates that were produced as a by-product of the computational model. To contextualize the computational model, we use data collected at a U.S. Military Medical facility. There were six groups which had initial high levels of a Context-for-Learning. Five of the associated leaders had CVF profiles that were the closest to the effective profiles suggested by Quinn and his associates.

In examining the output figures that showed the CVF profiles at the beginning and end of a run of the computational model, we found that all leaders learned when they lead a group with a high Context-for-Learning (Hypothesis 1 was supported). However, not all effective leaders moved towards the Master Manager profile of evenly balanced skills levels across the roles. Indeed some that were closest to the Master Manager profile became unbalanced (Hypothesis 2 was not supported). In examining these 5 effective leaders in each of the groups from the site, we found that only the two profiles which were closest to the Master Manager profile where able to learn in the same way no matter which group they lead. The rest of the leaders had different learning patterns depending upon which group they lead (Hypothesis 3 was not supported). The farther away from the Master Manager, the greater the variation in learning pattern. It was interesting to note that the two next closest to the Master Manager were able to learn in a balance way for one of the group at the work site but it was not the same group for each of these leader but different ones. It was also not in the same group as they were currently leading.

Implications for Researchers

For this paper, we have applied one of the most popular and powerful quantitative tools of complex system analysis -- computer based simulation modeling (Carley, 1995) to the issue of the effects of a practice of leadership training on nursing shift leaders and teams and their capability of creating a context for learning (Ghoshal & Bartlett, 1994; Black & Boal, 1997; Black & King, 2000). Using a computer model developed elsewhere (Black & King, 2000; 2004(forthcoming)), the model takes inputs
from organizational and leadership skill assessment surveys and generates simulated
developmental paths of the Context-for-Learning and records the simulated experiential
learning of the leader along the dimensions of Quinn’s Competing Values Framework.
This process revealed interesting effects of a work group on the experiential
development of a leader. The work group appears to matter unless you have a very
advanced leader who is highly skilled across all roles and behaviors. This suggests the
need for further research into this side of leadership development studies.
This work also demonstrates the usefulness of computational modeling and agent
based modeling in particular for assessing and identifying important areas for future
research. We find that the effort put into designing such a model is worth the investment.

**Implications for Practitioners**

This study has important implications for the practicing manager/leader. On a
personal level, the group that you lead matters in your own development. If you are
already highly skilled and a master manager the group matters less, but if not the group
makes a difference. Some groups can actually enhance your movement towards
becoming a Master Manager other groups can actually impede it. These groups are not
necessarily highly different from each other. In this paper, they were both in the general
category of groups with “high” Context-for-Learning scores.

**Limitations**

This was a study done only at one site and with only 6 leaders and work groups.
Furthermore the work groups all had a “high” Group Context-for-Learning score. The
work needs to be replicated using different sites with different compositions of Leaders
and work groups. The work would also benefit from investigations in differing industry
than health care.

**Conclusion**

This paper extends the value of the theoretical computational presented by Black
and associates (Black & King, 2004/forthcoming; Black, Oliver & King, 2004a,
2004b/forthcoming) into a field trial and into investigating a “by-product” the leader’s
experiential learning. The learning from these two areas is fruitful for both researchers
and practitioners. We look forward to continued use of computational modeling and
investigating strategically important resources.


*Paper Presented at the 2005 British Academy of Management, St. Andrews, Scotland*


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