# PROJECT TEAM DYNAMICS AND COGNITIVE STYLE

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## Abstract
Problem-solving styles and interpersonal dynamics of project teams are often critical factors for a team to function effectively. To study problem-solving styles and track intra-team interactions, the Kirton Adaption-Innovation Inventory (KAI) was used to determine the cognitive styles of engineering and management students in Bucknell's Institute for Leadership in Technology and Management (ILTM). KAI scores allowed interpretation and characterization of data from student journaling assignments that recorded observations about project team members' abilities to work and communicate with each other. KAI results show correlations with both positive and negative aspects of project team experiences. The results indicate potential sources of conflicts in project teams comprised of mature individuals working in a corporate environment.

## Introduction
Within Bucknell University's ILTM, the faculty traditionally assemble student project teams to maximize heterogeneity in gender, major, and grade point average (GPA). The heterogeneity not only balances the capabilities and skill sets of the teams, but also forces students to work with others who may have different approaches to problem solving. Previous experience shows that although the teams are designed to be as similar as possible, some teams inevitably function better than others, and often at least one team suffers significant problems with team dynamics.

To investigate and establish the functional heterogeneity (or homogeneity) of the teams, cognitive style theory and the KAI were introduced into the ILTM on-campus program in the summer of 2001. Kirton's Adaption-Innovation theory is based on the assumption that individual cognitive differences in approaches to problem solving produce distinctive patterns of behavior and that the differences can be identified by a relatively simple psychological instrument. Kirton's work indicates that significant differences (20 points or more in KAI scores) in problem-solving styles of project team members can lead to serious difficulties in team members' functioning, communication, and collaboration.

By studying engineering and management students in the ILTM program, this investigation seeks to determine whether KAI scores can be used to develop correlations and draw conclusions about project team dynamics. This was accomplished by determining the KAI scores of the students and faculty advisors, then tracking the progress of the project teams through student journal entries and faculty observations. While the results are clearly applicable to student project teams, our results, as well as those previously reported on project team dynamics (Foxall, 1986; Hammerschmidt, 1996; Keller, 1986; Schroder, 1994), suggest that our conclusions can be applied to a broad range of corporate, engineering, and managerial teams. The contributions of the present study are that it focuses on integrated teams of future engineers and managers, evaluates interactions of team members through journal entries, and closely ties KAI scores to observed functional problems.

We give an overview of the 2001 ILTM program with descriptions of the student project teams, a brief summary of cognitive style theory, and the approach to cognitive style developed by Dr. Michael J. Kirton. Specific data will be presented, including KAI score distributions and sample anonymous journal entries. Results indicate that KAI scores help with understanding and appreciating problem-solving strategies of others, and predict trouble spots within project teams.

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**Exhibit 1.** Week 2 of ILTM program syllabus (2001)

| | Week 2 | | | | |
|---|---|---|---|---|---|
| Time | Monday June 18, 2001 | Tuesday June 19, 2001 | Wednesday June 20, 2001 | Thursday June 21, 2001 | Friday June 22, 2001 |
| 9:00 a.m. | Teamwork and Conflict Resolution<br>Mr. Wise<br>T012 | (9:30 a.m.) Two Cases in Leadership<br>Prof. Gruver<br>T113 | (6:30 a.m. departure!)<br>Field trip<br>Corning<br>Corning, NY | Marketing<br>Prof. Allen<br>T113 | Transportation and Logistics<br>Prof. Willoughby<br>T113 |
| 1:00 p.m. | Operations Management<br>Prof. Willoughby<br>T113 | (noon) Exec.-in-Residence<br>William G. Gruver<br>General partner (retired)<br>Goldman, Sachs & Co.<br>LC217 | Field Trip<br>Corning<br>Corning, NY | Managing Human Resources<br>Prof. Pagana<br>T113 | Working with Emotional Intelligence<br>Prof. Pagana<br>T113 |
| 7:00 p.m. | | (8:00 p.m.) PBS Program<br>Prof. Stamos, LC301 | | Presentations Skills<br>Ms. Cronin, T203 | |

## ILTM Program Background and Team Descriptions

Bucknell's ILTM, founded in 1991 as part of the Lauren P. Breakiron Technology and Management Fund, provides "an integrated academic program to address the challenges of technological change and the changing global economy."

The ILTM is a two-summer, intensive experience for students majoring in one of the engineering programs at Bucknell (chemical, civil and environmental, computer, electrical, or mechanical) or in management or accounting. The goal is to provide Bucknell students with a learning experience that bridges the disciplines of engineering and management. The program combines on-campus course and project work for students following their sophomore year with an off-campus internship for continuing ILTM students following their junior year. The on-campus component was first offered in 1993.

Entry into the ILTM is by application and limited to 20 students. The program brings together 20 of the best, most motivated juniors in engineering and management. The curriculum, developed each year by four core faculty, offers a unique interdisciplinary combination of topics taught by the core faculty, adjunct faculty, and outside speakers, including four day-long sessions with executives-in-residence. The content is intentionally ambitious with correspondingly high expectations of the students.

**Overview of 2001 Program.** For the summer of 2001, the 20 students enrolled in the program consisted of nine engineering majors (two chemical, one civil and environmental, one computer, one electrical, and four mechanical), eight management, and three accounting majors. The students were selected based on application essays on leadership, the central themes of the ILTM program, future goals, and their GPAs. The nine females and 11 males selected had GPAs ranging from 3.00 to 3.91, with a mean of 3.51.

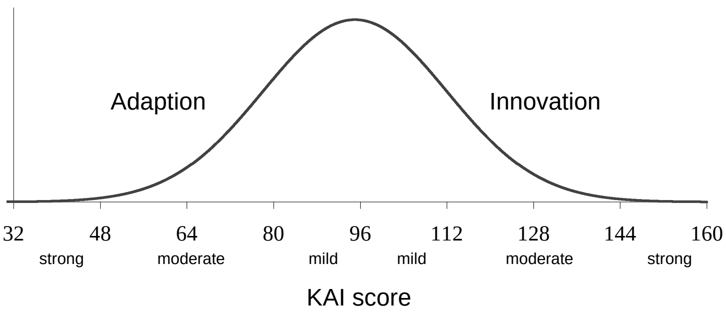
The curriculum for the summer of 2001 was typical, consisting of six weeks of classes, field trips, and project work, with at least six hours of class per day (occasionally more). Students also had reading, homework, and presentation assignments to be completed during the evenings. Approximately three hours per week were set aside for project work, and the sixth week was dedicated to project report completion and presentation. An example of the range of activities is shown in Exhibit 1. This shows the schedule of classes and field trips for week 2 of the 2001 program. Students participated in classes from 9 a.m. to 12 a.m. and 1 p.m. to 4 p.m. daily, with some evening sessions. The intensity of the program is one important contributor to the development rate and frequency of occurrence of issues with team dynamics.

**Project Descriptions.** Four companies sponsored the 2001 ILTM on-campus projects: G.E. Industrial Systems of Plainville, Connecticut; Corning of Corning, New York; Brodart Contract Furniture Division of McElhatten, Pennsylvania; and IBM Microelectronics Division of East Fishkill, New York. Each project team was assigned to one of the project sponsors, as well as to a core faculty advisor. Corporate liaisons were identified at each company.

The 2001 problem statements are summarized below:

- G.E. Industrial Systems (GEIS): Provide a recommendation of short-term and long-term strategies to improve services provided by GEIS to customers by examining GEIS's current business model of providing products to utilities customers, benchmarking major competitors' business models, researching the needs of GEIS customers, and investigating current trends and forecasts for several types of e-business.
- Corning: Determine the marketing and manufacturing resources investment Corning should make in the Selective Catalytic Reduction (SCR) emission control technology for success in the global air pollution market.
- Brodart Contract Furniture Division: Examine and analyze manufacturing processes at Brodart's custom library furniture production facilities to make recommendations for ongoing reengineering efforts.
- IBM Microelectronics Division: Assess the market

**Exhibit 2.** The adaption-innovation continuum




potential of Third Generation (3G) Technology by understanding how consumers and businesses will interact with 3G devices in different situations. The goal is to provide IBM with a marketing strategy for a future 3G device.

Each project was in an area in which the students had limited expertise (in many cases, no experience at all). Students had to assemble and assimilate large amounts of new information, understand the true goals of the problem statement, and think critically about the proper way to address them.

**Team Descriptions.** Traditionally the ILTM project teams have been assembled to maximize heterogeneity in gender, major, and GPA. The same approach was followed during the summer of 2001. Although KAI scores for the students were available when the teams were assembled, we decided not to consider them when developing the project teams. The goal for this introductory year of KAI analysis was to develop a baseline for future comparison based on how project teams were formed in the past. For the summer of 2001, each project team consisted of:

- Two females and three males (with one group of three females and two males)
- Three management/accounting majors and two engineering majors (with one group of three engineering majors and two management/accounting majors)
- One student with a GPA less than 3.3, two students with GPA's between 3.3 and 3.7, and two students with GPA's greater than 3.7.

The breakdown of the individual disciplines within the engineering and management/accounting majors provided each team with one mechanical engineer, two management majors, and one accounting major (except one team did not have an accounting major).

The ILTM project team development balances gender, disciplinary background, skill sets, and intellectual capacity, but does not balance the teams' advantages and disadvantages in relation to cognitive style. In previous years, some teams functioned more cohesively than others and seemed better suited to their projects, based on whether the project focused on developing new ideas or refining existing ideas. The intensity of the ILTM program, with its strong emphasis on teamwork, causes these issues, associated conflicts, and personality and communication differences to occasionally build to crisis level in the six short weeks of the program. The application of cognitive style theory was introduced to explore the characterization of these and other issues associated with team dynamics.

## Cognitive Theory Background

This study relies on the cognitive style theory of Dr. Michael J. Kirton, a British organizational psychologist. Kirton's theory is well established and has been validated in practice for over 25 years, with hundreds of international journal articles and graduate theses devoted to its study and application. Most team applications have occurred in corporate environments, with limited dissemination of the results. A few exceptions are Thompson's (1999; 2001) work with engineers, Hammerschmidt's (1996) investigation of management teams, and Keller's (1986) study of R&D project groups. More literature exists focusing specifically on managers and/or leadership (de Ciantis, 1987; Foxall, 1986, 1994; Gryskiewicz and Tullar, 1995; Hayes and Allinson, 1994; Jacobson, 1993; Schroder, 1994). A brief summary of Kirton's theory follows with further details available in his major works (Kirton, 1976, 1994, 1998b).

KAI theory assumes that all people solve problems and are creative, both resulting from the same brain function. The theory distinguishes between *level* and *style* of problem solving and creativity, or cognitive level and cognitive style. *Cognitive level* refers to an individual's inherent potential capacity (such as intelligence) or learned capacity (such as managerial competence). *Cognitive style* is defined as the "strategic, stable, characteristic, preferred manner in which people respond to and seek to bring about change," including solving problems (Kirton, 1998b). Adaption-Innovation theory is concerned with these preferences. Cognitive level is assessed by other means.

Cognitive style differences measured by the KAI lie on a continuum, ranging from strong adaption to strong innovation (Exhibit 2). For the general population, the score distribution forms a normal curve. Smaller groups can be predictably different from general populations, depending on their problem-solving orientation, and may exhibit skewed distributions with different means.

One distinction between adaptive and innovative individuals is that more adaptive individuals prefer more structure when problem solving, with more of this structure consensually agreed. More innovative individuals prefer solving problems with less structure, and are less concerned with consensus concerning the structure's design or existence (Kirton, 1976, 1994). We use "more adaptive" and "more innovative" to describe a continuous range of styles.

More adaptive individuals approach problems from within the given paradigm, striving to produce better rather than different solutions. These individuals are valued because they tend to be the system experts, dedicated to its maintenance and efficiency. They are especially good at fine-tuning the current rules and procedures to make them operate as effectively as possible. The more innovative tend to detach a problem from its frame of reference, searching for different, although not always better, solutions. More adaptive individuals prefer to solve problems using the rules, while more innovative individuals tend to solve problems despite the rules (Kirton, 1998a).

These differences in cognitive style produce distinctive patterns of behavior, important when individuals solve problems collaboratively. Problem solving includes the following stages: problem definition, data collection, idea generation, solution evaluation, and final solution implementation (Treffinger, Isaksen, and Dorval, 1997). More adaptive problem solvers generally accept problems as defined, along with any agreed-upon constraints. In data collection, they tend to be exhaustive, favoring information and perspectives closely related to the original problem structure. When generating ideas, more adaptive individuals prefer to generate a small number of novel and creative solutions that are relevant, readily acceptable, and aimed at improvements on the current paradigm. These solutions are often easier to implement than solutions generated by a more innovative person. When evaluating and implementing solutions, the more adaptive problem solver looks for a quick resolution to the problem that will limit disruption and immediately increase efficiency (Jablokow, 2000; Kirton, 1994, 1998a).

More innovative problem solvers tend to reject the original, generally accepted definition of a problem and redefine it. This new view of the problem may be difficult to communicate to others, but it may also bring new clarity. In collecting data, the more innovative often look outside the original problem structure for different perspectives, which they bring into the solution process. When generating ideas, more innovative individuals generally produce numerous novel and creative ideas, some unacceptable to others or that may appear irrelevant. When evaluating and implementing solutions, the more innovative problem solver is less concerned with immediate efficiency and potential disruption, looking ahead to potential long-term gains (Jablokow, 2000; Kirton, 1994, 1998a).

The problem definition stage has special implications depending on the type of individual. For a more adaptive individual, the goal of this stage is to define the problem explicitly in a way acceptable to authority and other team members. Once a problem is defined, a more adaptive person will accept it as fixed, clarify questions about details, and move forward to a quick solution. If any part of the problem is not well defined, the more adaptive person tends to be frustrated by the ambiguity and may have difficulty moving beyond this stage. For a more innovative individual, the problem definition stage can be enjoyable if given freedom to explore different problem formulations. Innovators delight in defining and redefining problems using new perspectives, even when a problem statement is supplied. This can lead to difficulties if they are undisciplined and fail to converge on a definition within a reasonable time. Further discussion of these and other implications are found in Kirton (1994, 1998a) and Jablokow (2000).

## Application of KAI to ILTM

The KAI, introduced by Kirton in 1976, measures preferred thinking or cognitive style. Respondents answer 33 questions focusing on the ease or difficulty one has in consistently presenting himself or herself in particular ways over a long period of time. Each answer is assigned a value using a 5-point scale. The inventory is easy to understand and can typically be completed in less than 15 minutes. The KAI is one of the most highly validated psychological instruments in existence. The KAI Manual (Kirton, 1998b) details the results of extensive testing and research studies using the instrument.

Exhibit 2 shows that individual KAI scores fall between 32 and 160: a score of 32 represents the theoretical limit of highest adaption; a score of 160 represents the theoretical limit of highest innovation. Most scores fall between 40 and 150. For large general populations, the distribution of scores forms a normal curve with a theoretical mean of 96. In the United States, the observed mean for the general population is 95, while the observed mean for both U.S. engineers and managers (measured separately) is 97. Additional statistics for these and other populations are available in the KAI Manual (Kirton, 1998b).

The KAI total score can be broken down into three interrelated sub-scores. The names and acronyms for the sub-scores are: sufficiency of originality (SO), efficiency (E), and rule/group conformity (R/G) (Kirton, 1998a, 1998b). The SO sub-score relates to idea generation style; the E sub-score relates to problem-solving method, and the R/G sub-score relates to dealing with structure, both impersonal (i.e., rule) and personal (i.e., group). Although sub-scores were determined for the ILTM students and faculty, they have not been fully analyzed and will not be reported here.

There is no correlation between KAI scores and any measure of level. High scores are not good and low scores are not bad. The difference between the scores of two individuals or between an individual and the mean of a group is important. A difference of 10 points between individuals is noticeable over time. A 20-point difference or more can lead to communication difficulties and require considerable coping behavior. Coping behavior and its implications are discussed further in several of Kirton's works (Kirton, 1976, 1994, 1998b).

**Administration of the KAI.** A qualified facilitator with certification and training must administer and score the KAI forms. The certification process is tightly controlled to preserve integrity and prevent misuse. Self-scorable and online forms are not available. Dr. Jablokow has received advanced training and certification and was the sole administrator of the inventory in this study. The KAI forms, distributed to students during an orientation session, were not used in the actual design of the project teams for this study.

**Reported KAI Scores.** A summary of the ILTM students' total KAI scores is presented in Exhibit 3. This group was slightly more adaptive than both the general U.S. population (mean of 95) and U.S. engineers and managers (means of 97), although the difference was not large in either case. A difference of only five points between the means of two groups is noticeable over time, so differences in the behavior of this small cohort compared to a large group of engineers and/or managers might become significant after a prolonged period. While the range of scores for the management students contains several of the most innovative scores in the entire group, the mean was almost identical to that of the engineering students. We did not expect any great cognitive style differences between the disciplines for this cohort of students.

**Exhibit 3.** KAI scores for ILTM students (2001)

| Sample | Size (N) | Range | Mean | S.D. |
|---|---|---|---|---|
| All students | 20 | 71–118 | 92 | 13.8 |
| Engineering students only | 9 | 72–107 | 91 | 13.2 |
| Management students only | 11 | 71–118 | 92 | 15.0 |
| Male students only | 11 | 78–109 | 95 | 10.9 |
| Female students only | 9 | 71–118 | 88 | 16.7 |

An interesting difference existed in the score distributions of male and female students from both disciplines. While the most innovative student in the group was female, most of the more innovative students were male, resulting in a noticeably higher mean for the male students (95) compared to the female students (88). This difference mirrors the general population. Males' scores are generally distributed around a mean of 98 and females' scores around a mean of 91. The KAI scores for the four ILTM faculty members were diverse (63, 66, 104, and 124), with a mean score of 95.

The project teams were assembled in the traditional ILTM fashion for this study, maximizing heterogeneity in gender, major, and GPA. The KAI profiles for the four teams had widely varying means and ranges, shown in Exhibit 4. The GEIS, Corning, and Brodart teams all have at least two individuals with a *cognitive gap* (i.e., difference in KAI scores) of more than 20 points, indicating potential trouble spots within the teams. Even the narrower diversity of problem solvers in the IBM team (range of 14 points) may experience problems with miscommunication due to cognitive style differences, according to Kirton's theory. Although not a significant factor in the results, the assignment of teams to core faculty resulted in the GEIS, Corning, Brodart, and IBM teams being advised by faculty with scores of 66, 63, 124, and 104, respectively.

**KAI Feedback Session.** During the first week of the ILTM program, Dr. Jablokow delivered a one-day session on basic Adaption-Innovation theory and its application in collaborative problem solving. The session opened with discussions of mental perception, barriers to effective problem solving, and creativity myths and misconceptions. The fundamental assumptions of Adaption-Innovation theory were also presented, including the difference between cognitive level and cognitive style, and the enabling and limiting roles of structure (see Kirton, 1998a and 1998b, for more on this Paradox of Structure). The students received a feedback pamphlet with their individual KAI scores. Although the results were delivered confidentially, most of the students shared their scores. No scores were divulged without permission.

Dr. Jablokow divided the students into groups based on KAI scores for several activities. First, four homogeneous groups (overall KAI scores within 10 points of each other) were asked to identify in writing the advantages and disadvantages of their score. Students then met in their project teams to report the results of the first exercise with their teammates. Finally, each project team identified challenges and benefits of their KAI team profile. The students reported the results of both exercises to the entire group.

The presentation styles gave strong indications of the KAI scores of the groups. When the students were in their homogeneous groups, the differences were striking. The most adaptive group (KAI scores of 71, 72, 73, 75, and 78; mean of 74) presented their results in neat columns in clear block lettering with little extraneous information. The most innovative group (KAI scores of 105, 105, 107, 109, 118; mean of 109), presented their results in multiple colors, with arrows and annotations sprawled across columns, with various shadings and cross-hatchings, in a more free-flowing style. These differences are typical of those expected, based on KAI scores.

**Journaling Assignment.** At the close of the KAI feedback session, students were assigned a journaling project to record impressions of their progress on their corporate projects and how their team members interacted. Most of the ILTM students wrote often, at length, and in detail throughout the course of the summer semester.

## Observations and Journal Excerpts

Observations from the ILTM student journals can be organized into six general themes:

- Structure
- Conformity and consensus

**Exhibit 4.** Project team KAI profiles

| Team | KAI scores | Range | Mean | S.D. |
|---|---|---|---|---|
| GEIS | 71, 72, 87, 102, 105 | 34 | 87 | 16.0 |
| Corning | 94, 105, 107, 109, 118 | 24 | 107 | 8.6 |
| Brodart | 73, 75, 78, 85, 99 | 26 | 82 | 10.5 |
| IBM | 83, 83, 93, 96, 97 | 14 | 90 | 6.9 |

- Relevance
- Conflict
- Other personality factors (non-KAI)
- Positive value.

In addition to these six general themes, two other themes were considered influential with the ILTM groups: importance of evaluation and leadership. These were overarching themes in the journals of all ILTM students and warrant consideration.

**Importance of Evaluation.** Evaluation in the ILTM takes several forms, both formal and informal. The most obvious formal evaluation is the grade for the program. Students are also given the opportunity to evaluate each other's contributions, and corporate liaisons provide evaluative comments. Informally, students and teams evaluate each other on progress and team dynamics throughout the duration of the ILTM program. Merging students of different majors, genders, and cognitive styles creates an environment in which peers are judged based on these characteristics. Finally, students self-evaluate to forecast success in their chosen profession. Perceptions based on gender and major were a point of conflict for one team. A student on the Corning project team (KAI 107) wrote, "We have been giving our writing to Student D (KAI 118), she wanted to be the singular voice woman, which is fine. Student D is stressing the most at this point, much more than the rest of us, and I don't understand why. She is the most innovative, which leads me to believe that she should be the least stressed of everyone in ILTM. Its [sic] probably because she is a management major and she never has had to work hard before in her life." Although the ILTM structure approximates the environment students will face in the future, the students have typically not had a project experience of the intensity found in the ILTM program. The program intensity, the evaluation intensity, and each student's need to achieve create stressors in the group dynamics.

Throughout the students' experiences in the ILTM, reactions to situations that may have seemed trivial were exacerbated because of future evaluations. ILTM students want to impress faculty and corporate liaisons with their knowledge and potential, and may perceive that their efforts are compromised by different cognitive styles within the team. Team conflicts can have drastic consequences for students attempting to achieve personal goals within the constraints created by working with unknown peers.

**Leadership.** The emergence of a leader is considered to be a defining event in the creation of a group. Although project teams in the ILTM are established without hierarchy, students emerge as leaders within their teams through a democratic process or by default. The contrasting processes were evident in the IBM and Brodart project teams.

In the IBM team, a leader (KAI 83) was chosen within the first few days to provide organization and leadership. From the IBM team's perspective, a leader would provide structure and direction. From the journals, this person was neither effective nor ineffective, and the role of leader remained open. As one student in the team (KAI 83) wrote, "It is interesting to note that Student D (KAI 97) does have the highest KAI score and is trying to assume the role of leader relatively speaking because our group dynamics are such that we don't have a 'leader' and it just works better that way."

For Brodart the role of leader was dynamic from the outset based on the task to be completed. The leader (KAI 73) who emerged early in the program was eventually replaced by an individual (KAI 99) who initially perceived his potential to impact the team as limited. The assumption of the role as leader by Student B (KAI 73) was bothersome to other team members and contributed to shifting roles. The task of the team changed significantly from structured (goal setting) to less structured (presentation development). This team's dynamic is demonstrative of various coping mechanisms and is discussed in more detail below. The cognitive style of a leader influences the direction of the team; however, more effective teams realize the value in the role of leader and are flexible as to who assumes the role. As a student on the Brodart team (KAI 78) noted, "Though we are enrolled in an elite leadership course, it is also important to realize that not all can be leaders at the same time. It is important to be a follower as well. I learned more about being a leader by being a follower. I learned that adaptors and innovators are great leaders, depending on the situation. A true leader realizes this and becomes a follower as the situation changes."

**Structure.** We observed a direct relationship between adaption and frustration when dealing with ambiguity and incomplete information. The more adaptive the student (the lower the KAI score), the more frustration they expressed with issues such as an open-ended project description, ambiguous tasks, or the inability to contact a corporate sponsor for clarification. In contrast, the team with the most innovative KAI mean (Corning) was only slightly bothered by a switch in project direction (until they realized how much work they had left to do). This is illustrated by the following comment from the most innovative member of the Corning team (KAI score of 118): "Today was our field trip to Corning. I had a great time and thought it was very interesting. Andre and Mike were very helpful—although they did completely change our problem. That didn't really bother me because I wanted to do something on a more global level anyway … No one else in my group seemed to mind either." … (Two days later) "OK, I no longer feel glad that the project was switched. I am starting to realize how much we have to do and I feel really far behind."

Other issues focused on different strategies for resource management, including time management. There was a direct relationship between adaption and tighter time management, including planning ahead and being on time for meetings. As one of the more adaptive students in the Brodart team (KAI 78) commented: "I am glad that we are more adaptive as a group. At this present time, the team needs more structure and direction rather than ideas. Assigning tasks is extremely important due to deadlines."

The more innovative students tended to be looser with time management, and this difference extended to meeting time itself. While the more adaptive students brought structure to team meetings through note-taking and sequential information processing, the more innovative students reported less note-taking and brainstormed topics or used nonlinear processes such as mindmapping. Even the journal entries of the more adaptive students were more detailed.

The team with the most innovative mean and range (Corning), experienced interesting difficulties related to their preference for less structure. They experienced problems with boredom, lack of focus, and the inability to stay on task. All three issues are typical for more innovative individuals. Ironically, team members initially expressed concern about the need for discipline to get their work done. Several team members tried to provide discipline, but encountered resistance, and were not successful. The Corning team's results came together at the last minute, with most of the team giving details to a team member willing to deal with them.

**Conformity and Consensus.** We observed a direct relationship between adaption and emphasis on group conformity. The more adaptive team members were concerned about moving forward together and getting along, and expressed frustration when this did not happen. A member of the GEIS team (KAI 87) expressed concern: "I was happy that Student A (KAI 72) asked Student D and I after Student E had left if we thought she was doing enough work. It showed she cared about the team as well as evening out the workload."

We also observed a direct relationship between innovation and the amount of work done independently, as opposed to group work. The more innovative students were more likely to work individually, then bring results to the team for discussion. A student from the IBM team (KAI 83) made this comment: "Today was a rough day for us as a group. It has become apparent that Student D (KAI 97) and Student E (KAI 93) are doing a lot of independent work, which is great for the group, but they did it without informing anyone else. It is not really an issue of leadership in my mind or Student A's (we talked about it together), however, it did bother us somewhat."

The more innovative team members were perceived as abrasive and even offensive. They were criticized for "having their fingers in everything," "bringing new ideas in at the end," "stepping on toes," and speaking up too much with faculty. The most adaptive members of two teams were perceived as offensive because of condescending attitudes and rejecting ideas of others.

**Relevance.** Some teams described issues surrounding the perceived relevance of input from more innovative team members. The more adaptive team members did not always value ideas of their more innovative teammates, who felt their work was disregarded or omitted without good cause. The most innovative member of the Brodart team (KAI 99) commented: "My group is starting to form better, but I still feel as though I am the person who fits in the least. Sometimes my ideas take longer to process and the longevity of this does not comply with the swiftness of my team members." Division such as this led more adaptive team members to see more innovative teammates as "refusing to join us," causing conflict within the team.

From the perspective of the more adaptive students, input from more innovative team members that seemed tangential to project goals caused a loss of momentum. A student on the GEIS team (KAI 71) wrote: "I think this is another problem the group faces with Student B (KAI 102). He seems to be a person who needs to take things slow and think them through systematically, whereas the rest of us talk over each other and are very loud and opinionated and share our ideas openly. By the time Student B shares his ideas, he has to have everyone's attention, and it takes him 20 minutes to get to the point, and once he gets there we all feel that is irrelevant information, whereas he feels that everything he says is right and the only way it should be done." The GEIS team perceived they were more productive when Student B was absent from group meetings. Shifting directions created discomfort for the more adaptive students. According to Student E (KAI 71), "We realized that we got a lot more done when Student B wasn't around to rebut every little thing we wanted to do." How ideas were presented was influential as well. More innovative students were characterized as uncommunicative and defensive—creating chaos for the group, and altering the structure and process desired by the more adaptive students. Relevance issues led to conformity issues, demonstrating the complexity of cognitive style differences.

**Conflict.** Conflict is inherent in any group. In the ILTM program, the importance of evaluation and the need to achieve had a strong influence on team members. Students in the ILTM want to feel valued by peers, faculty, and corporate liaisons. Conflict arises when students perceive that their contributions are not valued. Expectations for work quality and effectiveness of team members stem from individual cognitive styles. Managing these expectations depends on individual coping and communication skills, as well as group leadership (Murray and Mann, 1998).

The greatest conflicts observed were typically associated with the cognitive style extremes within a team. Conflicts were most often reported between the most adaptive and the most innovative team members, or between one of these two and the rest of the team. The most innovative member of the Corning team (KAI 118) observed: "Student A (KAI 94) and I disagreed several times, and I often felt that he was being condescending. Usually when I made a comment or suggestion, he would get defensive and didn't always listen to what I was trying to say. He would try to explain his way of doing things in a way that really bothered me at times." After these students discussed their differences via email, Student A commented: "We were arguing the same thing, just from a different perspective."

The greatest amount of conflict overall was reported by the team with the largest cognitive gap, or the largest range in KAI scores (the GEIS team). A team member noted: "For me it just seems emotionally draining when we meet as a group because I know we will not only have to tackle our GE assignment but also internal group struggles. Personally, I prefer not to work with Student B because his ways of thinking are so different from mine."

More homogeneous teams were not without conflicts. One team reported in-fighting among the most adaptive members of the team. They disagreed on the consensually agreed structure of the project. A member of the Brodart team observed: "I also realized very quickly that if you are an adaptor, it does not mean you get along with all other adaptors." The most innovative team (fairly homogeneous) also reported conflicts in trying to bring discipline to their efforts.

Correlation exists between self-grading among group members and range of KAI scores. Team members with the smallest range of KAI scores (IBM) gave each other an A or A- on project work. The team with the second smallest range of KAI scores (Corning) graded each other in the range of A to B. The students in the team with the second largest range of KAI scores (Brodart) graded each other from A to C-. The team with the largest range of KAI scores (GEIS) graded from A to F.

**Other Personality Differences.** Interactions described in the students' journals led us to conclude that other differences might be at work in addition to adaption and innovation. The journal data suggested differences described by Jung's psychological types (e.g., introversion/extraversion, sensing/intuition, thinking/feeling) might also be identified. The associated Myers-Briggs Type Indicator (MBTI) includes a fourth scale, judging/perceiving as well (Myers and Myers, 1980). A member of the Brodart team made this comment about another team member: "He often tells us how he feels and it is not very logical to me. I would rather hear the cut and dry facts than let emotions get in the way of our decisions." Other differences affecting team member interactions seemed to be linked to gender and major.

Other psychological factors including self-efficacy, coping mechanisms, and need-to-achieve/need-to-avoid-failure impacted the ability of team members to work together effectively. Each student brings to ILTM previous experiences with groups that shape their reality. The extent that conflict was detrimental within a team was determined by skills of its members. The Brodart team was proactive in determining strengths and challenges of each group member, allowing them to manage issues as they arose.

Coping skills can potentially bridge differences in cognitive style that can create discord in teams. Knowing one's cognitive style can be valuable in understanding tendencies in a group, but it can also become a way to rationalize behavior to explain conflict rather than manage it. When personality differences emerged, teams either managed the differences with strong communication or buried the differences by shutting out the contrasting group member.

Only elite students are selected for acceptance into the ILTM. Among this select group, high need-to-achieve/need-to-avoid-failure is common. Within groups, these students tend to consider personal rather than group effort and goals. As students prepared their final paper and presentation, conflict arose surrounding nearly every portion of the project. From format and style to the quality of the presentation, students' concerns of evaluation were evident by emerging egos and posturing described in the journals. This comment was made by GEIS team Student D (KAI 105) about his team's final presentation: "The questions is [sic] where we shined and where I felt I knew everything, and was super knowledgeable and prepared. I wanted to answer everything because I knew everything, and I feel I did a good job of letting others speak, even though I wanted some of them to keep quiet."

Teams that were most effective in managing differences in personality and cognitive style appeared to be the most flexible—considering the good of the group instead of focusing on their own achievement. As a student on the Brodart team (KAI 85) wrote, "It [ILTM] taught me a lot about compromising and finding out how everyone can be a piece of the larger puzzle."

**Positive Value.** Despite conflict, students expressed appreciation of each other's style differences. Many of the more adaptive team members recognized value in the more innovative teammates bringing ideas that they might not have devised on their own. As one more adaptive student commented: "It is not enough to know whether you are adaptive or not. What is important is the ability to bring your adaptive skills and be able to work with innovators to achieve the goal." Likewise, more innovative team members expressed appreciation for their more adaptive teammates' discipline and method in accomplishing tasks.

## Conclusions and Applications

This preliminary study demonstrates that applying cognitive style theory to characterize and better understand personal dynamics of individuals working in teams is appropriate and useful. The data we collected suggest correlations between cognitive styles and specific behaviors, although these relationships require further, more rigorous investigation. We predicted potential trouble spots based on conflicting styles. Most importantly, we conveyed appreciation of different problem-solving strategies to the students, which led to powerful insights in their thinking.

Although this study focused on students, we anticipate similar results with more mature individuals. Kirton (1998b), Clapp (1993), and others have demonstrated the stability of cognitive style in adults through longitudinal studies; that is, cognitive style does not change over time. We can expect similar behaviors from professionals in team environments, except possibly their manifested coping skills. Actual behavior combines preferred style and coping behavior, where preferred style is innate and coping behavior is learned. As individuals mature, they accumulate and improve their coping skills over time. New coping skills lead to higher tolerance for and better appreciation of individual differences, which leads to improved communication and efficacy when working with others. We might expect less open conflict between more mature individuals, although the cognitive differences remain in place.

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