# Small Group Research

http://sgr.sagepub.com

## From Climbing Stairs to Riding Waves: Group Critical Thinking and Its Development

D. Christopher Kayes Small Group Research 2006; 37; 612 DOI: 10.1177/1046496406294321

The online version of this article can be found at: http://sgr.sagepub.com/cgi/content/abstract/37/6/612

> Published by: SAGE http://www.sagepublications.com

Additional services and information for Small Group Research can be found at:

Email Alerts: http://sgr.sagepub.com/cgi/alerts

Subscriptions: http://sgr.sagepub.com/subscriptions

Reprints: http://www.sagepub.com/journalsReprints.nav

Permissions: http://www.sagepub.com/journalsPermissions.nav

Citations http://sgr.sagepub.com/cgi/content/refs/37/6/612

Small Group Research Volume 37 Number 6 December 2006 612-630 © 2006 Sage Publications 10.1177/1046496406294321 http://sgr.sagepub.com hosted at http://online.sagepub.com

## From Climbing Stairs to Riding Waves

## Group Critical Thinking and Its Development

D. Christopher Kayes The George Washington University, Washington, DC

This article provides a model, measure, and theoretical background for understanding group critical thinking. A research study was designed to test group critical thinking and its relationship to the learning style composition of teams. Groups were composed using a randomized block design based on learning style, and responses to a group exercise were coded for type of critical thinking. Results showed support for a group-level measure of critical thinking based on interrater agreement on codes. Some support was found for differences in critical thinking based on learning style. However, critical thinking was not shown to relate to group cohesion, psychological safety, or efficacy. This study marks the first empirical evidence supporting critical thinking at the group level. It provides a measure that can be used in assessing the level of critical thinking for vocational education and assessing team performance on ill-structured problems.

Keywords: critical thinking; groups and teams; learning style

**S** uccessful workers need critical-thinking skills. In the face of complex problems, the ability to think critically provides the tools to resolve and manage the unknowable. Vocational education, however, often creates challenges for the development of critical-thinking skills. Unlike more liberal education where the goal may be to develop intellectual capacity for its own sake, vocational education entails a more pragmatic agenda where students develop techniques that will eventually, at least in theory, be put to a specific use. A further challenge for improving critical thinking lies in the fact that most efforts to improve critical thinking result from the emphasis on individual critical thinking over critical thinking as a group process. As organizations assign more tasks to teams, critical thinking in a group environment becomes even more important.

This article advances a critical-thinking agenda by developing a model of group critical thinking and testing the model in ad hoc groups. The study provides empirical support for group-level critical thinking and provides insight into how critical thinking in groups develops. Results suggest that although group critical thinking is related to individual group member characteristics, strong relationships exist between group-level norms and group critical thinking.

#### **Critical Thinking**

Critical thinking stresses an individual's ability to manage, integrate, and organize complex information. Critical thinking deals with the ability to understand and assimilate complex information from multiple perspectives and has been linked to academic performance and successful adjustment to undergraduate education (Perry, 1970).

Although divergent goals or outcomes can be achieved through improved critical thinking, four primary assumptions underlie how the critical-thinking process develops in individuals: (a) critical thinking entails relatively stable, extended stages of similar critical thinking punctuated by moments of rapid growth; (b) each stage is represented by a minimum number of modes (usually one); (c) critical thinking is predominantly predetermined, impervious to the choices of the individual learner and related to his or her experiences and education; and (d) a predetermined goal of higher development exists (Siegler, 1996). The dominant metaphor for the development of critical thinking is climbing stairs, where each stair represents a new plateau to be reached and a new level of critical-thinking ability to achieve.

#### **Developing Critical Thinking**

#### **Critical Thinking and Job Performance**

Despite the broad acceptance and extensive theoretical attention given to critical thinking by the education community, the development of critical thinking in vocational education has received only minor attention (D. C. Kayes, 2002). Critical thinking has been linked to a variety of job competencies, including improved ethical reasoning (Kohlberg, 1969), effective management of complex interpersonal relationships (Kegan, 1994), the ability to adapt to changing environments (Bronfenbrenner, 1979), successful career and life stage transitions (Levinson, Darrow, Klein, Levinson, &

McKee, 1978; Levinson & Levinson, 1996; Leovinger, 1976; Schein, 1978; Sheehey, 1995), identity construction (Erickson, 1959), management of complex problems (Kolb, 1984), and leadership (Heifitz, 1994). Boyatzis (1982) claims that top-performing managers display critical thinking in the form of logical thought, sequential thinking, and pattern identification. Jacques (1989) contends that critical thinking provides the primary indicator of managerial success and that organizations should be organized according to an individual manager's ability to think critically (Das, 1994).

Spurred primarily by recent thinking in the study of child development, many have begun to question current conceptualizations of critical thinking in adults entering the work world. Effective vocational behavior requires critical-thinking skills, yet an adequate understanding of how critical thinking develops remains unclear. Two primary concerns have developed: the nature of the development of critical thinking and its individualistic nature.

#### New Directions: From Climbing Stairs to Riding Waves

The dominant metaphor of climbing stairs, with its qualitatively distinct stages of development, has been challenged in favor of a metaphor that reflects a more fluid trajectory of change in critical thinking. Siegler (1996) provides three reasons for adopting an alternative to the stair-step metaphor. First, the stair-step approach focuses on the "essence" of each step rather than the complexity and diversity of progression inherent within each stage. Second, stage theories tend to characterize learners as "passive bystanders" of a predetermined developmental stage. This downplays the role of choice. Third, stair-step metaphors focus on the "what" rather than the "how" of change. Thus, stair steps tell us where to go but not how to get there. In short, the predominant metaphor of development as stair steps emphasizes stability over change, ignores diversity in learning strategies, gives little credence to choice in developmental progression, and stresses the stages of development rather than the mechanisms of change.

Siegler (1996) proposes an alternative perspective on the development of critical thinking: that of overlapping waves. The basic premise of the overlapping waves theory lies in the idea that developmental learning is a series of multiple overlapping strategies. Each strategy may vary in its significance based on a number of factors. Principal among these factors is the nature of the problem one is faced with or one's particular life stage. The overlapping wave approach proposes three fundamental challenges to traditional models of critical-thinking development. First, critical thinking must be considered a factor of both learning and development. Learning causes development—which in turn causes learning (Vygotsky, 1978). In other words, learning and

development share a reciprocal relationship that is not currently reflected in most approaches to critical thinking. Second, critical thinking involves using a diversity of learning strategies. Thus, although critical thinking may entail use of one or more dominant learning strategies, individuals may utilize multiple critical-thinking strategies at any one time (Kolb, 1984). Third, critical thinking is highly dynamic, involving periods of stability, development, and continuous change. Although the overlapping waves approach provides a promising new way to look at development, it remains largely theoretical and applied primarily to individual childhood development. Application of the overlapping wave approach suggests that a combination of visual and empirical data provides the best method to understand group critical thinking.

#### **Critical Thinking in Groups**

The second challenge to the concept of critical thinking lies in its conceptualization as a primarily individualistic process. It has long been held that teams and groups are the basic units through which organizations coordinate work (Thelen, 1963). An interest in critical thinking in groups has slowly begun to emerge (Gruenfeld & Hollingshead, 1993). For groups to be successful, critical thinking in a group environment becomes a key aspect to success. Critical thinking in groups becomes essential for groups to succeed in the face of rapidly changing and complex tasks (D. C. Kayes, 2003). Group critical thinking has become particularly important for "knowledge work" (Mohrman, Cohen, & Mohrman, 1995), such as developing and implementing new products (Edmondson, Bohmer, & Pisano, 2001), and for fostering learning (Edmondson, 1999). With few exceptions, group critical thinking helps organizations deal with complex and changing environments while coordinating a diverse set of goals, roles, and cognitive abilities. Although extensive research has revealed the importance of critical thinking and found support for variables that support critical thinking in groups, research on group-level critical thinking remains in its infancy.

In summary, further understanding of how critical thinking affects vocational development requires a group-level model of critical thinking that focuses on how managers develop multiple strategies of critical thinking.

#### **Research Questions**

To begin building a model of group critical thinking, I developed a list of research questions guided by the research on critical thinking at the individual

level and then supplemented it with research findings on team learning. Critical thinking, as a form of knowledge creation, can be considered a type of team learning (A. B. Kayes, Kayes, & Kolb, 2005). Questions related to critical thinking were generated regarding the relationship among individual demographic characteristics, group norms, and individual team member diversity as measured by learning style.

#### **Demographics**

Several researchers have suggested that one of the most important goals of education lies in developing the critical-thinking skills of students (Bloom, 1956; Chickering, 1971; Perry, 1970). Studies have consistently shown that the ability to think critically is directly linked to a student's progression through college (Perry, 1970) and into graduate school (King & Kitchener, 1994). Although research consistently confirms a link between progression through college and the development of critical thinking, this research has been confined to the individual level of analysis. Based on this research, I propose that the relationship between critical-thinking ability and progression through school should also hold at the group level. Applying this logic to critical thinking in teams suggests that the development of critical thinking in teams is a function of the percentage use of a critical-thinking strategy (e.g., absolutism, relativism, and committed relativism) and academic progression through academics, resulting in Research Question 1:

*Research Question 1:* What is the relationship between group critical thinking and progression through college?

#### Learning Style Diversity

The nature of diversity and its impact on group performance has emerged as a central issue in groups. As with much of the extant group literature, group performance is narrowly defined in terms of performance on relatively well-defined tasks that fail to account for the complexity of critical-thinking tasks. Because this study was mainly concerned with the development of critical thinking and its application to groups, I borrowed from the literature on management learning and education, primarily experiential learning theory (Kolb, 1984), to explore relationships between group-level critical thinking and the cognitive composition of the team.

Research and theory on experiential learning theory contend that individuals will improve in their ability to think critically as they learn to integrate multiple learning modes (Wolfe, 1977). The ability to integrate complex information, often called integrative complexity, improves as a person develops skills to deal with contradicting information and to utilize multiple modes of learning. Individuals with balanced learning styles should be more adept at critical thinking as they are better able to integrate and respond to various learning demands. On the other hand, individuals with more extreme scores, those who are less balanced, should be less adept at critical thinking, as they are less able to flex, or adapt, to various forms of learning (Mainemelis, Boyatzis, & Kolb, 2002).

*Research Question 2:* What is the relationship between group critical thinking and the learning style composition of the team?

#### Method

#### **Research Strategy**

The research strategy employed to answer the questions consisted of two phases. In the first research session, participants were recruited from 10 sections of undergraduate and graduate business courses. Students first completed a measure of individual learning style. The scores served as the basis to compose groups based on similarity of learning styles. This was done to create two distinct groups or blocks, one block composed of members high on particular learning style scores and a second block composed of members with balanced learning styles. In the second session, the groups performed a critical-thinking exercise followed by five open-ended, group-level questions. After the groups worked together, participants completed an individual-level questionnaire on group process. Because of the smaller sample size necessary when doing group research resulting from individual aggregation, the significance level was set at p < .01 to test for minor effects.

#### Sample

The initial sample included 251 participants enrolled in business courses at a small private university in the midwestern United States. Of the initial sample, 187 participants attended both the first and second research sessions, resulting in a 75% participation rate. Ages ranged from 18 to 51 (M = 22.36, SD = 6.05). Participation rates were consistent across sex, age, and grade.

Of the participants, 35% were sophomores, 39% were juniors, 8% were seniors, and 19% were graduate students in the MBA program. The sample distribution of learning style scores was consistent with sample norms of the instrument (Kolb, 1999).

Participants were combined into 65 groups (individual n = 187), ranging in size from 2 to 4 members per group (mode = 3). Three groups (individual n = 11) were excluded from analysis because of incomplete data. This resulted in a total of 62 groups and 178 participants in the final sample. A pilot of this study tested the design with 13 participants.

#### Measures

Individual cognitive style was measured using Kolb's (1999) Learning Style Inventory Version 3 (LSI). The LSI is a self-report, forced-choice ranking of individual learning preference. The instrument consists of 12 sets of four incomplete sentences. Respondents rank each set of four choices that correspond to the four modes of learning: concrete experience, reflective observation, abstract conceptualization, and active experimentation. A total score for each of the four dimensions is then calculated and adjusted to a normative scale for cross-subject comparison.

#### Controls

Because prior research has shown a positive relationship between certain beliefs shared among team members, I wanted to control for the findings that shared beliefs among group members might relate to critical thinking. This helped ensure that the newly developed measure of critical thinking was not simply a factor of certain shared beliefs among members. Shared beliefs were measured using a combination of self-report scales at the individual and the group levels. All shared beliefs were measured on a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). Cohesion was measured using Stokes's (1983) five-item measure, and psychological safety was measured using Edmondon's (1999) seven-item measure, where scales were completed by individual group members and aggregated to a group mean. Efficacy was measured based on Zaccaro, Blair, Peterson, and Zazanis's (1995) definition by asking each group to assess its level of confidence in the comprehensiveness of its response and ability to outperform other groups, to communicate effectively, to provide a satisfactory answer, and to perform well in the future. Team size and the number of words per group response were also entered as controls.

#### **Measurement of Critical Thinking**

Group critical thinking was measured using a version of reflective judgment modified to elicit a group-level response (King & Kitchener, 1994). Each group was provided with one of two scenarios. One scenario required the group to deal with a business problem and the other a journalism problem. The scenarios were taken directly from King and Kitchener's (1994) reflective judgment model of critical thinking. In this seven-stage, hierarchical model, each of the seven stages evaluates two aspects of knowledge: a theory of knowledge and a set of implicit epistemological assumptions. The seven stages can be summarized into three categories: pre-reflective thinking, quasi-reflective thinking, and reflective judgment. Each group was asked to respond to the five-probe questions that were modified to elicit a group response. The critical-thinking scenarios and the probe questions are listed in the Appendix.

*Code development*. Two coders, both blind to condition, began the process of coding the responses based on the model. Test versions of the cases that were gathered from the pilot study but not included in the final sample were used to train the coders and assess common agreement about how to apply the model of reflective judgment to the responses.

After reviewing a cross-section of the responses, only a few reflected integrative complexity higher than Stage 5 on the model of reflective judgment. Despite the somewhat disappointing results, a decision was made that the original seven-stage model of reflective judgment was not applicable to the current data set. A modified code that better reflected the actual responses of the groups was developed.

The new code reflected both the original model of reflective judgment and the sample responses. Both inductive and deductive methods were used in the code development (Boyatzis, 1998). This newly developed code resulted in a three-stage, group-level model of critical thinking. As summarized in Table 1, the three strategies were named absolutism, relativism, and committed relativism based on Perry's categories.

Groups categorized as absolute displayed critical thinking that relied solely on experience or beliefs and felt a high degree of certainty about their response to the problem. Importantly, groups categorized as absolute only represented one viewpoint or solution to the problem. Unlike the absolute groups, relativistic groups were able to recognize multiple perspectives. Groups categorized as relativistic arrived at a solution to the problem but were less certain about their response while holding a belief in knowledge

Sum	imary of Major Criti	cal-Thinking Approaches a	nd the Group-Level	Approach
	Moral and Ethical Development	Reflective Judgment	Experiential Learning Theory	Group Critical Thinking
Principal theorist	Perry	King and Kitchener	Kolb	Extension of Kolb, Perry, King and Kirchener
Theoretical basis Inductive/deductive Theoretical strength	Deductive Descriptive model of moral and ethical development during college years	Deductive Theoretical model of epistemological assumptions of critical thinking when faced with ill-structured problems	Inductive/deductive Part of comprehensive theory of learning and development	Descriptive model of integrative complexity; descriptive of actual ways individuals assess and respond to ill-structured
Stages				dimore during a memoreout
.1.	Dualism	Pre-reflective	Acquisition	Absolutism
2.	Multiplicity	Quasi-reflective	Specialization	Relativism
3.	Relativism	Reflective	Integration	Committed relativism
4.	Commitment in relativism			
Target population	Undergraduate	Undergraduate and graduate	Broad range of adult	Adult learners in groups
	students	students	learners	
Level of analysis	Individual	Individual	Individual	Individual within group
Method of assessment	Qualitative interview	Qualitative interview		Qualitative: questionnaire and short answer

Table 1 • Critical-Thinking Ammagches and the Groun-Level A that was idiosyncratic—a matter of opinion or perspective rather than reason. Groups categorized as committed relativistic provided the most comprehensive response to the problem. Like the relativistic groups, the committed relativistic groups also saw knowledge as uncertain but did not give relativistic answers. Rather, committed relativistic groups went a step further by suggesting certain criteria by which to evaluate knowledge, setting conditions under which their response would hold or not hold and making judgments about the practical nature of their choices. Table 2 summarizes three major theories of critical thinking and the group-level approach advocated for management development.

*Code validation.* Working independently with the new codes, each coder recoded all group responses with a present/not present approach for each of the three levels of integrative complexity. The new variable of critical thinking reflected the characteristics of both a nominal and an ordinal scale. Each week for a month, the two coders compared scores, noted agreements and disagreements, and refined the code by noting particular phrases that exemplified each of the three stages. Disagreements were negotiated, and a consensus classification was decided on. After a month of coding, interrater agreement was 71%.

Two additional coders were enlisted to validate the code. After undergoing instructions from the principal investigator, the coders independently coded each of the 62 group responses. Taking all 4 coders' ratings into account, the final codes achieved an acceptable interrater reliability of 75%. Percentage agreement between coders on the presence of committed relativism (the highest level of critical thinking) was 95%. Of the 62 groups included in the final sample, 19 (30.6%) were classified as absolutism, 28 (45.2%) as relativism, and 15 (24.2%) as committed relativism.

The group critical-thinking measure results fell into a normal distribution, with about half of the groups able to recognize multiple perspectives (relativism) but only about one fourth of all groups able to integrate multiple perspectives (committed relativism). Another fourth of the groups relied primarily on experience or direct observation (absolutism).

#### Results

Results of the study provide initial understanding of group critical thinking and progression through college and some initial findings about the relationship between critical thinking and learning style composition of teams.

	Summary o	of Group Critical-Thinking Strate	gies
	Absolutism	Relativism	Committed Relativism
Characteristics	<ol> <li>Relies on direct observation (usually phrased in the form of prior experience).</li> <li>Appeals to authority.</li> <li>Considers the beliefs</li> <li>Considers the beliefs</li> </ol>	<ol> <li>Recognizes the uncertainty of knowledge but sees knowledge as idiosyncratic to individual perspectives, opinions, and beliefs.</li> <li>Views knowledge as uncertain but has not yet formulated criteria</li> </ol>	<ol> <li>Presents some specific criteria by which to judge knowledge.</li> <li>Uses a specific set of rules to further inquiry beyond direct observation. Experience may be included as a measure, but</li> </ol>
	Anowicage may be viewed as uncertain, but the reason given for the uncertainty is the lack of sufficient information to confirm knowledge.	or statutatus by writch to juuge knowledge.	ope of multiple criteria.
Example	"None of us have ever had experience hiring people, so we cannot really be sure."	"Everyone is entitled to have their own opinion, and there is no way to prove either answer right or wrong."	"Different types of firms (ex: service, merch., manuf.) and different industries require and value different skills from their employees. Many times prior experience [of the interviewee] is not necessary because they will train you on the job. It depends on who does the hiring and the specific criteria."

č • • . Table 2 ζ 6

Downloaded from http://sgr.sagepub.com at SAGE Publications on August 25, 2009

М	SD	MS <sub>B</sub>	$MS_w$	ICC	F
24.08	6.11	66.35	22.15	.08	2.99***
32.27	6.03	55.61	26.18	.03	2.12***
28.43	7.23	100.39	27.02	.09	3.72***
35.07	7.21	84.27	35.05	.04	2.04***
6.65	12.32	—	—	—	_
8.19	9.64	—	—	—	_
6.50	0.71	0.74	0.38	.13	1.95***
5.85	0.77	1.49	0.85	.11	1.73***
5.46	0.97	0.82	0.48	.33	1.73***
5.97	0.65	_	_	_	_
6.62	0.61	—	_	—	
	M           24.08           32.27           28.43           35.07           6.65           8.19           6.50           5.85           5.46           5.97           6.62	M         SD           24.08         6.11           32.27         6.03           28.43         7.23           35.07         7.21           6.65         12.32           8.19         9.64           6.50         0.71           5.85         0.77           5.46         0.97           5.97         0.65           6.62         0.61	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

 Table 3

 Descriptive Statistics and Interclass Correlations for Study Variables

Note:  $MS_B$  = mean square between groups;  $MS_W$  = mean square within groups; ICC = interclass correlation coefficient.

a. Measured at the individual level; n = 178.

b. Aggregated group score; n = 178.

c. Measured at the group level; n = 62.

\*\*\**p* < .001.

#### **Control Variables**

Cronbach's alphas for control variables ranged from .64 for psychological safety to .71 for cohesion. To determine the appropriateness of grouplevel measures, interclass correlations (ICCs) were calculated on all group-level measures, as displayed in Table 3. ICCs distinguish the amount of variance that can be attributed to the group from that attributed to the individual. A positive ICC is necessary to establish the existence of a grouplevel variable (Kenny & LaVoie, 1985). Using mean squares generated from ANOVAs, ICCs were significant (p < .01). Notice the magnitude of the ICCs for all individual learning style measures versus the magnitude for all group measures, as individual measures reveal significantly lower ICCs. To establish the validity of blocking criteria, ANOVAs revealed significantly lower within-group variance than between-group variance (p < .001), suggesting that the appropriate differentiation between groups had been achieved.

Group critical-thinking ability was not significantly correlated with any of the control variables, as displayed in Table 4.

			Tabl	e 4						
	Corre	lations /	Among ar	nd Betw	een Vari	ables				
	-	2	3	4	5	9	7	8	6	10
1. Sum of concrete experience										
2. Sum of abstract conceptualization	60									
3. Sum of reflective observation	42	01								
4. Sum of active experimentation	.03	22	74**							
5. Cohesion	60.	17	02	.06						
6. Psychological safety	00.	05	.07	07	.56**					
7. Efficacy	11	04	08	.25	.04	.07				
8. Year in school	10	.20	09	.05	08	<u>9</u> .	05			
9. Team size	.02	11	.10	07	01	10	12	-00		
10. Number of words	18	03	.30	13	.15	.18	.10	13	.17	
11. Group critical thinking	.07	07	.18	21	22	22	17	19	06	04

Note: N = 62. \*\*p < .001.

#### **Learning Style Composition**

There was no significant difference in critical thinking between groups composed of members with balanced learning styles and groups composed of members with more extreme learning style scores ( $\chi^2 = 2.58$ , ns,  $\eta = .20$ ). However, follow-up analysis provided further insight into the role of learning style and group critical thinking. When teams were further subdivided into five blocks, each representing five distinct learning styles (e.g., diverging, assimilating, converging, and accommodating), there was evidence of a relationship between the learning style composition of the groups and critical thinking ( $\chi^2 = 15$ , p < .05,  $\eta = .20$ ). Two further analyses were conducted. First, teams coded as absolutism and relativism were treated as independent samples. Second, relativism and committed relativism were treated as independent samples. Results revealed that learning style composition was related to the difference between absolutism and relativism ( $\chi^2 = 10.23$ , p < .05) but not the difference between relativism and committed relativism ( $\chi^2 = 7.70$ , ns).

#### **Graphic Representation of Overlapping Waves**

The overlapping wave approach was explored by creating two graphs that displayed the progression of critical thinking over time. The first graph displayed the mean critical-thinking scores of each grade level, whereas the second graph displayed the percentage of the time each of the three criticalthinking approaches was utilized by each grade level (Figures 1 and 2). Figure 1 reveals that, over time, the mean critical-thinking score increased with progression through college. This finding provides insight into how group critical thinking may change over time spent in a vocational training setting. However, Figure 2 reveals a different story: It shows that critical thinking in teams was not a linear progression across grades; rather, over time, absolutism decreased and relativism increased. However, surprisingly, committed relativism, as a percentage of use, stayed relatively stable. This suggests that the increase in the mean score, revealed in Figure 1, was attributable mostly to an increase from absolutism to relativism.

#### Discussion

The finding that progress through college is positively related to critical thinking is consistent with findings on individual-level critical thinking.



Figure 1 Mean Group Critical-Thinking Scores as a Factor of Academic Progression (Traditional Model)

This study provides the first comprehensive method for measuring critical thinking at the group level across levels of higher educational achievement. The results show that critical thinking can be conceptualized at the group level and that group-level critical thinking changes over time.

The suggestion here is that although individual-level factors such as progression through higher education may be strong predictors of group critical thinking, the combination with group-level factors may provide the strongest model for understanding group critical thinking. Closer examination of critical thinking as a function of relative use of each of the three strategies and year in school reveals a slightly different picture. The data provide three general insights. First, over time, the ability of a group to develop critical thinking increases. A number of factors could account for this, including increased individual critical-thinking ability and the improved



Figure 2 Graphic Display of Group Critical Thinking (Overlapping Wave Model)

Note: Group critical thinking as a function of academic progression and percentage use of each strategy.

ability to work in groups. Second, as a percentage, the lower strategy of absolutism decreased over time, whereas the midrange strategy of relativism increased. Relativism and absolutism converge somewhere between the junior year and graduate school. Third, the highest critical-thinking strategy of committed relativism decreased over time. It may be that committed relativism is more valued in the educational environment. As students become more pragmatic, they may tend to enlist safer forms of thinking, such as relativism, or employ more direct means of critical thinking, such as absolutism.

The cross-sectional correlation design of the study does not address causality; it only implies change over time. The laboratory-like setting of the study limits the ability to generalize the findings to intact teams. Future research should include a longitudinal design to measure critical thinking in teams over time to provide a better indication of how critical thinking develops in teams. Such research could be conducted with intact teams or cohorts as they progress through college. Although the team-level ICCs of cohesion, psychological safety, and efficacy provide evidence of team-level interaction, future research requires factoring the variance of critical thinking to either individual- or team-level measures. Although the three-level-measure presented here shows initial promise, more robust theory and the development of a more sensitive measure are needed. Such a measure may be the first step in the development of a quantitative measure of critical thinking that maintains the requisite complexity.

The ability to think critically about problems remains a key part of job performance. With the increasing use of teams and groups in the workplace, the ability to think critically in the context of a team becomes more important. This article outlines a means to understand how critical thinking develops over time during the process of vocational training.

### Appendix Scenario for Critical-Thinking Exercise

#### Problem 1: Business Problem

Selecting and hiring the best employee is a difficult decision for employers. Some people believe that the most important criterion is how highly qualified the applicant is in relation to the written job description. Others believe it is more important that a new employee fit in with the personalities of the other members of the work team, assuming the applicant's qualifications are adequate.

#### Problem 2: News Story Problems

Some people believe that news stories represent unbiased, objective reporting of news events. Others say that there is no such thing as unbiased, objective reporting, and that even in reporting the facts, the news reporters project their own interpretations into what they write. Probe Questions for Critical-Thinking Exercise

What does the group think about the problem presented? What is the group's position on this topic?

What prior knowledge influenced the group's decision process?

On what basis does the group hold this point of view? In other words, why does the group believe what it does? What are the arguments in support of its position?

Can the group ever be sure that its position on this issue is correct? Why or why not? How is it possible that people may have different points of view on this topic?

Note: Adopted from King and Kitchener (1994).

#### References

- Bloom, B. S. (Ed.). (1956). Taxonomy of educational objectives. The classification of educational goals. Handbook I, Cognitive domain. New York: Longman.
- Boyatzis, R. E. (1982). The competent manager: A model for effective performance. New York: John Wiley.
- Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. Thousand Oaks, CA: Sage.
- Bronfenbrenner, U. (1979). The ecology of human development: Experiments by nature and design. Cambridge, MA: Harvard University Press.
- Chickering, A. W. (1971). Education and identity. San Francisco: Jossey-Bass.
- Das, T. K. (1994). Educating tomorrow's managers: The role of critical thinking. *International Journal of Organizational Analysis*, 2, 333–360.
- Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, 44, 350–383.
- Edmondson, A. C., Bohmer, R. M., & Pisano, G. P. (2001). Disrupted routines: Team learning and new technology implementation in hospitals. *Administrative Science Quarterly*, 46, 685–719.
- Erickson, E. (1959). Identity and the life cycle. New York: International University Press.
- Gruenfeld, D. H., & Hollingshead, A. B. (1993). Sociocognition in work groups. The evolution of group integrative complexity and its relation to task performance. *Small Group Research*, 24, 383–405.
- Heifitz, R. (1994). Leadership without easy answers. Boston: Harvard Business School Press.

Jacques, E. (1989). Requisite organization. Arlington, VA: Carson Hall.

Kayes, A. B., Kayes, D. C., & Kolb, D. A. (2005). Experiential learning in teams. Simulation & Gaming, 36, 330-354.

Kayes, D. C. (2002). Dilemma at 29,000 feet: An exercise in ethical decision making based on the 1996 Mt. Everest disaster. *Journal of Management Education*, 26, 307–321.

Kayes, D. C. (2003). Proximal team learning: Lessons from United Flight 93 on 9/11. Organizational Dynamics, 32(1), 80–92.

- Kegan, R. (1994). In over our heads: The mental demands of modern life. Cambridge, MA: Harvard University Press.
- Kenny, D. A., & LaVoie, L. (1985). Separating individual and group effects. *Journal of Personality and Social Psychology*, 48, 339–448.

- King, P. M., & Kitchener, K. S. (1994). Developing reflective judgment. San Francisco: Jossey-Bass.
- Kohlberg, L. (1969). Stages and sequences: The cognitive-developmental approach to socialization. In D. A. Goslin (Ed.), *Handbook of socialization theory and research* (pp. 347-380). Chicago: Rand McNally.
- Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.
- Kolb, D. A. (1999). Learning Style Inventory Version 3. Boston: Hay/McBer.
- Leovinger, J. (1976). Ego development: Conceptions and theories. San Francisco: Jossey-Bass.
- Levinson, D. J., Darrow, C. N., Klein, E. B., Levinson, M. H., & McKee, B. (1978). The seasons of a man's life. New York: Ballantine.
- Levinson, D. J., & Levinson, J. D. (1996). The seasons of a woman's life. New York: Ballantine.
- Mainemelis, C., Boyatzis, R. E., & Kolb, D. A. (2002). Adaptive flexibility: Testing experiential learning theory of development. *Management Learning*, 33(1), 5–34.
- Mohrman, S. A., Cohen, S. G., & Mohrman, A. M. (1995). Designing team-based organizations: New forms for knowledge work. San Francisco: Jossey-Bass.
- Perry, W. G. (1970). Forms of intellectual and ethical development in the college years: A scheme. Chicago: Holt, Rinehart & Winston.
- Schein, E. H. (1978). Career dynamics: Matching individual and organizational needs. Reading, MA: Addison-Wesley.
- Sheehey, G. (1995). New passages: Mapping your life across time. New York: Random House.
- Siegler, R. S. (1996). Emerging minds: The process of change in children's thinking. New York: Oxford University Press.
- Stokes, J. P. (1983). Components of group cohesion: Intermember attraction, instrumental value, and risk taking. *Small Group Behavior*, 14, 163–173.
- Thelen, H. (1963). The dynamics of groups at work. Chicago: University of Chicago Press.
- Vygotsky, L. S. (1978). The mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.
- Wolfe, J. (1977). Learning styles rewarded in a complex simulation with implications for business policy and organizational behavior. Paper presented at the Academy of Management Annual Meeting, University of Illinois.
- Zaccaro, S. J., Blair, V., Peterson, C., & Zazanis, M. (Eds.). (1995). *Collective efficacy*. New York: Plenum.

**D.** Christopher Kayes (PhD, organizational behavior, Case Western Reserve University) is assistant professor of organizational behavior at The George Washington University, School of Business, and visiting professor at the University of Hull. He is the author of *Destructive Goal Pursuit: The Mount Everest Disaster* (2006). His work on learning, teams, and leadership has been recognized with numerous awards, including "the most significant contribution to the practice of management in the field of OB" in 2005 by the Academy of Management–Organizational Behavior Division.