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Thinking Styles and Modes of Thinking: Implications for Education and Research

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ABSTRACT. The author investigated the relationship of thinking styles to modes of thinking. Participants were 371 freshmen (aged 18 and 19) from the University of Hong Kong. Participants responded to the Thinking Styles Inventory (R. J. Sternberg & R. K. Wagner, 1992) and the Style of Learning and Thinking (Youth Form; E. P. Torrance, B. McCarthy, & M. T. Kolesinski, 1988). A major finding was that creativity generating and complex thinking styles were significantly positively correlated with the holistic mode of thinking but significantly negatively correlated with the analytic mode of thinking. Thinking styles that denote the tendency to norm favoring and simplistic information processing were significantly positively correlated with the analytic mode of thinking and significantly negatively correlated with the holistic mode of thinking. In a preliminary conclusion, it appears that the thinking style construct overlaps the mode of thinking construct. Implications of this finding for teachers and researchers are delineated.

Key words: modes of thinking, thinking styles

IN EDUCATIONAL SETTINGS it is common that one student gets straight As and another student at the same ability level frequently fails tests. There are various ways to explain this phenomenon because there are many ways to explain individual differences in academic performance. For example, two students with the same abilities may use their abilities differently—that is, they use different learning styles.

Styles, as an individual-difference variable in human performance, have long occupied the minds of many scholars. Between the late 1950s and mid-1970s, there was a proliferation of literature in the area of theories and models of styles that has become stagnant partially because of the overwhelming output in the field and partially because of a lack of internal dialogue among researchers

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(Jones, 1997). When Riding and Cheema (1991) reviewed the literature on styles, they identified over 30 labels for the style construct. Consequently, we are left with a research field that embraces a confusing variety of seemingly different yet similar constructs.

In the past decade or so there has been renewed interest in theories and models of styles manifested in two topics—conceptually integrating existing style labels and empirically testing the style labels. Literature on the conceptual integration of styles is best represented by Curry's (1983) three-layer "onion" model of style measures, by Riding and Cheema's (1991) model of two style dimensions and one family of learning strategies, and by Grigorenko and Sternberg's (1995) three traditions of the study of styles. These works have been reviewed in detail in my recent article (Zhang, 2000b). My present article is based on Grigorenko and Sternberg's conceptualization of styles in the literature. Thus, only Grigorenko and Sternberg's work is recapitulated.

Grigorenko and Sternberg (1995) contended that existing models and theories related to style labels can be classified into three traditions of studying styles: cognition centered, personality centered, and activity centered. Styles in the cognition-centered tradition most closely resemble abilities. These styles have often been measured by tests of maximal performance with right and wrong answers. Within this tradition, Witkin's (1964) field dependence–independence and Kagan's (1966) reflection–impulsivity models have generated the most interest.

Styles in the personality-centered tradition most closely resemble personality traits, and styles in this tradition are measured with typical performance tests (no right or wrong answers) rather than maximal performance tests. Models of styles in this tradition are best represented by Gregorc's (1982) four main types of styles and Myers and McCaulley's (1988) work based on Jung's (1923) theory of types. The activity-centered tradition emphasizes the notion of styles as mediators of various forms of activities that tend to arise from some aspects of cognition and personality. Literature in this tradition is represented by similar theories of deep- and surface-learning approaches proposed separately by Marton (1976), Biggs (1979), and Entwistle (1981).

Empirical studies that attempt to clarify the nature of the relationships among the different style labels are sparse. All the studies found in the literature (through a PsycLit search) were reviewed in my (Zhang, 2000b) recent work. This review suggested that empirical studies about the relationships among the different style labels have produced diverse results. The results of some of these studies showed more similarities than differences among various style labels, whereas others identified more differences than similarities. For example, after studying 38 university students, Ford (1995) concluded that students' holist and serialist competence, as measured by Pask and Scott's (1972) original testing materials designed to suit holist and serialist learning strategies, could be predicted by Riding's (1991) Cognitive Styles Analysis that is designed to measure field dependence–independence.

Harasym, Leong, Juschka, Lucier, and Lorscheider (1996) also found a strong association between two style labels. Harasym et al. investigated the relationship between the Myers-Briggs Type Indicator (MBTI; Myers & McCaulley, 1988) and the Gregorc Style Delineator (Gregorc, 1982). They found that each learning style assessed by the Gregorc Style Delineator corresponded to certain traits assessed by the MBTI. For example, individuals who scored higher on the Concrete Sequential learning style scale tended to have traits of sensing and judging on the MBTI, whereas individuals who scored higher on the Concrete Random learning style scale tended to have the traits of intuition and perceiving on the MBTI.

Other researchers, however, found more differences than similarities among different style labels. For example, Sadler-Smith (1997) carried out a study among 245 university undergraduates in business studies. The participants responded to the Cognitive Styles Analysis (CSA; Riding, 1991), the Learning Preferences Inventory (LPI; Riechmann & Grasha, 1974), the Learning Styles Questionnaire (LSQ; Honey & Mumford, 1992), and the Revised Approaches to Studying Inventory (RASI; Entwistle & Tait, 1994). After examining the correlation coefficients among the scales of the different instruments, Sadler-Smith concluded that there is some overlap between the dimensions measured by the LSQ and the RASI. However, no statistically significant relationships were identified between cognitive styles (as measured by the CSA) and any of the other style constructs investigated.

In a more recent study, Sadler-Smith (1999) examined the relationships between cognitive styles as measured by the Cognitive Style Index (Allinson & Hayes, 1996) and learning approaches as measured by the Approaches to Studying Inventory (Gibbs, Habeshaw, & Habeshaw, 1988). Although the results of this study indicated that analysts tended to adopt a deeper approach to learning than did intuitives and that intuitives exhibited a stronger preference for collaborative approaches than did analysts, Sadler-Smith concluded that the evidence found in the relationships between cognitive styles and learning approaches was not strong and that the two style labels are, at least superficially, independent.

Renewed interest in the style literature also manifested itself through an additional type of work, that is, the postulation of new theories of styles that encompass styles from all three traditions to the study of styles. Sternberg's (1988, 1997) theory of mental self-government is such a theory. The theory of mental self-government addresses thinking styles. A *thinking style* is defined as our preferred way of using the abilities that we have. Sternberg believes that just as there are many ways of governing our society, there are many ways to govern or manage our daily activities. These different ways of managing our activities or of using our abilities are called thinking styles. People's thinking styles vary depending on the stylistic demands of a given situation. Also, thinking styles are at least partially socialized (Sternberg, 1994, 1997).

The theory of mental self-government proposes 13 thinking styles that fall

along five dimensions of mental self-government. The first dimension is *function*, including the legislative, executive, and judicial thinking styles. The second dimension is related to *form*, including the hierarchical, oligarchic, monarchic, and anarchic thinking styles. The third dimension concerns *level*, including the global and local thinking styles. The fourth dimension is *scope*, including the internal and external thinking styles. The fifth dimension is *leaning*, including the liberal and conservative thinking styles. A brief description of each of the 13 thinking styles is provided in the Appendix.

In my opinion, 7 of these thinking styles can be categorized broadly into two types. The first type (including the legislative, judicial, global, and liberal styles) is creativity generating and requires complex information processing. People who use this type of thinking styles tend to be norm challenging and risk taking. The second type (including the executive, local, and conservative styles) requires simplistic information processing. People who use this type of thinking styles tend to be norm favoring and authority oriented.

There are two reasons for this new classification of the 7 styles. The first is related to the nature of the styles as manifested in their demands for the degree of complexity in information processing (complex vs. simplistic) and in the potential products that the use of each type of thinking style is likely to lead to (creative and norm challenging vs. noncreative and norm favoring). The second reason is related to the empirical findings based on Sternberg's theory of mental self-government. For example, I (Zhang, 2000b; Zhang & Sternberg, 2000) found that the first type of thinking styles were significantly positively related to the deep approach to learning but significantly negatively related to the surface approach to learning. Complementarily, the second type of thinking styles were significantly positively related to the surface approach to learning but significantly negatively related to the deep approach to learning.

In Zhang and Sternberg's studies, the concept of a deep or surface approach to learning was the one defined in Biggs's (1987, 1992) theory of student learning. An individual who uses a deep approach hopes to gain a real understanding of what is learned, whereas an individual who uses a surface approach aims to reproduce what is taught to meet the minimum requirements.

To gain a real understanding of what is learned, one needs to be creative and to use a nontraditional approach to learning that involves a great deal of complex information processing, as would an individual who uses the first type of thinking styles. To accurately reproduce what is taught, one needs to follow established rules in performing tasks, which requires mostly simple information processing, as would an individual with the second type of thinking styles. It was on the basis of this interpretation of the findings on the relationships between thinking styles and approaches to learning, along with the nature of styles as discussed earlier, that I classified the 7 thinking styles into the two types.

Several measures have been constructed to test the theory of mental self-government. These measures have been used to study a variety of populations

such as secondary school students; university students; and pre-service and in-service teachers in cross-cultural contexts including Hong Kong, mainland China, and the United States. Apart from obtaining good reliability and validity data for these measures, we have examined the usefulness of these measures in educational settings and have obtained a few major groups of interesting findings. First, we found that thinking styles are significantly related to both students' and teachers' characteristics. For example, students from higher socioeconomic status (SES) families scored higher on the legislative style than did students from lower SES families (e.g., Sternberg & Grigorenko, 1995). Students in natural science and technology tended to think more globally than those studying in social science and humanities (Zhang & Sachs, 1997). Students who had more extracurricular experience used such thinking styles as the legislative, hierarchical, and liberal styles, whereas those who had less extracurricular experience used executive, local, and conservative thinking styles (Zhang, 1999). Teachers with long experience used more executive, local, and conservative styles than those teachers who had taught for a short time (Sternberg & Grigorenko, 1995). Sternberg and Grigorenko also found that teachers inadvertently favored students who had thinking styles similar to their own.

Researchers have also indicated that thinking styles contribute to students' academic achievement beyond what can be explained by abilities (Grigorenko & Sternberg, 1997; Zhang & Sternberg, 1998). For example, higher achieving U.S. university students tend to employ the hierarchical thinking style. Higher achieving Hong Kong university students tend to score significantly higher on the executive, local, and conservative styles. Higher achieving mainland Chinese students score significantly lower on the executive style.

The thinking style construct defined by the theory of mental self-government has also been tested against constructs from two of the three traditions to the study of styles. The first is the activity-centered tradition. From this approach, Biggs's (1987) theory of learning approaches was tested against the thinking styles in Sternberg's theory. Results showed that students who use the creativity generating and complex styles (e.g., legislative, liberal) tend to report a deep approach to learning, whereas students who tend to use the norm favoring and simplistic thinking styles report a surface approach to learning (Zhang, 2000b; Zhang & Sternberg, 2000).

The second type of theory against which the theory of mental self-government has been tested is from the personality-centered tradition. Sternberg (1994) examined the correlations of the thinking styles scales to scales in the MBTI (Myers & McCaulley, 1988). Thirty of the 128 correlations were statistically significant. These correlations are well above the levels that would be expected by chance and suggest a significant overlap between thinking styles and personality types. In a recent study, I (Zhang, 2000a) found that research participants who scored higher on the Social and Enterprising scales of a short version of Holland's Self-Directed Search (Holland, 1994; Zhang, 2000c) tended to score lower

on the Internal thinking style scale, but scored higher on the External scale. Similarly, participants who scored lower on Holland's Artistic scale tended to score higher on the Executive, Local, and Conservative scales.

However, the theory of mental self-government has not been examined against a theory from the third tradition to the study of styles, that is, the cognition-centered tradition. In the present study, the thinking styles in the theory of mental self-government were tested against Torrance's (1988) Style of Learning and Thinking (SOLAT). Although the SOLAT is claimed to be based on theory and research on the specialized cerebral functions of the left and right hemispheres, I believe that the inventory is, in fact, measuring two different modes of thinking—holistic versus analytic. The use of both modes can be termed as an *integrative mode of thinking*.

My contention can be supported by the more recent research findings (e.g., Banich, 1998; Beeman & Chiarello, 1998) on the study of hemispheric asymmetries. In discussing the evolving perspectives on the specialization of the two hemispheres, Banich and Heller (1998) asserted that the two hemispheres are more dynamic than static and that they are more interactive than was believed 20 years ago. The authors argued that it is not that the left brain processes verbal information and the right brain processes spatial information. Instead, the left brain can be conceptualized as being specialized for processing information in a piecemeal, analytic, and sequential manner, which simply happens to be a good way for processing verbal information. The right brain can be conceptualized as being specialized for processing information in a holistic manner, which happens to be good for processing spatial information. The use of both modes allows the two hemispheres to process information dynamically. These more recent research findings indicate that what people used to call *cerebral dominance* is actually *mode of thinking*. Researchers using Torrance's model have mistakenly used the term *brain dominance*.

I chose the SOLAT for two major reasons. First, the inventory is clearly cognition centered. The SOLAT assesses people's preferred ways of processing information—analytic, holistic, and integrative. The second reason for choosing the SOLAT is that it is one of the major inventories that have resulted in findings that have important implications for curriculum development, teaching strategies, and assessment formats. For example, Bracken, Ledford, and McCallum (1979) found that students designated by SOLAT as left-brain dominant correctly completed significantly more multiple-choice questions than did right-brain dominant students. The authors concluded that right-brain dominant students may be penalized in instructional situations in which multiple-choice measures are used exclusively.

In the discussion of math learning and brain dominance, Grow and Johnson (1983) delineated gender differences that affect math learning in the specialization of the two hemispheres. They also pointed out that most school curricula favor students with left-brain dominance. In their research of 193 11th-grade

Korean high school students, Kim and Michael (1995) found that students classified as showing a learning and thinking style preference, hypothesized by the authors to correspond to right-brain dominance, scored higher on creativity measures than did students classified as displaying a learning and thinking style preference, hypothesized by the authors to be related to either a left-brain dominance or a whole-brain dominance. However, little relationship was found between school performance and students' scores on creativity measures that require right-brain dominance.

In the present study I have cast the SOLAT in a new light, that is, in the light of modes of thinking, which is more accurate in describing what this inventory really measures. My major goal in the present study was to explore the relationship of thinking styles as defined in the theory of mental self-government to modes of thinking as tested by the SOLAT (Torrance, McCarthy, & Kolesinski, 1988). My hypotheses were as follows:

1. Thinking styles that are more creativity generating and more complex (e.g., legislative, judicial, liberal, and global styles) are significantly positively correlated with the holistic mode of thinking but significantly negatively correlated with the analytic mode of thinking.
2. Thinking styles that exhibit a norm-favoring tendency and are more simplistic (e.g., executive, conservative, and local) are significantly positively correlated with the analytic mode of thinking but significantly negatively correlated with the holistic mode of thinking.

Method

Participants

Participants were 371 entering freshmen (154 men and 217 women) at the University of Hong Kong. The research was conducted during students' orientation session. Among these participants, 84 (22.6%) were 18 years old, and 287 (77.4%) were 19 years old. This sample of students was appropriate for use with the SOLAT (Youth Form, designed for use up to the 12th grade in the U.S.) because they had graduated from senior high schools just before they participated in the present research. Participation was voluntary and informed consent was obtained. Participants were from all of the 9 faculties (Architecture, Arts, Dentistry, Education, Engineering, Law, Medicine, Science, and Social Sciences) and the School of Business at the university.

Measures

All the students completed the Thinking Styles Inventory (TSI; Sternberg & Wagner, 1992) and the Style of Learning and Thinking (Youth Form, SOLAT; Torrance, McCarthy, & Kolesinski, 1988).

The TSI is a self-report test in which participants rate themselves on a 7-point scale with 1 denoting that the statement *does not describe them at all* and 7 denoting that the statement *characterizes them extremely well*. There are 65 items, each 5 falling into one of the 13 different style scales. In the present study, the students were required to respond to 35 items assessing the 7 thinking styles that had been classified into two types. The four forms (hierarchical, oligarchic, anarchic, and monarchic) and two scopes (internal and external) of thinking styles were omitted as they cannot be easily categorized into either one of the two types of thinking styles. For the same reason, no significant relationship was anticipated for the 6 omitted thinking styles to any of the scales in the SOLAT.

The TSI had been translated and back-translated between English and Chinese in 1996. Since then, I have carried out a series of studies using the Chinese version in both Hong Kong and mainland China. Results indicated that the TSI is reliable and valid for assessing the thinking styles of students in the two Chinese cultures (for details, see Zhang, 2000b; Zhang & Sternberg, 2001). In the present study, I used the Chinese version of the TSI. The Cronbach alphas for this version are .72 (legislative), .70 (executive), .79 (judicial), .60 (global), .47 (local), .82 (liberal), and .76 (conservative).

The SOLAT (Youth Form) is a self-report inventory consisting of 28 items. Each item allows individuals to choose one of two statements or both; one statement is characterized by the analytic mode of thinking and the other by the holistic mode of thinking. Choosing both statements results in scoring on the integrative mode of thinking. The following is an example:

- a. I am good at remembering verbal materials.
- b. I am good at remembering sounds and tones.

The choice of Item a is scored on the analytic mode of thinking scale; the choice of Item b is scored on the holistic mode of thinking scale; choosing both Items a and b is scored on the integrative mode of thinking scale.

Reliability and validity statistics for the SOLAT (Youth Form) have been reported in the SOLAT Administrator's Manual (Torrance, 1988). The Cronbach alpha was .77 for the Analytic scale and .74 for the Holistic scale. No reliability data were reported for the Integrative scale. In the present study, the Cronbach alpha was .75 for the Analytic scale, .70 for the Holistic scale, and .85 for the Integrative Scale.

Not much has been found in the literature regarding the validity of the Youth Form of the SOLAT. However, as Torrance (1988) pointed out, its validity can rest primarily on evidence accumulated for a few older versions of the SOLAT (for details, see Torrance, 1988). In general, it appears that although creative problem solving and creative thinking require both analytic and holistic modes of thinking, the essence of creative behavior calls for the holistic mode of thinking.

The SOLAT used in the present study is a Chinese version. It was translated and back-translated between Chinese and English.

Data Analysis

I conducted a preliminary test for identifying a possible gender difference in any of the thinking style and mode of thinking scales. Because no significant gender difference was found, the remaining statistical analyses were conducted with data for men and women combined.

I used three statistical procedures to explore the relationship between thinking styles and modes of thinking. First, all the scales from the two inventories were submitted to a principal-axis factor analysis with an oblique rotation. This procedure was based on the assumption that if thinking styles and modes of thinking are related, scales from the two inventories should share common variance accounted for by the data; that is, certain scales from each of the two inventories should load on the same factors. Second, I computed a zero-order correlation matrix. Third, I performed a one-way analysis of variance (ANOVA) to identify participants' differences in thinking styles on the basis of their scores on the SOLAT scales. Participants were divided into high, medium, and low groups for all three SOLAT scales (Analytic, Holistic, and Integrative). Cut-off scores were based on an exploration of score distributions. Scores in the lowest quartile were designated as low, scores in the middle two quartiles were designated as medium, and scores in the highest quartile were designated as high. Because the significance level of the Kolmogorov-Smirnov test of the variables was greater than .05, normality was assumed.

TABLE 1
Oblimin-Rotated Four-Factor Model for the Thinking Styles Inventory and the Style of Learning and Thinking ($N = 371$)

Scale	Factor 1	Factor 2	Factor 3	Factor 4
Analytic		.66	.57	
Holistic	.64			.41
Integrative	.35	.41	.79	
Legislative	.74			
Executive		.84		
Judicial	.82			
Global	.41		-.42	.59
Local	.49			-.64
Liberal	.82			
Conservative		.81		
% of variance	28.90	21.85	14.63	10.59
Cumulative				
variance	28.90	50.74	65.37	75.96
Eigenvalue	2.89	2.19	1.46	1.06

Note. Scales with factor loadings of less than $|.35|$ are omitted.

Results

Factor Analysis

The factor analysis performed on all scales from the two inventories resulted in four factors (accounting for 76% of the variance in the data) on the basis of visual inspection of eigenvalues with the scree test (Cattell, 1966). Each of the four factors was loaded with scales from both inventories, suggesting significant relationships between thinking styles and modes of thinking. The first factor showed high positive loadings on the Legislative, Judicial, Global, Local, and Liberal thinking styles scales as well as on the Holistic scale. The second factor was positively loaded on the Executive and Conservative thinking styles scales as well as on the Analytic scale. Factor 3 showed high positive loadings on both the Analytic and Holistic scales, but showed a negative loading on the Global thinking style scale. Factor 4 was dominated by positive loadings on the Holistic scale and the Global thinking style scale, but by a negative loading on the Local thinking style scale. Detailed statistics are summarized in Table 1.

TSI and SOLAT Scale Correlations

The correlation coefficients among the scales from the two inventories are summarized in Table 2. All correlations were in the predicted directions. Furthermore, the majority of the correlation coefficients were statistically significant. For example, the Analytic scale was significantly positively correlated with the Executive and Conservative thinking styles scales and significantly negatively correlated with the Liberal style scale. The Holistic scale was significantly positively correlated with the Legislative and Liberal thinking styles scales, whereas it was significantly negatively correlated with the Executive and Conservative styles scales.

TABLE 2
Pearson Correlation Matrix for the Thinking Styles
Inventory and the Style of Learning and Thinking ($N = 371$)

Scale	Analytic	Holistic	Integrative
Legislative	-.06	.32**	.18**
Executive	.32**	-.20**	.10
Judicial	.01	.33**	.21**
Global	-.08	.20**	.03
Local	.06	.13*	.10
Liberal	-.12*	.36**	.09
Conservative	.28**	-.25**	.06

* $p < .05$. ** $p < .01$.

ANOVA—Thinking Styles by Modes of Thinking

As mentioned earlier, as a result of their scores on each of the three SOLAT scales, participants were classified into low, medium, and high groups. I tested the possible modes of thinking group differences in thinking styles. A one-way ANOVA followed by post hoc tests using Tukey's honestly significant differences test indicated the following significant group differences. For the analytic groups, two thinking styles scales (Executive and Conservative) resulted in significant group differences. The high analytic group scored significantly higher on both the Executive and Conservative thinking styles scales than did both the medium and low analytic groups. Furthermore, the medium analytic group also scored significantly higher on the Executive thinking style scale than did the low analytic group.

Regarding the holistic groups, all thinking styles scale scores resulted in group differences. The higher holistic groups scored significantly higher on the Legislative, Judicial, Global, and Liberal thinking styles scales than did lower holistic groups. On the contrary, higher holistic groups scored significantly lower on the Executive and Conservative thinking styles scales. Finally, the low holistic group scored significantly lower on the Local thinking style scale than did both the high and medium holistic groups.

For the integrative groups, the Legislative and Judicial thinking styles scores

TABLE 3
Mean Scores for Thinking Styles Inventory Scales
Based on Mode of Thinking Groups ($N = 371$)

Mode of thinking/ TSI scale	Group					
	Low	<i>n</i>	Medium	<i>n</i>	High	<i>n</i>
Analytic						
Executive	4.67 ^{LL}	116	4.94 ^{LH}	145	5.17 ^{HH}	109
Conservative	4.29 ^L	113	4.51 ^L	145	4.75 ^{HH}	110
Holistic						
Legislative	4.80 ^L	93	5.01 ^L	178	5.37 ^{HH}	95
Executive	5.11 ^H	94	4.91	178	4.77 ^L	96
Judicial	4.28 ^{LL}	94	4.66 ^{LH}	177	5.03 ^{HH}	95
Global	4.07 ^L	93	4.23 ^L	177	4.54 ^{HH}	96
Local	4.29 ^{LL}	94	4.57 ^H	179	4.52 ^H	95
Liberal	3.72 ^{LL}	94	4.42 ^H	178	4.65 ^{HH}	96
Conservative	4.79 ^H	94	4.47 ^H	178	4.32 ^{LL}	94
Integrative						
Legislative	4.93 ^L	110	5.00 ^L	144	5.23 ^{HH}	112
Judicial	4.51 ^L	109	4.60 ^L	144	4.88 ^{HH}	113

Note. ^L denotes a mean significantly lower than that of one group; ^{LL} denotes a mean significantly lower than those of two groups; ^H denotes a mean significantly higher than that of one group; ^{HH} denotes a mean significantly higher than those of two groups.

resulted in significant group differences. The high integrative group scored significantly higher on both the Legislative and Judicial thinking styles scales than did both the medium and low integrative groups, whereas there was no significant difference in thinking styles between the medium and low groups. A detailed summary of the mean differences for the analytic, holistic, and integrative thinking groups in thinking styles is presented in Table 3.

Discussion and Implications

The results attained in this study largely support my hypotheses regarding the relationship between thinking styles and modes of thinking after being tested by three statistical procedures—factor analysis, scale correlations, and ANOVA. Integrated results from the three statistical procedures suggest that participants who scored higher on thinking style scales that are more creativity generating and more complex (Legislative, Judicial, and Liberal) tended to score significantly higher on the Holistic scale, but scored significantly lower on the Analytic scale than did those who scored lower on the Legislative, Judicial, and Liberal thinking styles scales. Participants who scored higher on thinking style scales that exhibit a norm-favoring tendency and are more simplistic (Executive and Conservative) tended to score significantly higher on the Analytic scale, but scored significantly lower on the Holistic scale than did those who scored lower on the Executive and Conservative thinking styles scales.

Across all three statistical analyses, a global thinking style was consistently significantly correlated with the Holistic scale. All these results confirmed my hypotheses. These results also make substantive sense. People's tendency to follow logic and instructions in task performance can be understood both as being an analytic mode of thinking and as using the two norm-conforming thinking styles (executive and conservative). Both the use of the holistic mode of thinking and of such thinking styles as legislative, judicial, liberal, and global may be explained as a manifestation of creative endeavors.

However, with the local thinking style, the three statistical analyses produced conflicting results. The correlation between the local thinking style and the Holistic scale revealed a significantly positive relationship, whereas the ANOVA indicated a significantly negative relationship. Although the factor loadings of the first factor suggested a positive relationship between the local style and the Holistic scale, the factor loadings on the fourth factor pointed to a negative relationship between the two. According to my prediction, the local thinking style should have a significantly positive relationship with the Analytic scale but a significantly negative relationship with the Holistic scale. People with a local thinking style and/or an analytic mode of thinking should deal with tasks or process information in a piecemeal manner. The conflicting results in the present study may be attributable to the low reliability of the Local thinking style scale ($\alpha = .47$, the only correlation coefficient below $.60$). The low reliability might be due

to some problems in the translation of the items in the scale or to the lack of relevancy of some items used with Hong Kong students.

I made no specific hypothesis on the relationship between the thinking styles and the Integrative scale. Nevertheless, I explored their relationships by using the same three statistical procedures. Results from factor analysis suggested that participants who scored higher on the Integrative scale tended to score higher on the Executive and Conservative thinking style scales, but scored lower on the Global scale than did those who scored lower on the Integrative Scale. Both computation of scale correlations and ANOVA indicated that those who scored higher on the Integrative scale scored significantly higher on the Legislative and Judicial thinking style scales than did their counterparts. In general, these results indicated that participants who reported adopting an integrative mode of thinking tended to use multiple thinking styles of both types.

The major value of the present study lies in its verification of the relationship of thinking styles to modes of thinking. The study was a continuation of my investigation of the nature of thinking styles proposed in Sternberg's theory of mental self-government against a theoretical model from the cognition-centered tradition of the study of styles. Results of the present study suggest that thinking styles significantly overlap with modes of thinking—analytic, holistic, and integrative. Whereas a consistent relationship between the local thinking style and modes of thinking was not found in the present study, I found consistent and strong relationships between other thinking styles and modes of thinking. The legislative, judicial, liberal, and global thinking styles are related to the holistic mode of thinking for processing information. The executive and conservative thinking styles are related to the analytic mode of thinking for processing information.

It should be noted, however, that the present study is only the first of its kind. Thus, the conclusion drawn regarding the relationships between thinking styles and modes of thinking should be considered preliminary. Researchers should carry out further investigations, especially those involving experimental procedures, to facilitate a better understanding of the relationships between the two constructs. Nevertheless, the findings from the present study have implications for teachers and researchers.

Teachers can foster students' creativity by using the relationships found between thinking styles and modes of thinking. Many study results have indicated that creativity is highly associated with an integrative mode of thinking and especially with the holistic mode of thinking (Harnad, 1972; Kim & Michael, 1995; Okabayashi & Torrance, 1984; Tan-Willman, 1981). For example, Harnad (1972) found that highly creative mathematicians habitually depend on a holistic mode of thinking.

Because I found significant relationships between thinking styles and modes of thinking—significant relationships that are essentially consistent with theoretical predictions—teachers should feel confident that they could foster creativity by allowing for a variety of thinking styles. Teachers can allow for different

thinking styles, as has been argued by Sternberg (1997) and Zhang (1999), by using different instructional styles and using different assessment schema. Teachers can foster creativity by tapping talents assumed to be generated from different modes of thinking and by accommodating to and challenging the development of multiple thinking styles.

Torrance (1988) claimed, "It now seems likely many of the objectives of education and of society can be (and have been) attained through the kind of operations performed by the right hemisphere, and that almost all could be attained more effectively using both kinds of functioning" (p. 1; also see McCarthy, 1980; Torrance, 1981). If, indeed, Torrance's claim can be substantiated by educational outcome, we could argue that allowing for different thinking styles may also contribute to the attainment of the objectives of education and of society.

The results of this study also point to the direction for future research. Much research has been done to examine the relationship between modes of thinking and performance on different types of learning tasks or of assessment. The results of the present study indicate that different types of learning tasks and/or of assessment favor students with different modes of thinking (e.g., Bracken et al., 1979; Okabayashi & Torrance, 1984).

Further research on the nature of thinking styles, especially in relation to modes of thinking, could be undertaken following research that has been conducted on brain functioning. For example, researchers should investigate such questions as "Do students with predominantly legislative, judicial, liberal, and global thinking styles perform better on learning tasks that require intuitive and nonlinear thinking? Do they perform better when they deal with materials that are nonverbal, and spatial?" "Do students with predominantly executive and conservative thinking styles perform better when dealing with learning tasks that require logical and sequential thinking? Do they perform better when dealing with materials that are verbal, analytical, and digital?"

In other words, do thinking styles that are significantly related to modes of thinking assist students in their academic performance in the same way that the two modes of thinking do? Answers to these questions can contribute to the research field of styles and enable educators to use their knowledge about thinking styles to facilitate more effective teaching and learning.

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APPENDIX
Sample Items From the Thinking Styles Inventory

Sample items	Scale type	Key characteristic
• I like tasks that allow me to do things my own way.	Legislative	Being creative
• I like situations in which it is clear what role I must play or in what way I should participate.	Executive	Being conforming
• I like to evaluate and compare different points of view on issues that interest me.	Judicial	Being analytical
• I like to complete what I am doing before starting something else.	Monarchic	Dealing with one task at a time
• When undertaking some task, I like first to come up with a list of things that the task will require me to do and to assign an order of priority to the items on the list.	Hierarchical	Dealing with multiple prioritized tasks
• I usually know what things need to be done, but I sometimes have trouble deciding in what order to do them.	Oligarchic	Dealing with multiple non-prioritized tasks
• When working on a written project, I usually let my mind wander and my pen follow up on whatever thoughts cross my mind.	Anarchic	Dealing with tasks at random
• Usually when I make a decision, I don't pay much attention to details.	Global	Focusing on abstract ideas
• I like problems that require engagement with details.	Local	Focusing on concrete ideas
• I like to be alone when working on a problem.	Internal	Enjoying working independently
• I like to work with others rather than by myself.	External	Enjoying working in groups
• I like to do things in new ways, even if I am not sure they are the best ways.	Liberal	Using new ways to deal with tasks
• In my work, I like to keep close to what has been done before.	Conservative	Using traditional ways to deal with tasks

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