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# The Relationship Between Thinking Styles and Scientific Giftedness in Korea

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This study investigated the thinking styles of Korean gifted students in Korea and examined whether thinking styles based on the theory of mental self-government could predict scientific giftedness based on Korean people's implicit concepts. Participants were 179 students from the two science high schools and 176 students from the general high schools in Korea. Participants responded to the Thinking Styles Inventory (Sternberg & Wagner, 1992) and Scientific Giftedness Inventory (Shim & Kim, 2003). Results indicated that Korean gifted students had higher scores than nongifted students in all factors, including scientific accomplishment, leadership, creativity, morality, motivation, and cognitive experimentalism. In addition, Korean gifted students prefered the legislative, judicial, anarchic, global, external, and liberal styles, whereas Korean nongifted students prefered the executive, oligarchic, and conservative styles. Results from the stepwise multiple regression analysis procedures indicated that the subscales of thinking styles could be significant predictors of scientific giftedness.

The development and implementation of school gifted programs should be based on gifted students' psychological characteristics and intellectual abilities. Sternberg (1988) pointed out that one cannot fully understand intellectual abilities unless one also knows how individuals apply them in adapting to the demands of their environment.

Sternberg's (1988, 1990, 1997) theory of mental self-government addresses intellectual styles as an interface between intelligence and personality. The basic assumption is that the way individuals use their mind is analogous to the various dimensions of government in the external world. At the heart of this theory is the notion that people need to somehow govern and manage their everyday activities. Just as there are many ways of governing a society, there are many ways of governing or managing one's daily activities. These different ways of governing or managing activities are what Sternberg (1988, 1990, 1994) calls "thinking styles." Sternberg's theory postulated 13 thinking styles that fall along five dimensions: functions (legislative, executive, and judicial thinking styles), forms (hierarchical, oligarchic, monarchic, and anarchic thinking styles), levels (global and local thinking styles), scopes (including internal and external thinking styles), and leanings (liberal and conservative thinking styles) of the mental self-government. Most people are at least somewhat flexible in their use of styles and try, with varying degrees of success, to adapt themselves to the stylistic demands of a given situation. Thus, an individual with a style preference in one situation may have a different preference in another situation. Table 1 presents the 13 thinking styles and sample items of mental self-government.

Table 1

## Thinking Styles' Characterization and Sample Items of Mental Self-Government

| Style | Characterization | Sample Item |
|---|---|---|
| *Functions* | | |
| Legislative | Likes to create, invent, design, do things his of her own way, has little assigned structure. | I like tasks that allow me to do things my own way. |
| Executive | Likes to follow directions, do what he or she is told, be given structure. | I like situations in which it is clear what role I must play or in what way I should participate. |
| Judicial | Likes to judge and evaluate people and things. | I like to evaluate and compare different points of view on issues that interest me. |
| *Forms* | | |
| Monarchic | Likes to do one thing at a time, devoting to it almost all energy and resources. | I like to complete what I am doing before starting something else. |
| Hierarchic | Likes to do many things at once, setting priorities for what to do when and how much time and energy to devote to each. | When undertaking some task, I like first to come up with a list of things that the task will require me to do and then assign an order of priority to the items on the list. |
| Oligarchic | Likes to do many things at once, but has trouble setting priorities. | I usually know what needs to be done, but I sometimes have trouble deciding in what order to do them. |
| Anarchic | Likes to take a random approach to problems; dislikes systems, guidelines, and practically all constraints. | When working on a written project, I usually let my mind wander and my pen follow up on whatever thoughts cross my mind. |
| *Levels* | | |
| Global | Likes to deal with big picture, generalities, abstractions. | Usually, when I make a decision, I don't pay much attention to details. |
| Local | Likes to deal with details, specifics, concrete examples. | I like problems that require engagement with details. |
| *Scope* | | |
| Internal | Likes to work alone, focus inward, be self-sufficient. | I like to be alone when working on a problem |
| External | Likes to work with others, focus outward, be interdependent. | I like to work with others, rather than by myself. |
| *Leaning* | | |
| Liberal | Likes to do things in new ways, defy conventions. | I like to do things in ways that have not been used by others in the past. |
| Conservative | Likes to do things in tried and true ways, follows conventions. | I stick to standard rules or ways of doing things. |

Zhang and Sternberg (2000) proposed that thinking styles and learning approaches are related: They hypothesized that the surface approach was positively and significantly correlated with styles associated with less complexity and negatively and significantly correlated with the legislative, judicial, liberal, and hierarchical styles. They also hypothesized that the deep approach was positively and significantly correlated with styles associated with more complexity and negatively and significantly correlated with the executive, conservative, local, and monarchic styles. Zhang (2002a, 2002b) has investigated the relationship between thinking styles and academic performance and modes of thinking among U.S. university students. According to his research, the more creativity-generating and more complex thinking styles are significantly related to a holistic mode of thinking, and the more norm-conforming and more simplistic thinking styles are significantly related to an analytic mode of thinking.

The initial evidence bears out some of the theoretical and practical significance of thinking styles. For example, teachers have been found to give more favorable evaluations to students whose thinking styles match their own, and secondary teachers are more likely to have an executive style than elementary teachers (Grigorenko & Sternberg, 1995, 1997). On the other hand, Sternberg (1994) proposed that various styles of mental self-government are also relevant to important issues regarding gifted learners. According to Sternberg and Grigorenko (1993), the implications of thinking styles for gifted education include issues of acceleration versus enrichment and individualistic versus cooperative learning structures.

Dai and Feldhusen (1999) suggested that gifted adolescent learners are quite diverse in thinking styles despite the fact that they have a relatively homogeneous profile of academic abilities and achievement. However, research that applies this model of thinking style to gifted students is still rare. As we have been able to show, there is some research on the relationship of thinking and learning styles to other variables, but not on the interrelationship of thinking styles and characteristics of giftedness.

The implicit theories and conceptions of giftedness are currently seen as residing in the minds of theorists, who can be either experts or laypersons (Sternberg & Zhang, 1995). The implicit theorists not only define giftedness, but also articulate the implications of their definitions. Theories of this kind deal with people's conceptions of a phenomenon, rather than dealing directly with the phenomenon itself. They are tested not by looking at the performance of people who are gifted, but by asking people what they mean by "giftedness" or some other construct (Sternberg, Conway, Ketron, & Bernstein, 1981).

It could be assumed that the implicit concepts of giftedness are different across cultures. For example, Zhang and Sternberg (1998) investigated the implicit concept of "excellence" among Chinese teachers in Hong Kong and compared them with the implicit concept of "excellence" among people in the U.S. They found that, in Hong Kong, unlike in the U.S., participants had higher expectations of excellence for boys than for girls. Thus, it may be culturally inappropriate when protocols for identifying gifted children are exported from one culture to another, particularly when implicit theories of giftedness differ cross-culturally.

Shim and Kim (2003) have identified the implicit concept of giftedness among people in Korea. Seventy-one scientists, 73 parents, 104 teachers, and 80 university students in Korea were asked to describe freely their opinions about giftedness using the open-ended question "When you hear the word *giftedness*, what do you think of?" The Koreans' implicit concepts of giftedness include creativity, need for achievement, task commitment, intellectual ability, learning styles, human relationship, self-confidence, and morality, as well as art/physical skill and personality. Furthermore, in the same study, they evaluated whether each implicit concept was being used by gifted Korean students. They selected from a science gifted program 469 gifted students who had high levels of performance, including demonstrated achievement and accomplishment. They found that the gifted students used scientific accomplishment, leadership, motivation, morality, creativity, and cognitive experimentalism to describe themselves.

Along these lines, the major goal of the present study was to compare the scientific giftedness and thinking styles of Korean gifted students to nongifted students and to examine whether thinking styles based on the theory of mental self-government could predict scientific giftedness based on Korean people's implicit concepts. This study is significant in three aspects: First, if there are significant differences in scientific giftedness between gifted students and nongifted students, it will provide a groundwork for identifying giftedness in science. Second, if there are significant differences in thinking styles between gifted students and nongifted students, it will provide the groundwork for improving the instruction and curricula for gifted students in science. Third, if there is a significant relationship between thinking styles and scientific giftedness, it will provide some implications based on a cross-cultural perspective.

The research questions were as follows:

1. Are there any differences in subscales of scientific giftedness between gifted students and nongifted students in Korea?

2. Are there any differences in subscales of thinking styles between the gifted students and nongifted students in Korea?
3. Is there a relationship in thinking styles and scientific giftedness of gifted students in Korea?

## Method

### Participants

The gifted group was comprised of 179 students (121 males and 58 females) from Busan Science High School and Dagwoo Science High School in Korea, which were established especially with the aims of cultivating high-quality intellects in the field of science and mathematics. The majority of applicants who are admitted to these schools have previously excelled, placing in the 95th percentile in their middle schools or receiving awards in the Math and Science Olympiad. The nongifted group was comprised of 176 students (106 males and 70 females) from general high schools in Korea. The average age of the two groups was 16.

### Inventories

All participants responded to the Korean version of the Thinking Styles Inventory (TSI; Sternberg & Wagner, 1992) and the Scientific Giftedness Inventory (SGI; Shim & Kim, 2003). The TSI is a self-report test consisting of 65 items on 13 scales, with five items per scale. The Korean-language version, created with data from this study, had comparable and acceptable psychometric properties. For each item, the participants were asked to rate themselves on a five-point Likert-type scale ranging from 1 (the statement did not describe them at all) to 5 (the statement characterized them extremely well). For Sternberg and Wagner's college sample, the median value of the coefficient alpha relative to the 13 scales is as follows: Legislative (0.78), Executive (0.75), Judicial (0.72), Monarchic (0.35), Hierarchic (0.74), Anarchic (0.59), Oligarchic (0.76), Global (0.78), Local (0.63), Internal (0.80), External (0.85), Conservative (0.83), and Liberal (0.88).

The SGI is a self-report test consisting of 69 items in six subcategories. For each item, the participants were asked to rate themselves on a five-point Likert-type scale ranging from 1 (the statement did not describe them at all) to 5 (the statement characterized them extremely well). The SGI has demonstrated overall internal reliability of 0.76, with subscales ranging from 0.64 to 0.88 for high school students: Scientific Accomplishment (0.88), Leadership (0.87), Morality (0.81), Creativity (0.70), Motivation (0.78), and Cognitive Experimentalism (0.64). The subcategories are Scientific Accomplishment (sample item: "Do you like complex problems?"), Leadership (sample item: "Do your friends usually rely on you?"), Morality (sample item: "Do you usually respect others' opinions?"), Creativity (sample item: "Do you often think of original ideas?"), Motivation (sample item: "Do you consider yourself very competitive?"), and Cognitive Experimentalism (sample item: "Do you think that rules are necessary?").

### Data Analyses

We used *t*-tests to examine the differences in thinking styles and scientific giftedness between gifted students and nongifted students. We also examined the relationship in thinking styles and scientific giftedness for gifted students using correlation and stepwise multiple regression analysis.

## Results

### Scientific Giftedness

Table 2 shows the summary statistics from the *t*-test procedures to compare the six subcategories of scientific giftedness for the gifted and nongifted students. In the categories of scientific accomplishment ($t = 6.773$; $p < .001$), leadership ($t = 3.061$; $p < .01$), creativity ($t = 2.939$; $p < .01$), morality ($t = 3.087$; $p < .01$), motivation ($t = 3.280$; $p < .01$), and cognitive experimentalism ($t = 5.460$; $p < .001$), the gifted students had statistically significant higher scores than the nongifted students. Using these results, we investigated the participants' characteristics of giftedness in science and found that the gifted students had higher scores than nongifted students in all six factors: scientific accomplishment, leadership, creativity, morality, motivation, and cognitive experimentalism.

Specifically, we found that gifted students are concerned with complex problems that challenge them to come up with diverse ideas; they analyze reason and synthesize their own knowledge to solve problems (scientific accomplishment). They are extroverted and can act as a leader among their friends; they express their own beliefs and tend toward easily understanding others' opinions (leadership). They have a strong sense of responsibility; they are honest, and they tend to obey rules (morality). They are willing to tackle problems and present unique ideas; they are very sensitive to everything (creativity). They challenge themselves by pursuing their goals and

Table 2

**Means and *t* Values of Scientific Giftedness for Two Groups**

| Factors | Group | Mean | *SD* | *t* |
|---|---|---|---|---|
| Scientific Accomplishment | Gifted | 93.7966 | 12.3152 | 6.773*** |
| | Nongifted | 84.7778 | 12.5233 | |
| Leadership | Gifted | 31.8371 | 6.0264 | 3.061** |
| | Nongifted | 29.8902 | 5.8840 | |
| Morality | Gifted | 34.1243 | 5.4685 | 3.087** |
| | Nongifted | 32.4509 | 4.6273 | |
| Creativity | Gifted | 37.1910 | 6.8690 | 2.939** |
| | Nongifted | 35.1686 | 5.9560 | |
| Motivation | Gifted | 32.3090 | 5.4192 | 3.280** |
| | Nongifted | 30.5543 | 4.5896 | |
| Cognitive Experimentalism | Gifted | 27.7095 | 3.9469 | 5.460*** |
| | Nongifted | 25.4400 | 3.8723 | |

*Note.* $N$ = 355 (179 gifted science high school students and 176 nongifted general high school students)
* $p < .05$ ** $p < .01$ *** $p < .001$

constantly competing with their peers (motivation). They prefer an adventure, and they do not hesitate to follow through on their ideas (cognitive experimentalism).

## Thinking Styles

To determine what scales were contributing to the group difference in thinking styles, *t*-test were computed for each scales of the TGI (see Table 3). No statistically significant difference was found on the Monarchic, Hierarchic, Local, and Internal scales. However, on the scales of Legislative ($t$ = 2,725; $p < .01$), Judicial ($t$ = 4.185; $p < .001$), Anarchic ($t$ = 2.115; $p < .05$), Global ($t$ = 3.181; $p < .01$), External ($t$ = 2.497; $p < .05$), and Liberal ($t$ = 2.293; $p < .05$), the gifted students had statistically significant higher scores than the nongifted students, while the nongifted students had statistically significant higher scores on the Executive ($t$ = -3.901; $p < .001$), Oligarchic ($t$ = -2.939; $p < .01$), and Conservative($t$ = -2.709; $p < .01$) scales.

Zhang (2002a, 2002b) categorized thinking styles into two types: Type I thinking styles (e.g., legislative, judicial, global, liberal), which are creativity-generating and more complex, and Type II thinking styles (e.g., executive, local, conservative), which are more norm-favoring and simplistic. Table 3 indicates that Korean gifted students prefer the legislative, judicial, global, and liberal thinking styles, whereas Korean nongifted students prefer the executive, oligarchic, and conservative thinking styles. Therefore, Korean gifted students preferred Type I thinking styles, whereas Korean nongifted students tended toward Type II thinking styles.

These results are different from the findings of other studies (e.g., Na & Kim, 2003; Yun, Yun, & Yu, 2003) that investigated the differences in thinking styles between gifted and nongifted students in Korea. However, the findings coincide with estimates obtained by other authors such as Dai and Feldhusen (1999), who used a sample of gifted secondary students in the U.S.

## Relationships Between Thinking Styles and Scientific Giftedness

To explore the relationship of thinking styles and scientific giftedness, we computed correlations (see Table 4). Of the compounding 78 correlations among the subscales of the TSI and SGI, we found 55 correlations, either positive or negative, that were statistically signifi-

Table 3

**Means and *t* Values of Scientific Giftedness for Two Groups**

| Scales | Groups | Mean | *SD* | *df* | *T* |
|---|---|---|---|---|---|
| Legislative | Gifted | 19.8256 | 2.4432 | 328 | 2.725** |
| | Nongifted | 19.0380 | 2.8056 | | |
| Executive | Gifted | 15.9553 | 3.0406 | 349 | -3.901*** |
| | Nongifted | 17.1860 | 2.8634 | | |
| Judicial | Gifted | 17.8418 | 2.7361 | 350 | 4.185*** |
| | Nongifted | 16.6000 | 2.8305 | | |
| Monarchic | Gifted | 17.9106 | 3.6524 | 352 | 1.328 |
| | Nongifted | 17.4286 | 3.1503 | | |
| Hierarchical | Gifted | 16.1124 | 3.0007 | 350 | -1.620 |
| | Nongifted | 16.6149 | 2.8133 | | |
| Oligarchic | Gifted | 15.0559 | 2.7879 | 348 | -2.939** |
| | Nongifted | 15.8830 | 2.4587 | | |
| Anarchic | Gifted | 17.1236 | 2.3085 | 346 | 2.115* |
| | Nongifted | 16.5941 | 2.3622 | | |
| Global | Gifted | 16.4261 | 2.6350 | 345 | 3.181** |
| | Nongifted | 15.5556 | 2.4569 | | |
| Local | Gifted | 16.0057 | 2.8091 | 341 | -.293 |
| | Nongifted | 16.0893 | 2.4588 | | |
| Internal | Gifted | 17.3764 | 3.1117 | 349 | 1.430 |
| | Nongifted | 16.8728 | 3.4802 | | |
| External | Gifted | 18.0838 | 2.9296 | 349 | 2.497* |
| | Nongifted | 17.2849 | 3.0637 | | |
| Liberal | Gifted | 17.927 | 2.860 | 351 | 2.293* |
| | Nongifted | 17.222 | 2.916 | | |
| Conservative | Gifted | 13.3051 | 3.4850 | 348 | -2.709** |
| | Nongifted | 14.2890 | 3.3039 | | |

*Note.* $N$ = 355 (179 gifted science high school students and 176 nongifted general high school students)

* $p < .05$ ** $p < .01$ *** $p < .001$

cant. The range of correlation coefficients ranged from .160 to .664.

Legislative, judicial, liberal, and anarchic styles were positively related with all subscales of the SGI: legislative ($r$ = .22 - .47), judicial ($r$ = .23 - .42), liberal ($r$ = .19 - .66), and anarchic ($r$ = .16 - .40). By contrast, executive and conservative thinking styles were negatively related to subscales of SGI. We found that the executive thinking style

Table 4

**Correlation Matrix Between Thinking Styles and Scientific Giftedness of Korean Gifted Students**

| | SA | LS | MO | CR | M | CE |
|---|---|---|---|---|---|---|
| Legislative | .467** | .217** | .223** | .243** | .227** | .397** |
| Executive | -.246** | .071 | .246** | -.018 | .372** | -.018 |
| Judicial | .386** | .233** | .260** | .265** | .260** | .423** |
| Global | .185* | .014 | .040 | .048 | .133 | .190* |
| Local | .122 | .216** | .229** | .250** | .236** | .209** |
| Liberal | .664** | .155* | .220** | .339** | .191* | .464** |
| Conservative | -.404** | -.087 | .022 | -.106 | .131 | -.244** |
| Hierarchical | .189* | .008 | .112 | .162* | .249** | .183* |
| Monarchic | .125 | .297** | .435** | .176* | .579** | .308** |
| Oligarchic | -.049 | .010 | .158* | .021 | -.070 | .019 |
| Anarchic | .402** | .158* | .160* | .227** | .161* | .343** |
| Internal | .260** | .035 | .004 | .058 | .074 | .120 |
| External | .122 | .183* | .232** | .075 | .159* | .252** |

*Note.* SA=Scientific Accomplishment. LS=Leadership. MO=Morality. CR=Creativity. M=Motivation. CE=Cognitive Experimentalism.
$N = 179$, * $p < .05$ ** $p < .01$

related negatively with scientific attitude ($r$ = -.25) and the conservative thinking style related negatively with scientific attitude ($r$ = -.40) and cognitive experimentalism ($r$ = -.24). These correlations indicated that gifted students tended to prefer legislative, judicial, liberal, and anarchic thinking styles, but not executive and conservative thinking styles.

Our question proposed an examination of the relative contribution of 13 subscales of thinking styles as predictors of 6 subscales of scientific giftedness. To address this issue, stepwise regression analysis was computed. In stepwise regression, the order in which the variable entered is based on a statistical decision, not on a theory. The first variable entered is the one accounting for the most variance in the dependent measure. The next variable entered is the one that adds most to the ability of the regression equation to account for the variance in the dependent variable (Bordens & Abbott, 1999). The detailed statistical results are summarized in Table 5.

Scientific accomplishment was regressed on a liberal style ($b$ = 2.19, $t$ = 8.34, $p < .001$), conservative style ($b$ = -.93, $t$ = -4.68 $p < .001$), judicial style ($b$ = .79, $t$ = 3.00 $p < .001$), and global style ($b$ = .64, $t$ = 2.45, $p < .05$). In all, these four styles accounted for 53% of the variance in the data. The liberal thinking style was the most important variable contributing to scientific accomplishment (43%).

Leadership was regressed on monarchic style ($b$ = .38 $t$ = 2.919, $p < .01$), liberal style ($b$ = .32 $t$ = 2.15 $p < .05$), conservative style ($b$ = -.31, $t$ = -2.381 $p < .05$), and local style ($b$ = .36, $t$ = 2.28, $p < .05$). In all, these four styles accounted for 13% of the variance in the data. The monarchic thinking style was the most important variable contributing to leadership (7%).

Morality was regressed on monarchic style ($b$ = .51, $t$ = 4.26, $p < .001$), liberal style ($b$ = .37, $t$ = 2.73, $p < .01$), and executive style ($b$ = .29, $t$ = 2.12, $p < .05$). In all, these three styles accounted for 24% of the variance in the data. The monarchic style was the most important variable contributing to morality (20%).

Creativity was regressed on liberal style ($b$ = .73, $t$ = 3.81, $p < .001$) and judicial style ($b$ = .39, $t$ = 2.05, $p < .05$). In all, these two styles accounted for 14% of the variance in the data. The liberal thinking style was the most important variable contributing to creativity (13%).

Motivation was regressed on monarchic style ($b$ = .74, $t$ = 6.99, $p < .001$), oligarchic style ($b$ = -.31, $t$ = -2.63, $p < .01$), executive style ($b$ = .38, $t$ = 3.01, $p < .01$), and liberal style ($b$ = .33, $t$ = 2.73, $p < .01$). In all, these four styles accounted for 41% of the variance in the data. The monarchic thinking style was the most important variable contributing motivation (35%).

Cognitive experimentalism was regressed on liberal style ($b$ = .34, $t$ = 3.32, $p < .01$), monarchic style ($b$ = .31, $t$ = 4.24, $p < .001$), judicial style ($b$ = .32, $t$ = 3.39, $p < .01$),

Table 5

**Stepwise Regression Analysis of the Thinking Styles and Scientific Giftedness of Korean Gifted Students**

| Variable | *b* | Seb | Beta | *t* | $R^2$ | $R^2$ change | Adjusted $R^2$ |
|---|---|---|---|---|---|---|---|
| *Scientific Accomplishment* (Constant) | 42.716 | 6.884 | | | | | .525 |
| Liberal | 2.190 | .262 | .511 | 8.349*** | .431 | .431 | |
| Conservative | -.937 | .200 | -.269 | -4.680*** | .480 | .049 | |
| Judicial | .792 | .264 | .182 | 3.000** | .519 | .039 | |
| Global | .636 | .259 | .138 | 2.451* | .537 | .018 | |
| *Leadership* (Constant) | 17.535 | 3.850 | | | | | .131 |
| Monarchic | .378 | .129 | .230 | 2.919** | .068 | .068 | |
| External | .324 | .151 | .163 | 2.146* | .100 | .032 | |
| Conservative | -.309 | .130 | -.182 | -2.381* | .124 | .024 | |
| Local | .360 | .158 | .174 | 2.284* | .153 | .029 | |
| *Morality* (Constant) | 14.021 | 3.268 | | | | | .236 |
| Monarchic | .505 | .119 | .344 | 4.256*** | .202 | .202 | |
| Liberal | .365 | .134 | .194 | 2.725** | .229 | .027 | |
| Executive | .295 | .139 | .171 | 2.118* | .250 | .021 | |
| *Creativity* (Constant) | 17.335 | 3.947 | | | | | |
| Liberal | .729 | .191 | .299 | 3.811*** | .126 | .126 | .138 |
| Judicial | .395 | .192 | .161 | 2.056* | .149 | .023 | |
| *Motivation* (Constant) | 11.627 | 3.118 | | | | | .405 |
| Monarchic | .737 | .105 | .494 | 6.995*** | .355 | .351 | |
| Oligarchic | -.314 | .119 | -.166 | -2.631** | .392 | .030 | |
| Executive | .381 | .126 | .217 | 3.011** | .423 | .023 | |
| Liberal | .326 | .119 | .172 | 2.734** | .420 | .001 | |
| *Cognitive Experimentalism* (Constant) | 9.205 | 2.490 | | | | | .409 |
| Liberal | .341 | .103 | .240 | 3.323** | .233 | .228 | |
| Monarchic | .309 | .073 | .278 | 4.242*** | .317 | .080 | |
| Judicial | .332 | .098 | .233 | 3.390** | .360 | .040 | |
| Conservative | -.278 | .076 | -.241 | -3.678*** | .407 | .044 | |
| Anarchic | .272 | .116 | .159 | 2.341* | .427 | .017 | |

*Note.* $N$ =179

*$p$ < .05, **$p$ < .01, ***$p$ < .001

conservative style ($b$ = -.28, $t$ = -3.68, $p$ < .001), and anarchic style ($b$ = .272, $t$ = 2.34, $p$ < .05). In all, these five styles accounted for 41% of the variance in the data. The liberal thinking style was the most important variable contributing cognitive experimentalism (23%).

## Implications

The goal of this study was to investigate the nature of Korean gifted science students based on the theory of mental self-government and Korean people's implicit concepts

of scientific giftedness. This goal was investigated by testing the significant differences in scientific giftedness and thinking styles between Korean gifted science students and Korean nongifted students and by examining the relationship between scientific giftedness and thinking styles of Korean gifted science students.

The first major result was that the gifted students at the science high schools had higher scores than the general high school students in all factors: scientific ability, leadership, creativity, morality, motivation, and cognitive experimentalism.

According to Renzulli (1986), there aretwo types of gifted performance: schoolhouse giftedness and creative-productive giftedness. Schoolhouse giftedness is characterized by the ease of knowledge acquisition and test-taking proficiency as demonstrated by high grades and high test scores. In contrast, creative-productive giftedness involves generating new ideas and products designed to have an impact on a targeted audience or field. We found that the participants in this study tended to fall under the category of schoolhouse giftedness because they ranked in the 95th percentile or higher in their middle schools' achievement grade scale.

Typically, students in Korea tend to be more oriented to a product-centered educational context. School examinations require students to reproduce what they have been taught. Those students who prefer to carry out learning tasks by adhering to existing rules and procedures should exhibit more academic achievement. We argue that the first major result of this study shows that Korean gifted students tend to display not only schoolhouse giftedness, but also creative-productive giftedness, as they exhibited higher scores in factors including creativity and cognitive experimentalism on the Scientific Giftedness Inventory. In this inventory, creativity was defined as a characteristic of students who exhibit generating original ideas, and cognitive experimentalism was defined as a characteristic of students who explore new areas and are unwilling to follow existing rules and procedures.

The second major result showed that Korean gifted students prefer the legislative, judicial, global, and liberal thinking styles. Specifically, they are concerned with formulating ideas and creating rules, which mainly involves comparing and evaluating ideas, rules, and procedures. Furthermore, they can distinguish among preferences for problems at a relatively high level of abstraction. Also, they have individual preferences for tasks, projects, or situations that involve unfamiliarity and ambiguity and require going beyond existing rules and procedures, depending on the theory of mental self-government. By contrast, Korean nongifted students prefered the executive, oligarchic, and conservative thinking styles. They were concerned with carrying out plans and implementing rules initiated by others and dealing with multiple and often competing goals of equally perceived importance, and they preferred familiarity and situations and tasks that required adherence to existing rules.

Zhang (2002a, 2002b) has proposed that two types of thinking—Type I and Type II—based on her investigation of the relationship between thinking styles and modes of thinking and academic performance. According to her research, Type I thinking styles (e.g., legislative, judicial, global, liberal) imply ways of doing things that are creativity-generating and more complex. Type II thinking styles (e.g., executive, local, conservative) imply ways of doing things that are more norm-favoring and simplistic. Zhang (2000) and Zhang and Sternberg (2000) found that thinking styles that require more complexity (e.g., legislative, judicial, and liberal) are significantly and positively related to the Deep Approach scales in the Study Process Questionnaire (SPQ; Biggs, 1987, 1992), while thinking styles that require less complexity (e.g., executive and conservative) are significantly positively related to the Surface Approach scales.

In this study, we can interpret the participants' thinking styles in relation to Type I and Type II. The second major result indicates that Korean gifted students prefer the legislative, judicial, global, and liberal styles and thus correspond to Type I thinking styles. Gifted students tend to do things that are creativity-generating and more complex, and they use a deep learning approach. In contrast, Korean nongifted students prefered the executive, oligarchic, and conservative thinking styles, thus they tend toward Type II thinking styles. They do things that are more norm-favoring and simplistic, and they use a surface learning approach. Also, there are significant relationships between the holistic mode of thinking (i.e., processing information in a synthesized and intuitive manner) and Type I thinking styles. Comparatively, there is a significant relationship between the analytic mode of thinking (i.e., processing information in a piecemeal and logical manner) and Type II thinking styles (Zhang, 2002).

Our conclusions have implications for science instruction and curricula for gifted students. Gifted students can be more successful if they are allowed to pursue tasks that match their abilities and styles (Sternberg & Grigorenko, 1993). Other researches have indicated that learning in at least partially matched conditions is significantly superior to that in mismatched conditions (Grigorenko & Sternberg, 1997; Sternberg, Grigorenko, Ferrari, & Clinkenbeard, 1999). Enrichment that allows gifted students with a legislative style to do just what they want will

suit their style extremely well. On the other hand, students with an executive style will prosper in an accelerated course because they will learn more quickly when they work within a structure imposed by someone else (Sternberg & Grigorenko, 1993).

Thus, we propose that teachers of gifted students need to offer a curriculum, program, and instructional method best suited for the individual style of each gifted student. We suggest that an enrichment curriculum should be implemented that makes room for Korean gifted students who prefer the legislative thinking styles. Also, based on Sternberg's (1997) research, we recommend implementing the methods of instruction for gifted students in the following ways: For students who prefer legislative/judicial style, a thought-based questioning method is necessary. For students who prefer a legislative style, projects are suitable. And for students who prefer a judicial style, reading for analysis is advantageous.

The last major finding of this study—that there were 55 statistically significant positive or negative correlations among all compounding 78 correlations in the subscales of the TSI and SGI—is evidence that there is a relationship between thinking styles based on the theory of mental self-government (which, we argue, is a predominantly Western perspective) and scientific giftedness as it is defined from a Korean perspective using Shim and Kim's (2003) definition of Korean people's implicit concepts.

Therefore, this study has made several contributions. First, we have found that the Thinking Style Inventory and the Scientific Giftedness Inventory overlap in measuring the constructs among the characteristics of gifted science students.

Second, we found that scientific accomplishment, creativity, and cognitive experimentalism can all be predicted by judicial and liberal thinking style. It could be that gifted science students, who highly exhibit scientific accomplishment, creativity, and cognitive experimentalism, are used to employing the judicial and liberal thinking style. With regard to this conclusion, educators could cultivate creativity by allowing for the use of judicial and liberal thinking styles.

Third, affective domains such as leadership, morality, and motivation can all be predicted by the monarchic thinking style. This conclusion could be interpreted as follows: Korea's educational system is highly competitive in terms of assessing students' academic achievement and their performance on college entrance examination; consequently, monarchic-style gifted students who devote almost all of their energy and resources to their education exhibit the attributes of leadership, morality, and motivation.

There are several limitations to the findings of this study. First, the concept of scientific giftedness used was based on the responses to an open-ended question and self-report checklist, not actual demonstrated scientific accomplishment, leadership, motivation, morality, creativity, and cognitive experimentalism in science. Another limitation to the findings is a lack of information about teachers' teaching styles associated with scientific giftedness. This might have affected the findings regarding the relationship of scientific giftedness to various thinking styles. To be more specific, the effect of certain thinking styles might have been overshadowed by that of other thinking styles that are caused by the specific teaching style in which the research participants were taught. Also, the sample chosen was restricted to students in two science high schools in Korea. Other samples should be used in future attempts to replicate and extend the results of this study, for example, students from different gifted educational systems and other countries. Because this was the first investigation to examine thinking styles and scientific giftedness, further investigations are required to adequately specify the relationship between the two.

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## Author Note

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