Perceived Multiple Intelligences and Learning Preferences Among Chinese Gifted Students in Hong Kong

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This study examined the relationships between self-perceived multiple intelligences and five learning preferences among 604 Chinese gifted students in Hong Kong. These students perceived their strengths in interpersonal, intrapersonal, and verbal-linguistic intelligences and their weaknesses in bodily-kinesthetic and naturalist intelligences. They also indicated greater preferences in learning activities related to discussion, lecture, and peer teaching, followed by projects and simulations. In predicting the five learning preferences, personal intelligences generally emerged as common and significant predictors, suggesting that reflection and interpersonal skills contributed substantially to these learning activities. Students who reported having a greater number of learning preferences also gave themselves higher ratings on personal intelligences and verbal-linguistic intelligence. Implications of the findings in mapping learning preferences on multiple intelligences for teaching and learning are discussed.

Rather than subscribing exclusively to the notion of a general unitary intelligence that cuts across all areas of human competence to explain human performance, many psychologists and educators now tend to regard that each individual has specific strengths and weaknesses and can be conceptualized to have multiple abilities (see Karolyi, Ramos-Ford, & Gardner, 2003; Guilford, 1967; Sternberg, 1986, 1997, 2000). Gardner (1983, 1993, 1999a), in particular, conceptualized these abilities as intelligences and proposed in his theory of multiple intelligences (MI) that there are several kinds of intelligences, which may be affected by culture, biology, and other factors. So far, Gardner (1999a) has identified eight intelligences and is considering other candidate intelligences. The eight intelligences can be defined and summarized as follows. Verbal-linguistic intelligence represents the capacity to use words effectively, whether orally or in writing. Musical intelligence represents the capacity to perceive, dis-

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criminate, transform, and express musical forms. Logical-mathematical intelligence represents the capacity to use numbers effectively and to reason well. Visual-spatial intelligence is the ability to perceive the visual-spatial world accurately and to perform transformations on those perceptions. Bodily-kinesthetic intelligence includes the ability to use the body to express ideas and feelings and the facility in using one's hands to produce or transform things. Intrapersonal intelligence is the ability to act adaptively on the basis of self-knowledge. Interpersonal intelligence is the ability to understand and interact effectively with others. Naturalist intelligence represents the ability in observing patterns in nature, identifying and classifying objects, and understanding natural and human-made systems.

Since its first publication, MI theory has been embraced by educators who find the perspective useful in not only expanding their thinking about abilities but also their avenues for teaching (see Armstrong, 1994, 1999; Campbell, Campbell, & Dickinson, 2004; Kornhaber, Fierros, & Veenema, 2004). However, the theory has not gone unchallenged from scholars and researchers who not only questioned the independence of the eight intelligences but also whether these domain-specific intelligences should be called intelligences, casting doubts that some of these intelligences could be considered personality factors rather than abilities (e.g., Delisle, 1996; Gottfredson, 2003; White & Breen, 1998). Further, in applications, it is said that some enthusiastic teachers might have misused or misapplied MI theory. With a simplistic version, they might, for example, attempt to include all intelligences in every lesson, no matter how inappropriate (Gardner, 1999b). Thus, despite the claim that the MI approach to identifying and promoting talents in students could enhance students' learning, there are doubts and skepticisms as to the benefits of the MI approach in teaching and learning. Indeed, Klein (2002) has argued that MI theory is too broad as to inform teachers how to teach. He cited the example that knowing that playing basketball relies on bodily-kinesthetic intelligence does not inform the coach the skills that the players need to learn.

Recognizing the difficulties in putting MI theory into practice, Gardner (1991, 1999c) has devised the entry-points framework as a tool for developing curricula. In this framework, curricular units are divided into multiple entry points (narrative, logical-quantitative, esthetic, experiential, interpersonal, and existential/foundational) such that students are allowed to gain different perspectives on the same substantive topic with deepened understanding, facilitating the application and transfer of knowledge from one context to another. Because the entry points largely map onto different intelligences, different students having different profiles of multiple intelligences would be differentially engaged by pursuing specific entry points. Following the same line of reasoning in curriculum design, it would be of interest to extend this conceptualization into teaching and learning and map learning activities onto different intelligences.

In gifted education, MI theory has implications for identification, assessment and evaluation, and teaching and learning (Fasko, 2001). Specifically, MI theory enhances education practitioners' awareness of the needs of gifted students who might have uneven or asynchronous development across different abilities. In addition, MI theory also alerts educators that traditional classrooms might identify students with well-developed conventional intelligences (e.g., verbal-linguistic and logical-mathematical intelligences) as gifted, and might overlook and exclude students with well-developed intelligences not conventionally assessed from gifted service provisions. Indeed, MI theory has provided an alternative approach in identifying underrepresented and culturally diverse groups of gifted students for participation in gifted education programs (see Maker, Nielson, & Rogers, 1994; Sarouphim, 1999), and in curriculum design and teaching and learning through multiple entry points that map on different intelligences (Armstrong, 1994, 1999; Campbell et al., 2004).

In the development of gifted education in Hong Kong, educators, like their counterparts in Western societies, have gradually moved away from relying on a single IQ measure and have broadened the notion of giftedness to include different facets of giftedness and talents (see Hong Kong Education Commission, 1990; Hong Kong Education Department, 2000). Notably, MI theory appeals to Hong Kong educators as an alternative and useful approach in assessing and identifying giftedness in students and in teaching and learning that are in line with the Chinese educational ideals of promoting students' all-round development in the five domains of *de, zhi, ti, qun,* and *mei* (ethics, intellect, physique, social skills, and esthetics). In this connection, it was deemed necessary that efforts should be directed at putting MI theory into school practice through the development and use of measuring instruments to assess students' profiles of intelligences and through the development and implementation of curricula with multiple entry points, as well as learning activities that map on different intelligences (see Chan, 2000; Hong Kong Education Department).

In assessing students' profiles of intelligences, Chan (2001a, 2003) has developed the Student Multiple Intelligences Profile (SMIP), a self-report measure that focuses on gifted students' activities or preferences that reflect their self-perceived multiple abilities or intelligences. The original SMIP had seven scales that assessed the seven (except naturalist) intelligences of students. Chan (2001a) has reported that these scales had sound psychometric properties, including moderate internal consistency (Cronbach's α = .64 to .76) and significant correlations with external measures such as nonverbal reasoning (Raven, Raven, & Court, 1998) and leadership scores (Roets, 1997), in studies with Chinese gifted students. An exploratory item factor analysis based on 192 students suggested that the seven-factor orthogonal solution corresponding to the seven intelligences was an adequate representation of the data, although the confirmatory factor analysis with a correlated factor model yielded only mediocre to at best moderate fit with indices around .80. Thus, it is recognized that an ongoing effort to improve the scales needs to be emphasized. In the continuous process of scale development, a revised SMIP (SMIP-24) has been developed with slight rewriting of some of the original items and incorporating naturalist intelligence as an eighth scale. While MI theory generally supports the use of authentic assessment involving performance rather than self-report measures (see Chen & Gardner, 1997), it is also believed that this self-report measure could be of great value, as self-perception reflects gifted students' own recognition of their talents and could be their first step in talent development (see Albert, 1994; Treffinger & Feldhusen, 1996). Further, positive self-perceptions could impact on various aspects of students' school life, leading to positive social and emotional development (Colangelo, 2003; Neihart, 1999), and self-narratives could open space for new opportunities and therapeutic changes (White & Epston, 1990).

In promoting teaching and learning through the MI approach, Chan (2001b) has done some initial work on delineating the learning activities or styles of gifted students using the Learning Styles Inventory (LSI) by Renzulli and his colleagues (Renzulli & Smith, 1978; Renzulli, Smith, & Rizza, 1998). The development of LSI was based on the rationale that if students' learning activities or preferences could be identified and students were permitted to learn through the methods of their choice, their achievement, motivation, and interest in school subjects would be enhanced (see also Dunn, Beaudry, & Klavas, 1989; Griggs, 1984; Griggs & Dunn, 1984; Grigorenko & Sternberg, 1997). Some supporting evidence could be gleaned from the work of Renzulli and Reis (2003) on their Schoolwide Enrichment Model and Sternberg's (2002) work on teaching for successful intelligence to raise students' academic achievement. Specifically, LSI assesses students' preferences for nine teaching modes: Discussion, Drill-and-Recitation, Independent Study, Lecture, Peer Teaching, Programmed Instruction, Projects, Simulations, and Teaching Games. By assessing student preferences for teaching strategies, the concrete teacher-centered approach of LSI avoids analysis of underlying explanations for student learning preferences, and has the advantage of allowing teachers to translate student preferences readily into practice. In the MI framework, students' preferences for specific learning styles could be reinterpreted as the learning preferences that would engage their specific well-developed intelligences for enhanced and optimal learning.

In using LSI with Chinese gifted and nongifted students, Chan (2001b) identified three major dimensions of learning activities, which included a dimension of learning through verbal interactions that encompasses Discussion, Peer Teaching, and Lecture; a dimension of learning by role-play or Simulations; and a dimension of learning by doing or Projects. Based on the item factor analysis of the study, a shortened LSI-20 was subsequently developed by considering the substantive content of the items and by selecting the best 20 items that loaded saliently on the three factors. The resulting five scales are Discussion, Peer Teaching, Lecture, Simulations, and Projects, each being represented by four items. With five scales representing five learning preferences of Chinese gifted students, it would be of interest to map these learning preferences onto the specific intelligences. The explication of the relationship between learning preferences and multiple intelligences would allow teachers to infer students' profiles of intelligences from their learning preferences, or conversely, to predict their learning preferences based on the knowledge of students' profiles of intelligences.

Building on past studies on multiple intelligences (Chan, 2001a, 2003) and learning preferences (Chan, 2001b) with Chinese gifted students, this study aimed to examine the relationships between multiple intelligences and learning preferences in a sample of gifted students nominated by their schools to participate in university gifted programs. Students' perceived multiple intelligences were assessed by using the 24-item Chinese SMIP-24 (Chan, 2001a, 2003) and learning preferences were assessed by using the 20-item Chinese LSI-20, which yielded scores on eight intelligences, as well as five learning preferences that included Discussion, Peer Teaching, Lecture, Simulations, and Projects (Chan, 2001b). Specifically, this study examined students' perception of their eight intelligences and their five learning preferences, assessed the relationships between students' multiple intelligences and their learning preferences, and evaluated the extent to which learning preferences could be predicted by specific intelligences. Further, this study also explored whether students with specific learning preferences and students having a greater number of learning preferences could be characterized by specific profiles of intelligences.

Method

Participants

A total of 613 primary and secondary Chinese students were nominated by their schools to join different gifted programs provided at different times at the Chinese University of Hong Kong over a period of 8 months. About 98.5% of these nominated students participated voluntarily in this study. These 604 participants (321 boys and 283 girls) were in grades 4 to 12, and were aged 7 to 18 (M = 11.98, SD = 2.11). In nominating students, schools were requested to recommend students who were judged to be either gifted intellectually (e.g., with a high IQ score), academically (e.g., with outstanding performances in school subjects), or had demonstrated talents in other specific nonacademic areas such as in music, fine arts, and leadership. Because there were no generally accepted standard measures in Hong Kong schools and schools generally did not have access to information on specific IQ scores of students, teachers making recommendations would make their own judgment based on their knowledge of their students. In general, teachers always tended to recommend students with the best academic records in their schools. Nonetheless, this sample of participants could be regarded as relatively heterogeneous in terms of their giftedness or talents and represented students from a broad age range.

Measures

Student Multiple Intelligences Profile. The SMIP-24 is a 24-item checklist of characteristics and behaviors constructed to reflect students' self-perceptions of their abilities in terms of Gardner's (1999a) multiple intelligences. The original 21-item SMIP was designed to assess students' seven intelligences (three items for each intelligence), that is, verbal-linguistic, musical, logical-mathematical, visual-spatial, bodily-kinesthetic, intrapersonal, and interpersonal intelligences (Chan, 2001a). In the revised SMIP-24, three items have been added to incorporate the addition of naturalist intelligence (Chan, 2003). The SMIP has been used in studies with Chinese students and has demonstrated sound psychometric properties. The scales have achieved moderate internal consistency values with construct validation using item factor analysis (see Chan, 2001a, 2003). A more elaborate description of the development of SMIP, with the items of SMIP in the Chinese Pinyin version could be found in Chan (2001a).

In completing SMIP-24, respondents were requested to rate themselves on the 24 items using a five-point scale ranging from 1 (*least descriptive*) to 5 (*most descriptive*). SMIP-24 can be scored on eight scales that yield eight scores reflecting the eight intelligences.

Learning Styles Inventory. The LSI-20 employed in this study was the Chinese shortened version. The Chinese version was translated from the revised English version (Renzulli et al., 1998) and has been used with Chinese gifted and nongifted students (Chan, 2001b). A review of the psychometric properties of the original English version can be found in Hudak (1985). The shortened Chinese version was developed based on item factor analysis and substantive considerations (see Chan, 2001b). LSI-20 has five four-item scales: Discussion, Peer Teaching, Lecture, Simulations, and Projects. In completing LSI-20, respondents were requested to rate themselves on their preferences for learning activities by responding to the items using a five-point scale ranging from 1 (*least descriptive*) to 5 (*most descriptive*).

Procedure

All 604 nominated students who volunteered to participate with the consent of their parents in this research project were requested to come to the university campus for assessment on their self-perceived multiple intelligences and their learning preferences. These students were tested in groups of 80 to 100 using the Chinese SMIP-24 (Chan, 2001a, 2003) and the Chinese shortened LSI-20 (Chan, 2001b).

Results

To assess the profiles of multiple intelligences and the learning preferences of the 604 gifted students, the relevant item responses of these students to SMIP-24 and LSI-20 were first tabulated. Preliminary maximum likelihood exploratory factor analyses were separately conducted on the 24-item and the 20-item correlation matrices to check whether relevant items did fall appropriately into eight factors and five factors corresponding to eight intelligences and five learning preferences respectively. Regarding learning preferences, the initial estimation yielded five factors with eigenvalues exceeding unity, accounting for 65% of the total variance. The chi-square value computed for the evaluation of the lack of fit for the five-factor solution, χ^2 (100) = 201.03, p < .001, accounting for an estimated variance of 52%, suggested that a statistically adequate solution might require even more than five factors. Because the model would be rejected by the chi-square statistic at a conventional alpha level if a large enough sample was used (see Browne & Cudeck, 1993), it was deemed appropriate to accept the five-factor solution as an adequate representation of the five learning preferences based on substantive consideration, given that the relevant items of learning activities did fall nicely into the five factors of learning preferences. Thus, the relevant items of learning activities were scored to yield scores on five learning preferences.

Similarly, in the analysis conducted on SMIP-24, the initial estimation yielded seven factors with eigenvalues equal to or exceeding unity, accounting for 61% of the total variance. The chi-square value computed for the evaluation of the lack of fit for the seven-factor solution, χ^2 (129) = 266.42, p < .001, accounting for an estimated variance of 47%, suggested that a statistically adequate solution might require even more than seven factors. Substantively, the relevant items of multiple intelligences largely loaded saliently on the relevant factors, with the items of intrapersonal intelligence and those of interpersonal intelligences loaded saliently on the same factor. In addition, there were some irregularities showing that three items (one logical-mathematical, one visual-spatial, and one bodily-kinesthetic) did not have salient loadings on their respective factors. On the other hand, the eight-factor solution, χ^2 (112) = 211.42, p < .001, accounting for only a slight increase of an estimated variance of 48% over the seven-factor solution, yielded one factor with no salient loadings among the eight factors. On the basis of the present factor analysis using orthogonal factors and past factor analytic studies on SMIP-24 (Chan, 2001a, 2003, in press) that the two personal intelligences were generally found to be closely associated, it was deemed appropriate to score the relevant items on the eight scales of multiple intelligences.

Table 1 shows the means and standard deviations of students' ratings, as well as the internal consistency measures of the five scales of learning preferences and the eight scales of multiple intelligences. The eight scales of multiple intelligences had moderate internal consistency as reflected in the values of Cronbach's α (.52 to .77), whereas the five scales of learning preferences had slightly higher values (.65 to .85). The relatively modest internal-consistency values of these scales were understandable as the number of items in each scale was small, and each item in general was intended to cover a different aspect of the relevant construct. For example, in assessing bodily-kinesthetic intelligence, one item has to do with the agility of bodily movements, another item has to do with the preference in engaging in activities related to dance and gymnastics, and a third item has to do with the ease in manipulating and repairing things. Thus, it was expected that a broadband approach as used in these scales would yield modest internal consistency.

It can also be seen from Table 1 that students generally rated their personal (intrapersonal and interpersonal) and verbal-linguistic intelligences relatively higher than the other five intelligences, and they gave relatively lower ratings to their bodily-kinesthetic and naturalist intelligences. For learning preferences, they rated themselves higher in learning through verbal interactions (Discussion, Lecture, and Peer Teaching), followed by Projects, and lowest on Simulations. The mean scores thus suggested that students perceived relative strengths in different intelligences and indicated preferences in different learning activities. Support for the perception of differences could be gleaned from the two separate one-way within-subjects analyses of variance (ANOVAs), treating the eight scores of multiple intelligences and the five scores of learning preferences respectively as dependent measures. The results for multiple intelligences indicated that the overall differences among the eight scores were significant, Wilks' $\Lambda = 0.54$, $F(7, 597) = 73.95$, partial $\eta^2 = .46$, $p < .001$. Follow-up paired t-tests on the differences of all possible pairs of scores indicated that 21 out of the 28 pairs were significantly different from each other after controlling for familywise

Table 1
Means, Standard Deviations, and Internal Consistency of Measures of Multiple Intelligences and Learning Preferences of Gifted Students (N = 604)

	Number of Items	*M*	*SD*	Cronbach's α
Multiple Intelligences				
Verbal-linguistic	3	12.43	2.07	.57
Musical	3	12.15	2.60	.73
Logical-mathematical	3	12.13	2.14	.52
Visual-spatial	3	11.31	2.44	.61
Bodily-kinesthetic	3	10.99	2.41	.57
Intrapersonal	3	12.59	2.10	.74
Interpersonal	3	12.85	1.93	.74
Naturalist	3	11.11	2.84	.77
Learning Preferences				
Discussion	4	17.05	2.81	.83
Peer Teaching	4	15.83	2.74	.65
Lecture	4	16.47	3.02	.74
Simulations	4	14.35	4.19	.85
Projects	4	15.39	3.73	.81

Note. The multiple intelligences scales are scored in the range of 3 to 15. The learning styles scales are scored in the range of 4 to 20. α is the Cronbach's alpha internal consistency measure.

error rate across the 28 tests using the Bonferroni procedure, with t-values evaluated at .05/28 or .00179 level of significance. The results for learning preferences indicated that the overall differences among the five scores were also significant, Wilks' Λ = 0.63, F (4, 600) = 88.01, partial η^2 = .37, p < .001. Follow-up paired t-tests on the differences of all possible pairs of scores indicated that 10 out of the 10 pairs were significantly different from each other after controlling for familywise error rate across the five tests using the Bonferroni procedure, with t-values evaluated at .05/5 or .01 level of significance.

Learning Preferences and Multiple Intelligences

Table 2 presents the matrix of correlations computed to examine the relationships among the five learning preferences and the eight intelligences. The correlations of intelligence-preference pairs were all significant (r = .24 to .59, p < .001). The highest correlations were those between the five learning preferences and the personal (intrapersonal and interpersonal) intelligences (r = .38 to .59), and between the five learning preferences and the verbal-linguistic intelligence (r = .32 to .44). The lowest ones were those between the five learning preferences and musical intelligence (r = .24 to .32). The correlations between all pairs of multiple intelligences were also significant (p < .001). The two personal intelligences correlated most highly with each other (r = .68), and the lowest correlation was obtained between naturalist intelligence and musical intelligence (r = .17). The correlations between all pairs of learning preferences were also significant (p < .001). The highest correlation was between Lecture and Discussion (r = .60), and the lowest correlation was between Lecture and Simulations (r = .27).

To examine more closely how specific learning preferences were related to the eight intelligences, a series of multiple linear regression analyses were conducted. Specifically, separate sets of multiple regression analyses were performed to predict the five specific learning preferences. For each of the criterion measures, three sets of analyses were conducted. In the first set of regression analyses, gender and age were used as predictors (Set 1 predictors) to examine whether demographic variables could account for a substantial amount of variance in the criterion measures of learning preferences without invoking the predictors of multiple intelligences. The second set of analyses used two ordered sets of predictors, with Set 1 predictors entered first, followed by Set 2 predictors of the eight intelligences. The changes in R square and F were assessed to evaluate whether the Set 2 predictors of multiple intelligences predicted the criterion measures over and above the Set 1 predictors of demographic variables. The third set of analyses used all 10 predictors with the stepwise procedure to retain significant predictors. Table 3 summarizes the results of the regression analyses.

From Table 3, it can be seen that Set 1 predictors of gender and age did significantly predict all five learning preferences, though the amount of variance accounted for was relatively modest (.02 to .06). Gender emerged as the significant predictor for all five learning

Table 2
The Correlation Matrix of Multiple Intelligences and Learning Preferences (*N* = 604)

	Learning Preferences				
Intelligences	Discussion	Peer Teaching	Lecture	Simulations	Projects
Verbal-linguistic	.44	.34	.39	.41	.32
Musical	.29	.24	.25	.32	.25
Logical-mathematical	.38	.28	.33	.28	.32
Visual-spatial	.30	.30	.26	.35	.34
Bodily-kinesthetic	.36	.33	.24	.42	.36
Intrapersonal	.59	.42	.54	.38	.40
Interpersonal	.52	.41	.45	.38	.40
Naturalist	.31	.29	.31	.28	.33

Note. All correlations are significant, $p < .001$ (2-tailed).

preferences whereas age was a significant predictor in predicting Peer Teaching only, suggesting that girls preferred the five learning preferences more than boys did, and older students might appreciate more the contributions of peers in their learning than did younger students. The addition of Set 2 predictors of multiple intelligences to Set 1 predictors yielded better prediction than using Set 1 predictors alone and accounted for a significantly greater proportion of variance in all five learning preferences. Gender continued to emerge as a significant predictor for all five learning preferences and age as one for Peer Teaching. Age also emerged, in the context of the multiple intelligences predictors, as a significant predictor in the prediction of Projects and Lecture suggesting that these two learning preferences were preferred more by younger students.

Apart from the contribution of gender and age in the prediction of the five learning preferences, it can be seen from Table 3 that the five learning preferences were each predicted by slightly different sets of predictors of multiple intelligences. The stepwise analysis also provided a simplified picture by trimming and retaining significant predictors. Specifically, Discussion was preferred by students who rated themselves highly on conventional (logical-mathematical and

Table 3
Multiple Regression Analyses for the Prediction of Specific Learning Preferences Using Demographic Variables and Multiple Intelligences ($N = 604$)

Criterion	Analysis Set	R^2	Adjusted R^2	R^2 Change	F	F Change	Significant predictor	t
Discussion	1	.03	.03		10.53***		Gender	3.98***
	2	.43	.42	.39	44.10***	50.75***	Gender	2.20*
							Verbal-linguistic	3.04**
							Logical-mathematical	4.11***
							Intrapersonal	6.89***
							Interpersonal	3.18**
							Naturalist	2.86**
	3	.41	.41		104.11***		Intrapersonal	7.31***
							Logical-mathematical	4.56***
							Interpersonal	4.19***
							Verbal-linguistic	3.73***
Peer Teaching	1	.06	.06		19.73***		Gender	4.38***
							Age	3.87***
	2	.29	.28	.23	23.89***	23.46***	Gender	3.42***
							Age	3.47***
							Logical-mathematical	2.36*
							Bodily-kinesthetic	2.12*
							Intrapersonal	2.16*
							Interpersonal	2.56*
							Naturalist	3.46***
	3	.26	.25		42.14***		Intrapersonal	3.68***
							Naturalist	4.30***
							Interpersonal	3.42***
							Age	3.76***
							Bodily-kinesthetic	3.41***
Lecture	1	.03	.03		10.37***		Gender	4.47***
	2	.37	.36	.33	34.16***	38.80***	Gender	2.99**
							Age	-3.18**
							Verbal-linguistic	2.13*

							Logical-mathematical	3.87***
							Intrapersonal	7.14***
							Interpersonal	2.28*
							Naturalist	3.43***
	3	.34	.33		76.45***		Intrapersonal	11.14***
							Naturalist	4.00***
							Logical-mathematical	3.99***
							Gender	3.38***
Simulations	1	.02	.02		6.85***		Gender	3.70***
	2	.31	.30	.29	26.36***	30.56***	Gender	2.59**
							Verbal-linguistic	4.61***
							Bodily-kinesthetic	4.91***
							Naturalist	2.12*
	3	.28	.28		77.39***		Bodily-kinesthetic	7.26***
							Verbal-linguistic	6.45***
							Interpersonal	3.76***
Projects	1	.04	.04		11.82***		Gender	4.83***
	2	.30	.29	.26	25.02***	27.28***	Gender	4.38***
							Age	-2.27*
							Logical-mathematical	3.19***
							Visual-spatial	2.31*
							Bodily-kinesthetic	2.51*
							Intrapersonal	1.97*
							Interpersonal	2.32*
							Naturalist	3.61***
	3	.27	.27		45.13***		Intrapersonal	4.96***
							Naturalist	4.79***
							Bodily-kinesthetic	3.91***
							Gender	4.47***
							Logical-mathematical	3.62***

Note. Analysis 1 predictors are Set 1 predictors of Gender and Age, evaluated with $F\,(2, 601)$. Analysis 2 predictors are all Set 1 predictors and Set 2 predictors of 8 intelligences, with Set 1 predictors entered first followed by Set 2 predictors evaluated with $F\,(10, 593)$, and R^2 and F change are evaluated with $F\,(8, 593)$ after controlling for the effects of Set 1 predictors. Analysis 3 predictors are all predictors as in Analysis 2, but Analysis 3 follows a stepwise procedure for selecting the best predictors. Stepwise criteria are .001 or less as probability of F to enter and .005 or above as probability of F to remove.
$^*p < .05$; $^{**}p < .01$; $^{***}p < .001$.

verbal-linguistic) and personal (intrapersonal and interpersonal) intelligences, and thus tended to be reflective, sociable, articulate, and rational. Peer Teaching was preferred by students who tended to be reflective (intrapersonal), organized (naturalist), sociable (interpersonal), physically active (bodily-kinesthetic), and were more likely to be older in age. Lecture was preferred by students who tended to be reflective (intrapersonal), organized (naturalist), and rational (logical-mathematical), and who were more likely to be female. Simulations were preferred by students who tended to be physically active (bodily-kinesthetic), articulate (verbal-linguistic), and sociable (interpersonal). Projects were preferred by students who tended to be reflective (intrapersonal), organized (naturalist), rational (logical-mathematical), and physically active (bodily-kinesthetic), and who were more likely to be female.

The Multiple Intelligences Profiles of Students With Specific Learning Preferences

From a slightly different perspective, it was also of interest to explore whether the profiles of multiple intelligences were different for students who had a specific learning preference as opposed to students who did not have that specific learning preference. For the purpose of this study, students who scored above 16 on a specific learning preference were regarded as endorsing that specific learning preference. This criterion was in line with the criterion adopted using an average score of four in the original study (see Renzulli & Smith, 1978). Accordingly, students who indicated specific learning preferences of Discussion, Lecture, Projects, Peer Teaching, and Simulations were 61.6%, 54.5%, 44.5%, 42.5%, and 35.6%, respectively. Using learning preference (scored 16 or below vs. scored above 16) as a grouping variable and the eight intelligences as dependent measures, five separate MANOVAs were conducted. The results suggested that students who had a specific learning preference had significantly different multiple intelligences profiles from students who did not indicate such preference, as indicated by the significant preference main effects: Discussion (Wilks' $\Lambda = .71$, $F\,[8, 595] = 29.82$, partial $\eta^2 = .29$, $p < .001$), Lecture (Wilks' $\Lambda = .74$, $F\,[8, 595] = 26.62$, partial $\eta^2 = .26$, $p < .001$), Projects (Wilks' $\Lambda = .84$, F [8, 595] = 14.52, partial $\eta^2 = .16$, $p < .001$), Peer Teaching (Wilks' $\Lambda = .87$, F [8, 595] = 11.07, partial $\eta^2 = .13$, $p < .001$), and Simulations (Wilks' $\Lambda = .80$, F [8, 595] = 18.75, partial $\eta^2 = .20$, $p < .001$). Subsequent univariate ANOVAs on each of the eight intelligences were conducted as follow-up tests to the significant MANOVA main effect on preference separately for each of the five learning preferences. The evaluation of significant difference of each ANOVA was based on the Bonferroni procedure of adjusting for multiple tests at the value of .05/8 or .00625. The results indicated that, for all five learning preferences, students who indicated preference had significantly elevated profiles on all eight intelligences (higher scores on the eight intelligences) than had students who did not indicate such preference.

According to the present classification based on learning preferences, students might indicate preference on none of the learning preferences or one to five learning preferences. Indeed, the percentage of students indicating preference on zero, one, two, three, four, and five learning preferences were 18.0%, 14.6%, 19.5%, 18.2%, 17.7%, and 11.9%, respectively. To further clarify the differences between students who had no preferences or preferences on a small number (one to two) of learning activities and students who had preferences on three or more learning activities, a one-way MANOVA was conducted on the eight intelligences as dependent measures. The results indicated that these two groups of students differed significantly in their self-perceived multiple intelligences, Wilks' $\Lambda = .69$, F (8, 595) = 32.98, partial $\eta^2 = .31$, $p < .001$. Subsequent separate univariate ANOVAs on the eight intelligences were conducted as a follow-up test to the significant MANOVA results. Using the Bonferroni procedure to adjust for multiple tests, each ANOVA was evaluated at the level of .05/8 or .00625. The results indicated that these two groups of students differed significantly from each other on all eight intelligences ($p < .001$). The greatest differences with substantial effect size indices were in intrapersonal intelligence (partial $\eta^2 = .22$), interpersonal intelligence (partial $\eta^2 = .18$), and verbal-linguistic intelligence (partial $\eta^2 = .16$). Thus, students who had a greater number of learning preferences tended to have elevated profiles of intelligences especially in the two personal intelligences and verbal-linguistic intelligence. The profiles of intelligences of these two groups of students are summarized in Table 4.

Discussion

This study served to expand past findings on perceived multiple intelligences and those on learning preferences of Chinese gifted students in Hong Kong and sought to make connection between the two research traditions. In recent years, Gardner's MI theory has gained increasing acceptance among Hong Kong educators who regard the development of multiple intelligences as in line with the Chinese traditional educational ideals of nurturing children in five domains of ethics, intellect, physique, social skills, and esthetics (*de, zhi, ti, qun*, and *mei*), and as a way of educating the whole person to yield a balanced development in children (see Chan, 2000). While the five Chinese educational domains could not precisely map onto the eight intelligences, MI theory lends renewed support to the notion that it is important to adapt the current education system with its curricular overemphasis on verbal-linguistic and logical-mathematical intelligences to a system that aims to meet various individual differences in the development of multiple intelligences for better educational gains (Kornhaber, Krechevsky & Gardner, 1990; Walters & Gardner, 1986).

Despite the recognition that the MI approach could become a promising approach in Hong Kong school practice, the question remains as to how educators could make the approach more appealing to teachers without requiring them to deviate too much from their usual classroom teaching and learning activities. Very often, teachers are requested to assess and accommodate students' learning preferences in order that students' learning outcomes can be optimized. The assumption is that students will learn more easily and enjoyably when their learning preferences are accommodated in instructional strategies that are congruent with these preferences (see Renzulli & Smith, 1978; Renzulli et al., 1998). In this regard, the assessment of students' learning preferences or

Table 4
Profiles of Multiple Intelligences of Students With Less or Greater Number of Learning Preferences

	Less Number of Learning Preferences (n = 315)		Greater Number of Learning Preferences (n =289)			
Intelligences	*M*	*SD*	*M*	*SD*	F(1, 602)	Effect Size partial η^2
Verbal-linguistic	11.63	2.07	13.30	1.69	118.05*	.16
Musical	11.43	2.71	12.92	2.25	53.27*	.08
Logical-mathematical	11.52	2.24	12.80	1.81	58.32*	.09
Visual-spatial	10.65	2.46	12.02	2.21	51.92*	.08
Bodily-kinesthetic	10.24	2.31	11.80	2.25	70.37*	.11
Intrapersonal	11.66	2.14	13.61	1.50	164.49*	.22
Interpersonal	12.07	2.00	13.70	1.44	130.07*	.18
Naturalist	10.21	2.86	12.09	2.48	74.55*	.11

Note. Students with less number of learning preferences were students who reported two or less learning preferences; students with greater number of learning preferences were students who reported three or more learning preferences.
*p < .001.

corresponding teaching strategies, as well as the mapping of these learning preferences onto multiple intelligences, could be revealing to teachers and students. Thus, both assessment and mapping will help point out the variety of learning preferences within a classroom, alerting teachers to make use of a variety of instructional strategies to reach students with different profiles of intelligences and to use the more adaptive teaching strategies that have proved to be beneficial in engaging different intelligences of students for their optimal learning. Future studies could also aim to expand the repertoire of learning activities and mapping this expanded repertoire onto the multiple intelligences of students.

The findings in this study indicated that Chinese gifted students in this sample perceived their strengths in interpersonal, intrapersonal, and verbal-linguistic intelligences and their weaknesses in bodily-kinesthetic and naturalist intelligences. They also indicated greater preferences in learning activities related to verbal interactions (Discussion, Lecture, Peer Teaching), and their least preferred learning activities were related to Simulations. It was plausible that the opportunity for Simulations as a type of learning might be limited in Hong Kong classrooms. Nonetheless, this conjecture needs to be tested in future investigations. Further, the present findings also indicated that specific learning preferences could be associated with specific intelligences. Students' well-developed intelligences could thus be meaningfully engaged through the assessment of students' learning preferences and accommodating these preferences with corresponding learning activities. For example, students who prefer discussion are likely to be those who have well-developed conventional (verbal-linguistic and logical-mathematical) and personal intelligences. On the other hand, students who prefer simulations are likely to be physically active (bodily-kinesthetic), articulate (verbal-linguistic), and sociable (interpersonal). Conversely, teachers who involve students in discussion may help engage students' conventional and personal intelligences, reinforcing these intelligences if they are well developed and strengthening these intelligences if they are less developed. In a similar vein, teachers using simulations as learning activities might help engage and develop students' different intelligences, especially bodily-kinesthetic, verbal-linguistic, and interpersonal intelligences. More importantly, the present findings also suggested that students with a greater number of learning preferences could be characterized by specific profiles of intelligences identified by high points in personal and verbal-linguistic intelligences. In summary, the assessment of students' profiles of multiple intelligences could be helpful in delineating their strengths, as well as weaknesses, and teachers who are sensitive to students' profiles of multiple intelligences could help students strengthen their well-developed and less developed intelligences through learning activities congruent with these intelligences. Future studies might focus on how congruent or incongruent learning activities with an individual student's profile of multiple intelligences could affect the student's learning and talent development.

This study certainly had many limitations. One obvious limitation, among many, was the representativeness of the present sample, as all students were nominated by teachers who, at least in this study, tended to nominate academically achieving students. Thus, it is not known to what extent this possible bias in sample selection might be reflected in students' profiles of multiple intelligences, their learning preferences, and the relationships between intelligences and learning preferences. While high achievers could have gifts and talents in different areas in addition to academic achievement, caution must be exercised in generalizing the present findings to the larger population of Chinese gifted students. Thus, the need for replication with more representative samples of Chinese gifted students should be emphasized in future studies.

Another important limitation of this study was the reliance on self-report measures for assessing students' multiple intelligences and learning preferences—the present measures inevitably assess only a small part of the total spectrum of students' abilities and learning preferences. Specifically, it can be argued that perceived multiple intelligences and learning preferences could be very different from "actual" multiple intelligences or learning styles, and it is not known to what extent the two would correspond. Accordingly, one should guard against the reification of these self-perceptions and avoid making unwarranted inferences beyond these self-perceptions. On the other hand, it can also be argued that using self-reports does have advantages. Students' views and reports on their own abilities and learning preferences should have more meaning for students, and students should have expert knowledge about themselves, their unique strengths, weaknesses, needs, and what learning activities would best suit them. Despite these possible advantages, the use of self-reports in the present study to assess both multiple intelligences and learning preferences of students also raised the issue of inflating the association between multiple intelligences and learning preferences because of common method variance. Indeed, it was possible that students who tended to rate themselves highly on multiple intelligences would also tend to give higher ratings on preferences for specific learning activities, yielding the findings that students with a greater number of learning preferences would have uniformly elevated profiles of multiple intelligences. With this view, and considering the complexity and multidimensionality of human abilities and students' possibly limited classroom exposure to different learning activities, the use of alternative assessment procedures, especially those involving observation and performance-based assessment, for identifying and evaluating students' abilities and strengths in multiple intelligences and learning preferences should be emphasized and explored in future studies (see Chen & Gardner, 1997; Sternberg & Grigorenko, 2002).

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