Achievement Goal Orientations, Learning Strategies and Mathematics Achievement: A Comparison of Chinese Miao and Han Students

Meng Guo and Frederick K.S. Leung

Teacher Education and Learning Leadership Unit, Faculty of Education, The University of Hong Kong, Hong Kong, China

Author Note

Meng Guo https://orcid.org/0000-0002-5247-6241

Frederick K.S. Leung https://orcid.org/0000-0003-1725-3883

Correspondence concerning this article should be addressed to Frederick K. S. Leung, Faculty of Education, Room 312, Runme Shaw Building, The University of Hong Kong, Pokfulam Road, 999077, Hong Kong, China. Email: frederickleung@hku.hk

Abstract

This study compared the relationships between the goal orientations, learning strategies and mathematics achievement of Chinese Miao and Han students. A total of 211 Han and 321 Miao fifth and sixth grade students from Qiandongnan participated in the study. The results suggest that, in both samples, mastery orientation positively predicted the use of surface/deep learning strategies and mathematics achievement, and that performance-approach orientation significantly predicted the use of surface strategies. Ethnic differences were also detected. The positive relationship of the performance-approach orientation to deep strategies was stronger among the Han than the Miao students. Overall, our findings confirm that goal orientations have an important influence on Chinese students' strategy use and achievement, and that ethnic differences affect the patterns of these relationships. Possible explanations for the results and the practical implications for school practitioners are discussed.

Keywords: cross-ethnic comparison; goal orientations; learning strategies

Achievement goal orientations refer to the purposes and reasons that motivate students to engage in learning activities (Ames, 1992), mainly including mastery, performance-approach, and performance-avoidance goal orientations (Elliot & Church, 1997). The important role of goal orientations in students' learning processes has been well documented in previous studies (Chen & Wong, 2015; Hulleman et al. 2010; Kaplan & Maehr, 2007; Wolters, 2004). In recent decades, researchers have increasingly shown interest in Asian students' goal orientations and cognitive processes (Chan & Lai, 2008; Chen, 2015; Chen & Wong, 2015; Lau & Lee, 2008), due to their outstanding achievement in recent large-scale international assessments, such as the Trends in International Mathematics and Science Study (Mullis et al., 2016) and Programme for International Student Assessment (OECD, 2016). However, previous relevant research on goal theory was mainly Western-oriented, with the relationship between goal orientations, learning strategies, and mathematics achievement in non-Western contexts, especially in mainland China, not being sufficiently studied.

Previous studies have pointed that goal orientations may not function in the same way in Chinese contexts as it does in Western countries (Ho & Hau, 2008; King et al., 2012; King & McInerney, 2019). For example, in Chinese contexts, performance-approach goals always have positive correlations with mastery goals (Chen & Wong, 2015; Ho & Hau, 2008; King et al., 2012; Lau & Lee, 2008), while their relationship is not consistent in Western studies. Some researchers explain this phenomenon from a social-cultural perspective (King et al., 2012); due to China's traditional Confucian culture and exam-oriented educational environments, Chinese students tend to meet parents' expectations by working hard to master knowledge and pursuing high scores in school examinations (Tao & Hong, 2014), which may let them adopt mastery and performance goals simultaneously.

Some researchers moved beyond cross-national comparisons of goal orientations to focus on ethnic differences within countries (D'Lima et al., 2014; Hau & Ho, 2008; McInerney, 2008; Wilson et al., 2014; Zusho et al., 2005). For instance, D'Lima et al. (2014) compared students' goal orientations across American ethnic groups (Caucasian, African, Latino/Hispanic, and Asian) and found Caucasian students adopted lower performance-approach and performance-avoidance orientations by the end of the semester than did Asian-American and African-American students. Notably, previous cross-ethnic comparisons have mainly focused on Western contexts (McInerney, 2008; Wilson et al., 2014), with surprisingly few studies exploring potential ethnic differences in goal orientations in Asian contexts, especially in mainland China. To fill this research gap, this study examines the relationships of goal orientations to students' learning strategies and mathematics achievement in the Chinese context and compares the patterns of the relationships across Chinese ethnic groups.

Literature Review

Goal Orientations, Learning Strategies and Achievement

Achievement goal orientations were originally divided into two categories: mastery and performance goal orientations (Ames, 1992; Elliot & Church, 1997). In recent decades, the performance goal category was further separated into the performance-approach and performance-avoidance orientations (Elliot & Church, 1997). Mastery goal orientation refers to students who engage in learning to understand the subjects and develop their ability (Elliot & Church, 1997; Kaplan & Maehr, 2007). In contrast, students with a performance-approach goal orientation focus on proving their capacity and performing better than others, whereas those with a performance-avoidance goal orientation seek to avoid appearing incompetent (Elliot & Church, 1997; Pintrich et al., 2003). Based on these distinctions, researchers have divided mastery goal orientation into two categories (mastery-approach and mastery-avoidance) and proposed a 2 × 2 achievement goal framework (Elliot & McGregor, 2001). As mastery-avoidance goal orientation seems less common among young people than the other three orientations (Elliot, 2005), this study did not include it and adopted the three-component framework (mastery, performance-approach, and performance-avoidance goal orientations) widely used in the literature (Chen, 2015; Chen & Wong, 2015; Payne et al., 2007; Wolters, 2004).

An important hypothesis in goal theory is that goal orientations have significant effects on students' use of learning strategies (Liem et al., 2008; Wolters, 2004). Studies have identified two main types of learning strategies: deep strategies (i.e., relating to previous knowledge and exploring the patterns among different sources of information; Biggs et al., 2001) and surface strategies (i.e., repeated rehearsals and memorization; Biggs et al., 2001). Research has shown that deep strategies generally contribute to academic success (Chan et al., 2012). However, the effects of surface strategies seem less consistent in the literature. In Western studies, surface strategies always lead to maladaptive results (e.g., low achievement; Diseth, 2011; Murayama et al., 2013), but this negative effect is not necessarily found in Asian contexts (Chan et al., 2005; Chan & Lai, 2008). A possible reason for this is that East Asians frequently combine memorization with understanding and link repeated practice with meaningful variations, which may reduce the negative influence of surface strategies (Ho & Lau, 2008; Leung, 2001).

Previous studies have consistently found that students with high mastery orientation were more inclined to adopt deep strategies in the learning process (Chan & Lai, 2008; Elliot & McGregor, 2001; King et al., 2012). However, the effect of mastery orientation on surface strategies is not clear, with the effect being positive in some studies (Ho & Hau, 2008; Jiang & Liu, 2005; Liem et al., 2008) but negative or null in others (Diseth, 2011; King et al., 2012; Sins et al., 2008). The varied results might be related to students' views on surface strategies.

Al-Emadi (2001) suggested that mastery goals may positively predict surface strategies if the students think these strategies will help them master new knowledge. In contrast, if the surface strategies are regarded as useless or detrimental to understanding the material, the relationship of mastery goals to surface strategies might be null or negative.

Although some studies have found that mastery goals decrease Hong Kong students' use of surface strategies (Chan & Lai, 2008; King et al., 2012), caution is needed when drawing conclusions, due to Chinese people's positive views on surface strategies (Leung, 2001). Specifically, given that Chinese people generally believe surface strategies can contribute to desirable learning outcomes (Leung, 2001), they are likely to use such strategies to achieve mastery goals. This positive relationship is supported by Jiang and Liu's (2005) study in mainland China. The inconsistent results in Chinese contexts call for more investigation.

Researchers have found that the pursuit of the performance-approach and performance-avoidance goals leads to more frequent use of surface strategies (Chan et al., 2012; Chan & Lai, 2008; Elliot & McGregor, 2001). However, the relationship between performance-approach goal orientation and deep strategies remains inconclusive in the literature. Different from most Western findings (Elliot & McGregor, 2001; Wolters, 2004), some researchers have identified that performance-approach goals positively predict students' use of deep strategies in Chinese contexts (Chan et al., 2005; Jiang & Liu, 2005; King et al., 2012). For example, in a study of 697 Hong Kong secondary students, King et al. (2012) found students' performance goals had a positive relationship with their use of deep strategies. This suggests that, if Hong Kong students wanted to demonstrate their ability or surpass other students, they tended to do so by increasing their understanding of and elaborating on learning materials.

Studies have demonstrated that goal orientations have influence on students' academic achievement by shaping their learning strategies (Chan et al., 2012; Zhou et al., 2010). For instance, in a study of 1381 Hong Kong students, Chan et al. (2012) found that the students' mastery goal orientation positively affected their deep learning strategies and further contributed to their academic success. Similarly, Zhou et al. (2010) surveyed 667 Chinese college students and found both a direct effect of mastery goals on performance and an indirect effect of mastery and performance goals on their achievement, via strategy use. Based on these findings, in this study, learning strategies are expected to play a mediating role in the relationship between goal orientations and students' achievement.

Cross-cultural Differences in Goal Theory

Culture has been found to significantly affect students' achievement motivation, cognition, and academic performance (Hu et al., 2018; King & McInerney, 2016; Leung, 2006; Salili & Lai, 2003; Urdan & Bruchmann, 2018; Zusho & Clayton, 2011). Accordingly, the role played by achievement goal orientations may vary across cultural-ethnic groups (Hau & Ho, 2008). Therefore, researchers have suggested extending goal theory by applying it to various cultural settings and ethnic groups (Harackiewicz & Linnenbrink, 2005; Hau & Ho, 2008; Lau & Lee, 2008; Pintrich, 2003; Urdan, 2004; Urdan & Bruchmann, 2018).

Previous studies have indicated that Western findings on goal theory may not be fully generalizable to Asian contexts (Hau & Ho, 2008; King, 2016; King et al., 2012). For instance, performance-avoidance goal orientation is consistently regarded as a maladaptive motivation in Western contexts but does not necessarily lead to negative outcomes in Asian contexts (King, 2016). In addition, the relationship of mastery orientation to surface strategy use may also vary in Asian and Western contexts, due to their different views on surface strategies. As mentioned before, Asian people, especially Chinese, believe surface learning strategies can lead to understanding and mastery (Leung, 2006), while Westerners regard it as "rote learning" (Leung, 2001). Thus, it is possible that Chinese students may more often adopt surface strategies in pursuit of mastery goals than do their Western counterparts.

Ethnic differences were also found in the relationship between goal orientations and students' learning (D'Lima et al., 2014; McInerney, 2008; Zusho et al., 2005). For instance, Meissel and Rubie-Davies (2015) compared students' achievement goals across four ethnic groups in New Zealand and found New Zealand European students adopted fewer mastery, performance-approach, and performance-avoidance goals than did New Zealand Asian, Māori, and Pasifika students. Zusho et al. (2005) investigated Asian-American and Anglo-American students' achievement goals in mathematics learning and found Asian-American students had higher achievement, anxiety, and performance-avoidance orientation than their Anglo-American counterparts. These studies suggest that, even within the same country, different ethnic backgrounds may affect students' achievement goals and learning outcomes (Hau & Ho, 2008). However, cross-ethnic studies in goal theory have mainly been conducted in Western countries, like Australia (McInerney, 2008), New Zealand (Meissel & Rubie-Davies, 2015) and America (D'Lima et al., 2014; Zusho et al., 2005); less is known about the internal similarities and differences across ethnic groups within Asian countries, especially China.

The Present Study

The literature provides important evidence supporting the significant effects of goal orientations on strategy use and academic achievement in a Chinese context (Chan & Lai, 2008; King et al., 2012; Lau & Lee, 2008). However, the pattern of the relationships is not consistent, especially for the relationships between mastery orientation and surface strategies and between performance-approach orientation and deep strategies (Chan & Lai, 2008; Chan et al., 2012; Jiang & Liu, 2005; King et al., 2012; Lau & Lee, 2008; Zhou et al., 2010). Thus, further research is needed to clarify how Chinese students' goal orientations shape their strategy use and mathematics achievement. Moreover, to the best of our knowledge, due to the high proportion of Han population (about 91.60% in 2010; National Bureau of Statistics of China, 2012) in China, previous studies on goal theory in Chinese contexts have mainly focused on Han samples; thus, it remains unclear whether their findings are generalizable to other Chinese ethnic groups. To understand the potential ethnic differences and extend the complexity and cultural diversity of goal theory in Chinese settings, comparative studies across Chinese ethnic groups are required.

This study selected Han and Miao groups to represent China's majority group and one minority group, respectively. The Han population of roughly 1.221 billion accounted for about 91.60% of Chinese people in 2010 (National Bureau of Statistics of China, 2012). Confucian philosophy, mainly developed by the ancient Han, has had a profound influence on the behaviours and values of all Chinese people, especially the Han (Yao, 2000). Coupled with the impact of imperial examinations in ancient China, the Han people especially value achievement, effort, surface/deep strategies (Leung, 2001) and competition (King et al., 2012; Watkins, 2009) in learning processes. The Miao, also called the Hmong, are distributed throughout China, Southeast Asian countries (e.g., Laos and Vietnam), and some Western countries (e.g., America, Australia, and France). The Miao are China's fourth largest minority group, with a 2010 population of 9,426,007, or about 0.71% of China's total population (National Bureau of Statistics of China, 2012). Like the Han, the Miao are seen as collectivist and as placing a high value on family responsibility and education (Lee, 2001). However, some potential differences may exist between Miao and Han groups, due to their different histories and ethnic traditions. For instance, the ancient Miao people mainly lived in mountain or highland areas; in such environments, they had to rely greatly on cooperative work for their survival. Thus, Miao people may place more emphasis on cooperation in learning than on competition (Chiang, 2000; Hvitfeldt, 1986; Timm et al., 1998). Therefore, it is possible that the Han may hold more positive views on competition than do the Miao, which may make performance-approach goals more adaptive for Han students. To clarify the potential ethnic differences in goal orientations between the Miao and Han, more investigation is needed.

Understanding Miao and Han students' motivation and cognition in mathematics learning is very important for educational practice, especially in mixed Miao/Han areas in China (such as the Qiandongnan Miao and Dong autonomous prefecture in Guizhou province), where Miao and Han students learn together in schools. Notably, as Miao (Hmong) and Han groups are also located outside China, studies on their mathematics learning might be also valuable for educational practitioners around the world (Vang, 2005), especially those working in Hmong and Chinese communities. More specifically, these studies can help them better understand how goal orientations affect Miao and Han students' cognition and mathematics performance and whether there are cross-ethnic differences in the groups' learning processes. This information can guide teachers to, with the help of school administrators and psychologists, optimise teaching strategies and offer targeted support for students with different ethnic backgrounds, to increase their adaptive goal orientations and cognitive engagement in mathematics learning.

Therefore, given the lack of cross-ethnic comparisons on goal orientations in China and its important implications for school practitioners, this study compares the relationship of goal orientations to learning strategies and mathematics achievement between Chinese Miao and Han students. Based on the theoretical assumptions of goal theory and the relevant literature, we expect students' uses of learning strategies to be influenced by their goal orientations, which are in turn expected to contribute to their mathematics achievement (see Figure 1). Specifically, we hypothesise that, in both the Miao and Han samples, mastery goal orientation will positively predict the use of deep strategies; performance goal orientations will be positively linked to surface strategies; and deep strategies will be positively related to mathematics achievement. As for ethnic differences, we expect the performance-approach orientation may be more adaptive in the Han group.

Research Methods

Participants

The participants in this study were 532 Chinese fifth and sixth grade Miao and Han students from two primary schools in Qiandongnan, in Guizhou province. The Miao sample (n=321) included 139 girls and 182 boys, with an average age of 11.02 years (SD =1.06). There were 95 girls and 115 boys in the Han sample (n=211); their average age was 10.89 years (SD = .98). One Han student did not supply gender information.

Measures

The students' background information, including their gender and parents' highest educational level, was collected via self-reporting. This study used two five-point Likert scales: one a mathematics goal orientation scale, the other a mathematics learning strategy scale. The students were asked to indicate their level of agreement with each item on a scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Responses to questionnaires showed that all the measures in this study had acceptable internal reliabilities (DeVellis, 2003), although the Cronbach's alpha values were slightly low for the surface strategy and performance-approach orientation subscales in both the Miao and Han samples (see Table 1). Low reliabilities for the two subscales have also been obtained in many previous studies. For example, King et al. (2012) found the Cronbach's alpha value for surface strategies was .62 among Hong Kong students. Roeser et al. (1996) found the Cronbach's alpha reliabilities for performance-approach orientation were relatively high for eighth grade students (.84), but lower for younger (sixth grade) students (.62). Thus, the low average age of our sample might be one reason for the somewhat low alpha values. Notably, although the reliabilities of the two subscales were slightly low, they all met or exceeded the lowest acceptable standards (i.e., greater than .60; DeVellis, 2003), and were thus still used to measure students' adoption of surface strategy and performance-approach orientation in this study; however, caution should be used when discussing and explaining the results.

Mathematics Goal Orientation

To assess the students' goal orientations in mathematics learning, a 10-item scale was developed based on the Goal Orientation Scales (Midgleyet al., 1998). The original items were modified to focus on the subject of mathematics. Mastery goal orientation consisted of four items measuring students' emphasis on understanding new knowledge and preference for challenging tasks in mathematics learning (Miao: $\alpha = 0.82$; Han: $\alpha = 0.81$); a sample item is 'I learn mathematics to master new maths knowledge'. Performance-approach orientation was assessed by three items that focused on students' emphasis on demonstrating ability and performing better than others in mathematics activities (Miao: $\alpha = 0.66$; Han: $\alpha = 0.66$); a sample item is 'it is important for me to perform better in mathematics than other students'. Performance-avoidance orientation was assessed using three items (Miao: α=0.73; Han: α =0.79) that focused on students' avoidance of failure in mathematics learning (e.g., 'I try to learn maths so other people do not think I am stupid').

Mathematics Learning Strategy

The scale used to measure students' mathematics learning strategies was developed based on the Motivational Strategies for Learning Questionnaire (Pintrich & DeGroot, 1990) and the revised Learning Process Questionnaire (Biggs et al., 2001), and included two subscales: deep strategies and surface strategies. The first subscale consisted of five items assessing students' use of deep strategies in mathematics activities (Miao: $\alpha = 0.83$; Han: $\alpha = 0.80$); a sample item is 'I try to find the relationships between different concepts in maths learning'. The second subscale used three items to measure students' use of surface strategies in mathematics learning (Miao: $\alpha = 0.61$; Han: $\alpha = 0.61$); a sample item is 'I try to remember the answers and methods of the possible questions in maths examinations'.

Mathematics Achievement

Students' grades in their final examinations were used to assess their mathematics achievement. Per Qiandongnan's educational assessment standards, students' possible grades range from 0 to 100, with a minimum of 60 needed to pass.

Data Analysis

After replacing the missing data using the expectation-maximisation algorithm (Little & Rubin, 2002), the descriptive statistics, *t*-test, and bivariate analysis results were collected to provide preliminary information. In the main analysis, structural equation models (SEM) were used to explore the relationships between the goal orientations, learning strategies, and mathematics achievement of the Miao and Han students, followed by a multi-group SEM to compare the relationships between the two groups. The parameters in the SEM models were estimated by the maximum likelihood method, using AMOS software (Version 25.0).

Results

Descriptive Statistics and Bivariate Analysis

In both samples, the students were more likely to use a mastery goal orientation than a performance-approach or -avoidance goal orientation. Deep and surface strategies were frequently used by the Miao and Han students in our study (see Table 1). The results of the independent sample *t*-test showed no significant differences in goal orientations, learning strategies, and achievement between the two groups.

Table 1

The Means, Standard Deviations and Internal Consistency Coefficients for the Miao and Han Samples.

Variable	Miao			Han		
	M	SD	α	M	SD	α
Mas	3.67	.96	.82	3.79	.93	.81
Pap	2.74	1.02	.66	2.84	.99	.66
Pav	3.02	1.12	.73	2.94	1.17	.79
DS	3.57	.85	.83	3.67	.84	.80
SS	3.34	.95	.61	3.41	.99	.61
MA	69.29	17.97		71.70	18.27	
PE	2.67	1.01		2.69	.95	
SG	.43	.50		.45	.50	

Note. Mas = mastery goal orientation; Pap = performance-approach goal orientation; Pav = performance-avoidance goal orientation; DS = deep strategies; SS = surface strategies; MA = mathematical achievement; PE = parents' highest educational level; SG = student gender; M = means; SD = standard deviations; α = Cronbach's alpha coefficients.

The Pearson correlation coefficients between the studied variables in this study are presented in Table 2. In both samples, the correlations between the mastery and performance-approach orientations (Miao: $r = .20$, $p < .01$; Han: $r = .24$, $p < .01$), and between the performance-approach and performance-avoidance orientations (Miao: $r = .35$, $p < .01$; Han: $r = .44$, $p < .01$) were positive and significant, with mastery goal orientation being positively correlated with surface strategies (Miao: $r = .43$, $p < .01$; Han: $r = .38$, $p < .01$), deep strategies (Miao: $r = .54$, $p < .01$; Han: $r = .52$, $p < .01$) and mathematics achievement (Miao: $r = .38$, $p < .01$; Han: $r = .25$, $p < .01$). The two types of performance goal orientations had significant and positive correlations with surface strategies. Deep strategies were positively correlated with the Miao ($r = .27$, $p < .01$) and Han ($r = .27$, $p < .01$) students' mathematics achievement. In terms of ethnic differences, the positive correlation between performance-approach orientation and deep strategies was significant for the Han (r = .23, p < .01) but not the Miao (r = .09, r > .05) students. Surface strategies were only significantly correlated with the Miao students' mathematics achievement (r = .13, p < .05). The bivariate correlations showed that the two covariates were significantly correlated with some measurement variables. Thus, gender and parents' highest educational level were both controlled in subsequent analyses.

Table 2

Bivariate Correlations for the Miao and Han Samples.

	Mas	Pap	Pav	DS	SS	MA	PE	SG
Mas	1	.24**	.09	.52**	.38**	.25**	-.03	.17*
Pap	.20**	1	.44**	.23**	.26**	-.04	-.11	-.13
Pav	-.05	.35**	1	.02	.11	-.14*	-.10	-.06
DS	.54**	.09	-.04	1	.45**	.27**	-.01	.09
SS	.43**	.35**	.17**	.46**	1	.05	.01	-.07
MA	.38**	.06	-.08	.27**	.13*	1	.04	.17*
PE	.11	-.06	-.18**	.08	-.01	.09	1	-.03
SG	.05	-.10	-.09	-.00	-.03	.10	.13*	1

Note. The correlations above the diagonal are for the Han sample, and correlations below the diagonal are for the Miao sample; Mas = mastery goal orientation; Pap = performance-approach goal orientation; Pav = performance-avoidance goal orientation; DS = deep strategies; SS = surface strategies; MA = mathematical achievement; PE = parents' highest educational level; SG = student gender.

$^{*}p < .05$. $^{**}p < .01$.

Separate SEMs for the Miao and Han Samples

The normality of all variables (including scale items, maths achievement, and covariates) were first checked based on the standards proposed by Finney and DiStefano (2006) ($|\text{skewness}| < 2$, $|\text{kurtosis}| < 7$). The results showed that both the Miao (skewness: -.802 to .380; kurtosis: -1.938 to -.004) and Han (skewness: -1.030 to .517; kurtosis: -1.978 to .850) samples had satisfactory normality for the maximum likelihood estimation.

The model fit was assessed based on chi-square ratio (χ^2/df), goodness of fit index (GFI), comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA), with χ^2/df< 2, RMSEA < .06, GFI > .90, CFI > .90 and TLI > .90, indicating adequate model fit (Byrne, 2001). As χ^2 is sensitive to sample size, it was not used to assess the individual models in this study.

The tests on the hypothesised model revealed good fit indices for the Miao sample: $\chi^2(df = 164, N = 321)$ =235.670, p<.001;χ^2/df= 1.437, GFI = .935, CFI = .961, TLI = .951 and RMSEA = .037, with 90% confidence intervals of .026 to .047. The Han model also showed acceptable model fit, with $\chi^2(df = 164, N = 211) =$ 227.072, p < .001;χ^2/df= 1.385, GFI = .908, CFI = .947, TLI = .932 and RMSEA = .043 (90% confidence intervals of .028 to .056). The Miao and Han models explained 18% and 17% of the variance in the students' mathematics achievement, respectively. The factor loadings of the items were all more than .47 and were significant at the .001 level in both samples. The significant paths in the Han and Miao models are displayed in Figures 2 and 3, respectively.

As expected, in both samples, mastery goal orientation served as a positive predictor of students' use of deep strategies(Miao: $\beta = .66.,\text{p} < .001$; Han: $\beta = .57, \text{p} < .001$) and mathematics achievement (Miao: $\beta = .38.,\text{p} < .001$; Han: $\beta = .22, \text{p} < .05$), and performance-approach orientation was positively linked to surface strategies (Miao: $\beta =$

.30, $p < .01$; Han : $\beta = .35, p < .05$). Notably, students' use of surface strategies was positively predicted by mastery orientation (Miao: $\beta = .51.$, $p < .001$; Han: $\beta = .48, p < .001$). Some differences were also identified in the Miao and Han models. The positive and significant link between performance-approach goal orientation and deep strategies was only found in the Han sample ($\beta = .24, p < .05$); moreover, deep strategies significantly predicted the Han ($\beta = .32, p < .05$) but not the Miao ($\beta = .12, p > .05$) students' mathematics achievement.

Multi-group SEM

The aim of the multi-group SEM in this study was to compare the effect sizes of the paths in the Miao and Han models. To maintain the comparability of the path coefficients, the factorial invariance between the two samples was first examined (Byrne, 2001). Two nested models – the baseline model (unconstrained model) and measurement model (factor loading invariance model) – were compared. In the baseline model, all parameters were freely estimated, whereas the measurement model fixed the factor loadings between the Miao and Han samples. In this study, chi-square difference ($\Delta\chi^2$) and difference in the degree of freedom (Δdf) were used to assess the differences in model fit between the nested models, with a significant $\Delta\chi^2(\Delta df)$ indicating a significant change in the model fit (Byrne, 2001).

The results indicated that the baseline model had good fit with the data $\chi^2(df = 328, N = 532)$= 462.814, $p < .001$; CFI = .956, TLI = .943 and RMSEA = .028 (90% confidence interval: .022 to .034). No significant differences were found between the baseline model and the measurement model ($\Delta\chi^2(N = 532) = 9.636$, $\Delta df = 13$, $p > .05$), indicating that the model structure and factor loadings were invariant across the Miao and Han samples.

After establishing the factorial invariance, we tested whether the structural paths were equivalent between the Miao and Han samples. Only the significant paths in the Miao and Han models, labelled P1 to P6 (see Figure 2), were compared. Byrne (2001) indicated that differences in the structural paths across groups can be tested by comparing the model fit between an unconstrained model and a path-constrained model. Thus, based on the measurement model, we constrained the six paths between the Miao and Han samples and compared their model fit indices with the measurement model (see Table 3). Significant differences were only identified between the constrained model P4 (fixed path from students' performance-approach orientation to deep strategies) and the measurement model ($\Delta\chi^2(N=$ 532) = 5.719, $\Delta df = 1$,p = .017). This suggests that performance-approach goal orientation had a significantly stronger positive relationship with the deep strategies of the Han students than with those of the Miao students.

Table 3

Multi-group SEM Results.

Models	$\chi^2(df)$	χ^2/df	RMSEA (90%CI)	CFI	TLI	$\Delta\chi^2(\Delta df)$
Baseline model	462.814 (328)	1.411	.028(.022,.034)	.956	.943	
Measurement model	472.449 (341)	1.385	.027(.021,.033)	.957	.947	9.636 (13)
Constrain P1	473.416 (342)	1.384	.027(.021,.033)	.957	.947	.996 (1)
Constrain P2	472.904 (342)	1.383	.027(.021,.033)	.957	.947	.454 (1)
Constrain P3	472.452 (342)	1.381	.027(.021,.033)	.957	.947	.002 (1)
Constrain P4	478.168 (342)	1.398	.027(.021,.033)	.955	.945	5.719 (1)*
Constrain P5	472.578 (342)	1.382	.027(.021,.033)	.957	.947	.129 (1)

Constrain P6	473.702 (342)	1.385	.027(.021,.033)	.957	.947	1.252 (1)

Note. P1 to P6 represent the constrained paths (see Figure 2); $\chi^2(df) =$ chi-square (degree of freedom); $\chi^2/df =$ chi-square ratio; RMSEA = the root-mean-square error of approximation; CFI = comparative fit index; TLI = the Tucker-Lewis index; $\Delta\chi^2(\Delta df) =$ chi-square difference (difference in degree of freedom).

$^*p < .05$.

Discussion

This study examined the relationships between the goal orientations, learning strategies, and mathematics achievement of students in mainland China, and explored whether these relationships differed between Miao and Han Chinese. Our results revealed the important role of goal orientations in Chinese students' mathematics learning and found both similarities and differences in the patterns of the relationships in the Miao and Han groups.

Overall, the relationships between the goal orientations, learning strategies, and mathematics achievement were similar in the two Chinese ethnic groups. The findings of this study show that for both samples, mastery goal orientation was positively related to students' deep strategies and achievement, meaning students who aimed to master knowledge always had better mathematics performance and tended to use organizational methods (e.g., relating new concepts with learned knowledge and useful examples) in their learning processes. These positive relationships were also found by Zhou et al. (2010) in mainland China. Moreover, our results also show that, in line with the literature (Chan & Lai, 2008; Jiang & Liu, 2005), the performance-approach orientation enhanced both Miao and Han students' use of surface strategies.

Notably, in this study, mastery orientation was positively linked to students' use of surface strategies, in both samples. This result was also found in some previous studies in Chinese contexts (Ho & Hau, 2008; Jiang & Liu, 2005). For instance, in a study of 283 students in mainland China, Jiang and Liu (2005) found that students' mastery goals had positive correlations with their surface strategy use. Similarly, Ho and Hau (2008) also identified that students with high endorsement of mastery goals reported more adoption of surface strategies (i.e., memorization) in mathematics and English learning.

Influenced by Confucian culture, Han Chinese generally believe that surface strategies like memorization and repeated practice can lead to understanding (Cai, 2007; Leung, 2001). This is reflected in the ancient Chinese idiom, 'You can understand the book when you read it many times,' which informs both the Chinese educational wisdom of 'practice makes perfect' (Zhang et al., 2004) and the unique Chinese learning method of 'memorization with understanding' (Ho & Lau, 2008; Leung, 2001). In Miao culture, memorization has also played a critical role in the mastery of knowledge and preservation of cultural practices, as the Miao lacked a writing system until the early 1950s (Timm et al., 1998). Thus, both the Miao and Han people hold positive views of surface strategies, which may explain why students from both groups used surface strategies to achieve their mastery goals.

An alternative explanation is related to the Chinese mathematics curriculum, which places strong emphasis on basic knowledge and basic skills ('Two Basics'; Zhang et al., 2004). Thus, in Chinese educational practice, memorizing mathematics knowledge (e.g., definitions and formulas) and repeatedly practising mathematics skills (e.g., calculation) are regarded as necessary processes for developing a comprehensive understanding of mathematics (Zhang et al., 2004). In these learning settings, Miao and Han students may tend to internalise surface strategies and use them to master mathematics knowledge, which may have contributed to the positive relationships between surface strategies and mastery orientation observed in both groups.

Ethnic differences were also found in the relationship between goal orientations and learning strategies. The results show that Han students' performance-approach goal orientation positively predicted deep strategies, which is consistent with some Chinese studies in which Han students were the main sample (Jiang & Liu, 2005; King et al., 2012); however, this was not significant in the Miao group. The results of the two-group SEM further documented that the positive linking was significantly stronger in the Han model than in the Miao model. In Han culture, deep strategies are regarded as necessary tools for fostering efficient learning (Leung, 2001; Tan, 2015). This is reflected in the *Analects*: 'Learning without *si* (thinking) leads to bewilderment; *si* (thinking) without learning leads to perilousness' (Analects, translated by Tan, 2015, p. 431). Mencius echoed this, saying, 'If you believe everything in the book without critical thinking, it would be better not to read.' In this cultural context, the Han people generally believe that deep thinking reflects a higher learning ability and may lead to better performance, and thus tend to use deep strategies to achieve performance-approach goals. However, as mentioned above, in Miao history, memorization appears to have been more important than deep strategies for preserving knowledge and culture, which may influence Miao parents to pay special attention to whether their children have precisely memorized knowledge and processes. Timm et al., (1998) found Hmong (Miao) parents tended to evaluate their children's performance based on process accuracy; thus, Miao students may tend to select surface strategies rather than deep strategies to demonstrate their learning competence to their parents, which may partly explain why Miao students' performance-approach orientation was only relevant to their surface strategies.

Another possible explanation is related to the groups' different views on competition. Han Chinese generally regard competition as an important means of promoting personal growth and acquiring educational/career success (Watkins, 2009). The basis of this value can be traced back to the ancient imperial examination system; beginning in the Sui Dynasty, ordinary people who wanted to better their social and economic status by entering the bureaucratic class had to complete highly competitive imperial examinations (Leung, 2008). In this social context, Han learners had to adapt to the competitive educational system to succeed, and gradually internalised the positive role of competition in the learning process. However, as the ancient Miao people mainly lived in high mountainous areas and seldom took part in imperial examinations, they might have been less affected by the competitive educational context. Cooperation seemed to have played a more important role in the lives of the ancient Miao people (e.g., for protecting clans and hunting), which may have affected the educational values of Miao parents. This is reflected in previous studies on Hmong (Miao) family education (Timm et al., 1998), which found that American Hmong (Miao) parents emphasised cooperation over competition in their children's learning. Taken together, Han students may value competition more than Miao students, for cultural and family education reasons. Given that performance goals were found to be more adaptive in environments with a positive view on competition (King et al., 2012), it is reasonable that the performance-approach orientation led to more positive outcomes (i.e., use of deep strategies) in the Han group.

Surprisingly, deep strategies failed to predict the Miao students' mathematics achievement, possibly because the positive influence of deep strategies on achievement might be not very immediate (Dupeyrat & Mariné, 2005). Another possibility is that some Miao students failed, due to a lack of proficiency and experience, to use deep strategies effectively, which may reduce the positive effects of these strategies on their mathematics performance. Thus, teachers are advised to offer Miao students more supports to improve their abilities and skills for using deep strategies.

Conclusions

This study examined the relationship of goal orientations to students' learning strategies and mathematics achievement in mainland China and compared the relationship between Miao and Han Chinese students. The results suggested that the patterns of the relationships in the Chinese setting were similar but not identical to those in Western contexts. More specifically, similar to Western studies, in both Chinese samples, mastery goal orientation positively predicted the students' use of deep strategies, and performance-approach goal orientation was positively linked to the use of surface strategies. However, different from most Western studies, this study identified strong positive relationships between mastery goal orientation and the use of surface strategies in both Chinese samples. The results also revealed some ethnic differences within China. In particular, performance-approach goal orientation had a more positive relationship with the deep strategies of the Han students than with those of the Miao students. Additionally, deep strategies only significantly predicted Han students' mathematics performance.

Taken together, the findings of this study make a substantive contribution to the literature on goal theory and mathematics education. First, our findings underscore the important role of goal orientations in predicting Chinese students' mathematics achievement and provide new evidence on the mediating role of students' learning strategies. Second, this study sheds light on cross-cultural/ethnic differences in China and contributes to the development of a more comprehensive understanding of Chinese learners' achievement motivation, mathematics cognition, and academic achievement. These differences highlight the influence of cultural values and ethnic traditions on outcomes relating to goal theory.

Limitations

Some limitations to this study should also be noted. First, given the internal reliabilities of surface strategies and performance-approach orientation were somewhat low, the findings of this study should be interpreted and generalized with caution. Future studies may consider revising the two subscales to increase their internal reliabilities in young samples. Second, this study only collected data on the Miao and Han students in two schools in Qiandongnan, using convenience sampling. Goal orientations may not function the same way for all Miao (or Han) students because of within-ethnicity variational factors, such as region, school, and family economic background. Thus, future studies should validate and generalize our findings by conducting larger-scale investigations in different Miao/Han regions. Third, this study only focused on two Chinese ethnic groups. To further examine the possible ethnic differences in goal theory, more comparative studies involving other different ethnic groups are needed.

Implications

Our results have important practical implications for teachers, school psychologists, administrators, and parents who hope to optimise students' motivation and cognitive process in mathematics learning, both within and outside of China. Consistent with Western findings, our results indicate the positive role of mastery goal orientation and deep strategy use in mathematics learning; thus, both Western and Chinese school administrators are advised to organise, with the help of school psychologists and experienced educators, teacher professional development or online workshops to introduce teaching methods that increase students' mastery goal orientation and use of deep strategies. Teachers are urged to create mastery-oriented learning environments (Wang & Rao, 2019) to attract students' interests and increase their endorsement of mastery goals by developing meaningful tasks, connecting mathematics knowledge with real-life situations, and encouraging self-discovery in mathematics learning. To optimise strategy use, teachers could introduce specific deep strategies using typical examples and guide students to practice them via a series of well-designed variation tasks (Gu et al., 2004; Margolis & McCabe, 2006). Training is also needed to guide parents to focus on their children's learning processes, rather than on just their test scores, and to encourage children to understand math knowledge instead of just memorizing it.

Given that ethnic differences were found in this study, Chinese educational officers and school administrators are advised to provide targeted training to increase teachers' awareness of how achievement motivations may operate differently in diverse ethnic groups. This is especially important for teachers who work with multi-ethnic student populations. Teachers could tailor their teaching methods and tasks to suit students, based on their motivations, cognitive preferences, and ethnic features (D'Lima et al., 2014). For example, as our results highlight the diverse relationship of performance-approach orientation to Miao and Han students' deep strategies, teachers are advised to treat this type of goal orientation cautiously. On the one hand, they could appropriately motivate Han students to set competence-based performance-approach goals and to utilise deep strategies to pursue them; on the other, they must also pay special attention to Miao (Hmong) students' needs and provide targeted assistance and constructive feedback to optimise the role of performance-approach orientation in their learning process. Our results also show that, different from the Han group, Miao students' deep strategies failed to significantly predict their achievement, reminding teachers of the need to pay closer attention to Miao students' strategy use. Teachers could assess Miao students' strategy use by questionnaire survey, classroom observation, and homework analysis. Then, based on the information gathered, teachers could offer purposeful support to deepen their understanding and proficiency of deep strategies.

Notably, ethnic differences in motivation and cognition between the Miao and Han are also useful for school practitioners outside China. Given the advance of globalization and the increasing number of immigrants worldwide, having a deep understanding of cultural-ethnic differences in students' learning processes becomes increasingly important for modern teachers and school administrators, globally. For example, previous American studies have found that, different from stereotypical high achieving "Asian model minorities" (e.g., American Chinese), American Hmong students face many challenges in learning (Vang, 2005). Thus, it is dangerous to regard all Asian-American students as a homogenous group in educational practice. Xiong and Obiakor (2013) suggested that it is important for non-Hmong American teachers and administrators to understand Hmong students' learning processes and culture. As Chinese and Hmong students worldwide are closely linked to Han and Miao groups in China (Tapp, 2002), respectively, they may have cultural values and learning preferences similar to those of their Chinese counterparts. Thus, the results of this study can help teachers, school psychologists, and administrators working with Hmong and Chinese students around the world to better understand their motivation, cognition, and culture, provide targeted support for their learning, and communicate better with their parents.

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Figure 1

The Hypothesised Relationships between Chinese Students' Goal Orientations, Learning Strategies and Mathematics Achievement

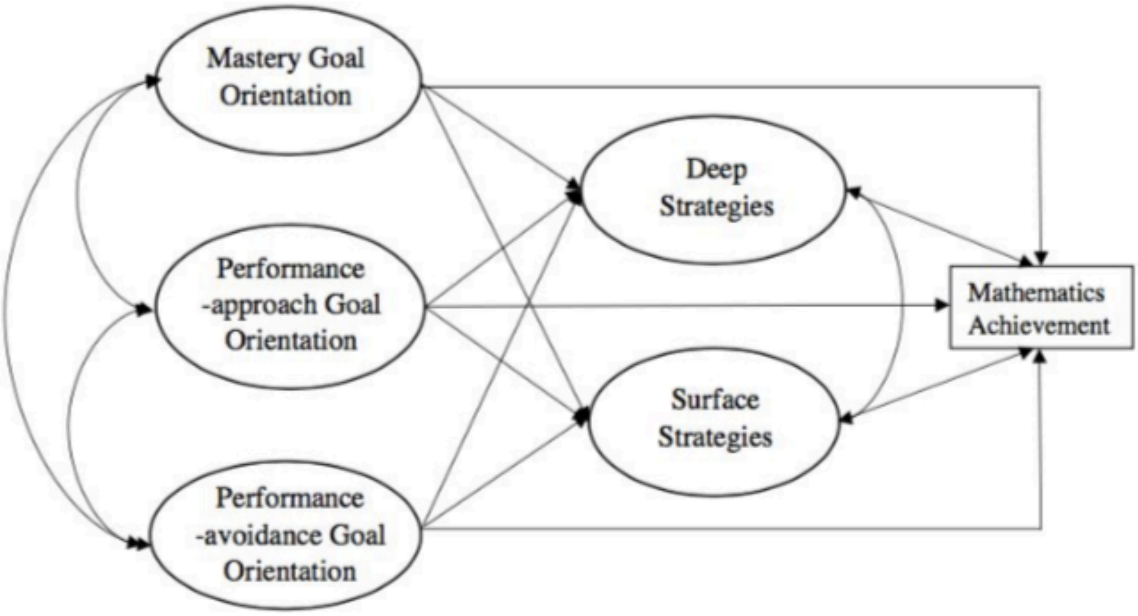
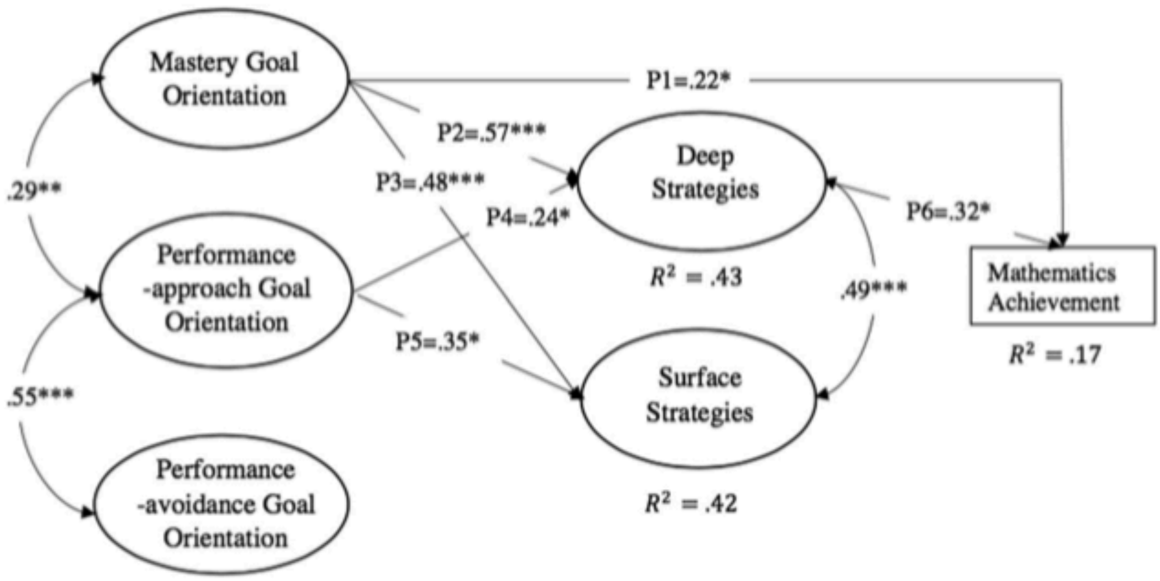


Figure 2

Significant Paths in the Han Model

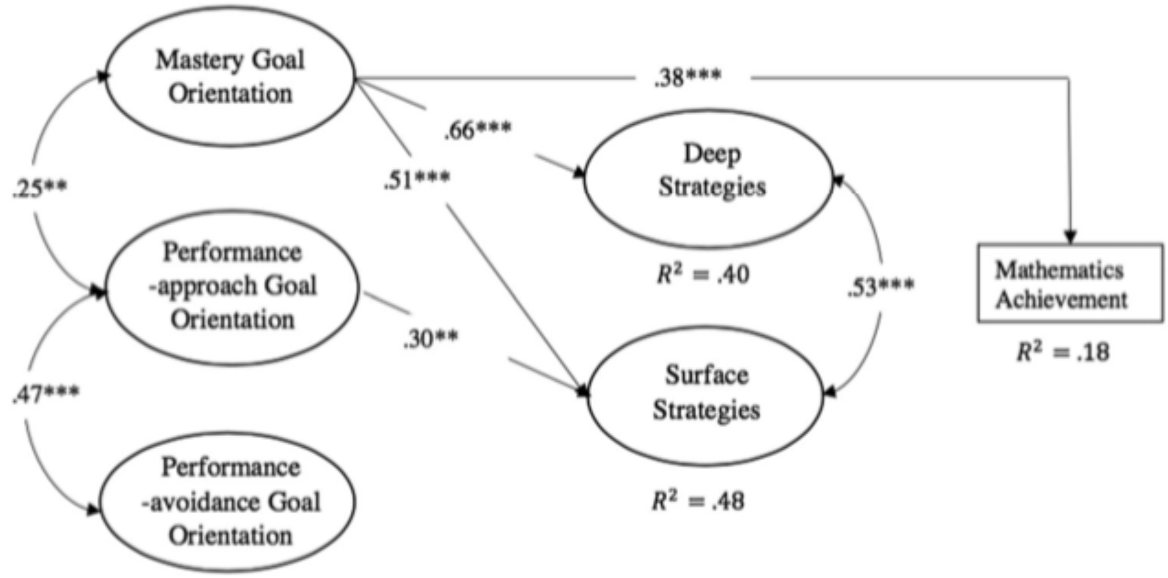


Note. The control variables include parents' education level and student gender.

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

Figure 3

Significant Paths in the Miao Model



Note. The control variables include parents' education level and student gender.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.