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A cross-cultural comparison of school disciplinary climate between Asia and North America using a large-scale international dataset and Rasch measurement theory

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Introduction

Educational researchers and other stakeholders are interested in finding different ways that may be conducive to students' academic performance. Hattie (2009) identified and synthesized several hundreds of variables that can improve student achievements from different aspects, such as school, teacher/teaching, curricula, home, and so forth, among which 31 factors were major contributors to a better student performance. School disciplinary climate is considered as one of the main contributors to student outcomes regardless of subject matters, especially reading, math, and science (Ma & Klinger, 2000). However, empirical research regarding how school disciplinary climate facilitates student learning is very limited.

Purpose

The major purpose of this study is to examine differences in the principals' perceptions of the difficulty related to the school discipline and safety across four countries and regions: (1) Chinese Taipei, (2) China's SAR, (3) the United States, and (4) Canada. Essentially, these countries and regions were chosen because they are the well representations of Asia and North America. Additionally, a secondary purpose of this paper is to demonstrate how the modern measurement theory can be used to evaluate the extent to which survey indicators measuring school discipline and safety function in a comparable fashion across different geographical locations. To reiterate, the study was designed to answer the following research questions:

1. What are the psychometric properties of the School Discipline and Safety Subscale when using Rasch Measurement?
2. Do meaningful patterns of differential severity emerge for principals when rating their school disciplinary climate across Chinese Taipei, China's SAR, the United States, and Canada?

This empirical research contributes to the relevant literature in various ways. In the first place, this study utilized data from an international large-scale dataset to conduct a cross-cultural comparison of principals' perceptions of school disciplinary climate. Moreover, the study applied a measurement technique that was relatively unique for exploring differences in school disciplinary climate based on the modern measurement theory, that is conducive to achieve more meaningful cross-cultural comparisons than the more widely accepted statistical comparisons based merely on total scores or correlational analyses. Last but not least, the analytic results from our study add more insights into the disciplinary climate differences across Asia and North America.

Disciplinary Climate in School Settings

For the past three decades, educational stakeholders strive to find versatile ways to improve teaching effectiveness and reduce student achievement gaps. Münch & Wieczorek (2023) indicated that effective school practices can be achieved by “enlarging school autonomy, strengthening school management, and enhancing accountability” (p. 59). Schools, like many other complex organizations, function in a sophisticated fashion. Previous literature indicated a vital impact of a positive school climate on student outcomes, such as social skills, academic performance, and other comprehensive long-term outcomes (Raudenbush & Williams, 1995). Various literature has confirmed the strong and positive impact of school disciplinary climate on student learning (Leithwood et al., 2009; Leithwood et al., 2020; Ma & Willms, 2004; Tan et al., 2023). Students spend most of their time socializing in a school setting, thus, it is important to provide a safe and orderly school environment to promote student advancement and their academic outcomes (Doucet, 2008; Ma et al., 2022). Ning et al. (2015) also pointed out that school disciplinary climate is amongst one of the imperative aspects of school climate. A

positive school disciplinary climates benefits students in a comprehensive way, more specifically, it not only exerts a preferable impact on student achievement, but also promote student motivation, which, in turn, enhances their academic performance (McMahon et al., 2009; Ma & Willms, 2004). As one may be curious to ask, “what is discipline”? The word “discipline” was originated from the Latin *discipulus*, meaning the intention of correcting and training behaviors (Short et al., 1994). School disciplinary climate has been defined in various ways. Ma and Williams (2004) indicated that disciplinary climate “is a classroom- or school-level phenomenon that is in part shaped by features of schools and communities” (p. 169). During the early exploratory stage in disciplinary climate related literature, nearly all studies treated student discipline behavior as a classroom level variable. School discipline research conducted at the student level showcased a reliable correlation between poor academic achievement and delinquency (e.g., Hunt, 1995). Over the last several decades, researchers have found that factors outside of the school cannot thoroughly explain the indiscipline differences among different schools, thus the focus on disciplinary climate has shifted gradually from student to school (Ma & Willms, 2004). the relationships between student achievement and school disciplinary climate have become more evident that it functions better at an organizational level (classroom level and school level) (Sortkær, & Reimer, 2018; Wang et al., 2022).

Four significant categories of school disciplinary climate, namely, controlled, conflictual, liberation, and autonomous have been identified (Cohen & Thomas, 1984). As a result, principal leadership and school operations are differentiated via different types of policies reinforced in different school, and it makes a difference on students’ behavior (Safran & Oswald, 2003). Ma and Willms (2004) suggested that there were three major theoretical perspectives (social control, school change, and student alienation) utilized to measure school discipline. First, the *social*

control perspective measures how school norms and values were perceived through the students' lenses and the degree to which the students accommodate these disciplinary rules into their own belief. The second perspective, which is referred to as *school change*, has a focus on the relationship between the individual and the organizational factors. It takes into account of the differences in academic background among different schools, and advocates that students, teachers, and classroom can factor in and make contributions to the whole-school organizational factors. Lastly, according to Newmann's (1981) *student alienation* perspective, when a school failed to meet students' needs of integration, individuality, and communality, that's when student delinquencies often take place. As a result, violence (e.g., theft, physical fights, intimidation, or verbal abuse), vandalism, poor academic performance (e.g., arriving late at school and absenteeism), and many other problematic behaviors may occur.

Dempsey (2008) maintained that school disciplinary climate typically was referred to as participants' perceptions on school safety (e.g. Crosnoe et al., 2004; Planty & DeVoe, 2005), the fairness and effectiveness of discipline in school (e.g., Lee & Byrk, 1989; Ma, 2003), and to what extent school rules are enforced, and the frequency of disciplinary incidents occur within the school setting (e.g., Brand et al., 2003; Lee & Byrk, 1989). Previous literature has shown that when students perceived their schools to be safe and secure, they were more likely to have a positive perception on school rules (Farmer, 1999; Hong & Eamon, 2012; Ingels et al., 2005; Williams et al., 2018). On the other hand, students' perceptions on school safety were found to be negatively correlated with school disorder (Gottfredson et al., 2005; Hamlin, 2020; O'Neill & Vogel, 2020).

Better student academic achievement is associated with more positive attitudes toward school and less exposure to discipline problems such as absenteeism, violence, and dropping out

of school (Hallinan, 2008). Disciplinary climate is considered an important school characteristic as it contributes significantly to reading achievement (Ma & Crocker, 2007). The researcher made an attempt to search for literature pertaining how different regions of the world perceive disciplinary climate differently. Unfortunately, very little research systematically compared school disciplinary issues across region, also very scarce attention has been given to the relationship of student engagement and student achievement in a safe and orderly school environment where appropriate discipline rules have been practiced (Dempsey, 2008). It is also worth noting that there are far less studies done on how disciplinary climate is perceived differently between Asian cultures and North American cultures. This study design examines disciplinary issues in Asian and North American contexts will contribute to how different education systems deal with school disciplinary problem. Two major benefits for using international package in this type of study are listed below: (1) “comparing country performances for identifying the countries with the best education systems” and (2) “generating insights about effective policy and practice strategies that are associated with higher learning outcomes” (Ercikan, Roth, & Asil, 2015, p. 1).

Cross-national Differences in Disciplinary Climate

Across various cultures, school administrators and instructors view noise, disorder, and distractions as hindering factors to classroom management (Haydn, 2014; Ning, 2019). Universally, students generally performed better academically within schools that had a more orderly disciplinary climate, even after controlling for school level and student level SES (Ma et al., 2022). Ning et al., (2015) examined the relationship between the classroom disciplinary climate and student reading achievement using PISA 2009 dataset, he found that a better disciplinary climate contributed positively to a higher student reading performance among 82%

of the participating countries and regions. Ma et al., (2013) conducted a comparative study on disciplinary climate in Hong Kong SAR, Taipei, and Japan, the classroom disciplinary climate was positively correlated with student academic achievement in all subject matters (reading, math, and science). Teachers in less disciplined classrooms tend to spend more time on managing students' disruptive behaviors and less time on effective instruction, resulting a series of unwanted consequences, such as decreasing respects from students for teachers, lower student self-efficacy on subject matters, and worsening academic performance (Cheema & Kitsantas, 2014; Split et al., 2011). School leaders from different countries and regions sought to find solutions to this universally pervading problem.

With the differences in cultural norms and the educational systems, there exists a vast difference in terms of how the classroom disciplinary climate was scored (Ning et al., 2015). In Asian countries such as China, the schools advocate a sense of “wholesome” in classroom teaching. Classes are taught with a very large class size, and students demonstrate a high level of respect for teachers and principals (Ning, 2019). An orderly school disciplinary climate has been emphasized as one of the fundamental attributes of school success (Elliott & Phuong-Mai, 2008; Ma et al., 2013). Compared to Western students, Chinese students perceive teachers' corrective feedback to their behavioral problems to be constructive rather than controlling. Being immersed in a self-striving and self-discipline atmosphere guided by the Confucian philosophy, most Chinese students respond very positively to correct their disruptive behavior (Ning, 2019; Yang et al., 2013; Yu, 2008).

Research on international comparative studies using large scale datasets has never lost its popularity. Hong Kong and Macao are two special cases as they are both specially administered regions from the mainland China. Their education systems have been heavily influenced by

traditional Chinese culture yet still demonstrate uniqueness in historical context. Over a decade ago, the Hong Kong government initiated a school decentralization policy, hoping that school disciplinary climate would improve by giving authoritative power to all educational stakeholders (Ho, 2005). Sit et al., (2021) compared the discipline situations among the low-achieving students in Macao and Taiwan. Reports for PISA 2015 unveiled that low-achieving students in Macao experienced more frequently bullying than their Taiwan counterparts. Ning (2019) utilized the 2012 Programme for International Student Assessment to explore the relationship between students' math performance and classroom disciplinary climate. Data were drawn from Shanghai (China), Hong Kong SAR, Macao SAR, and Taipei. Results indicated that the top math performers were more densely clustered in schools where the disciplinary climate was relatively strict. In the comparative study, most students from Shanghai and Hong Kong benefited from an orderly disciplinary climate, especially for those medium and high performance in Shanghai. On the contrary, most students in Chinese Taipei and Macao suffered from a disruptive disciplinary climate in their school.

With an attempt to explore the mediating effect of the school climatic factors on decentralization and students' academic performance, Ho (2005) conducted a study utilizing data from Programme for International Student Assessment (PISA 2003) package (the Hong Kong subset). The operationalization of school climate variables was administered to both principals and students asking for their perceptions regarding climatic issues (sense of belonging, attitude towards schools, disciplinary climate, student-teacher relationship, and teacher support). The results indicated that Hong Kong students' perception of disciplinary climate in the school are slightly higher than the PISA average. In addition, disciplinary climate and sense of belonging are the strongest attributors to students' math achievement. These results confirmed with

previous studies suggesting that positive effects on school effectiveness and student learning may be mediated by improved school disciplinary climate, enhanced accountability, and increased flexibility and responsiveness (Brown, 1990; Murphy & Beck, 1995).

In countries and economies, such as the United States and Canada, that advocate an individualistic culture, students sit in smaller classes where teachers provide more differentiated instructions and more freedom (Ma et al., 2013). Educational systems in the United States and Canada share some similar features yet they still have distinctions (e.g., disciplinary climate is more closely associated with science outcomes in the United States, whilst in Canada, very scarce literature explored the relationship between school climate and science literacy). Li and Shi (2014) comparatively explored school-related factors and their relationships to student literacy, finding that school climate exhibited a positive association with science literacy in the Canadian context, but negative impacts were discovered in the United States.

Across many international data packages, including PISA, TIMSS, and PIRLS, Korean and Japanese students have the highest math scores among the top-performing countries (Stevenson, & Lee, 1996; Stigler et al., 1987), whereas American students' academic performance was relatively lower. The discrepancies in student performance may be partially explained by cultural differences and school disciplinary policies (Shin et al., 2009). Shin, Lee, and Kim (2009) investigated both student-level and school-level discipline factors that contributed to students' math between Korea, Japan, and the United States. A Hierarchical Linear Modeling (HLM) was performed, and the results suggested that, at the individual-level, statistically significant differences were detected in all the variables among the selected countries, among which the American students demonstrated the highest level. At the organizational level, likewise, all the variables within the three countries were statistically

different, the only exception was no statistical significance was found for school disciplinary climate between Korea and the United States. These research results confirmed that in school where disciplinary climate is well-ordered, assertive and strong, students are more inclined to demonstrate better academic outcomes and have less disruptive behaviors (Kim, Namgung, & Kang, 2004).

Methodology

Based on the research focus, I applied the Rasch measurement theory for the data analysis. Specifically, a Rating Scale formulation of the Many-Facet Rasch model (Andrich, 1978; Linacre, 1989) was used. The Many-Facet model is an extension from the original Rasch model for it includes additional facets related to explanatory variables such as demographic characteristics. Introducing additional facets to the model makes it possible to consider the differences in the item ordering across subgroups of participants using interaction analyses.

In this study, I applied a 3-facet Rasch model: individual respondents (principals), (disciplinary climate) items, and regions. The basic theoretical structure of the model can be illustrated as follows:

$$\ln \frac{P_{nij(k=x)}}{P_{nij(k=x-1)}} = \theta_n - \delta_i - \gamma_j - \tau_k, \quad (1)$$

where θ_n is the logit-scale location for Principal n ; δ_i is the logit-scale location for item i ; γ_j is the logit-scale location for region j ; and τ is the location on the logit-scale where rating scale categories k and $k-1$ are equally probable across principals, items, and regions.

When Equation (1) is applied to the Disciplinary Climate subscale, principal locations on the logit scale (θ) represent each principal's overall level of perception in their school's disciplinary climate. Principals with high logit-scale locations reported high overall confidence

in their school's safe and orderly disciplinary environment, and principals with low logit-scale locations reported low overall levels of confidence as they perceive more discipline issues in their school. As for items, logit-scale locations (δ) reflect principals' judgements of the school disciplinary climate. Items with low logit-scale locations suggest that a specific student disciplinary behavior is perceived as easy to manage, and items with high logit-scale locations suggest that a specific student disruptive behavior is harder to be under control. For regions, logit-scale locations (γ) reflect the overall level of perceived school disciplinary climate among principals within each country or region. Regions with high logit-scale locations reflect high overall levels of school disciplinary climate, indicated the school was well-managed and students were disciplined, and regions with low logit-scale locations reported low overall levels of school discipline. The last term (τ) in the equation is not a facet. Instead, this parameter reflects the difficulty associated with a response in a particular category, rather than the category just below it.

Rasch Interaction Analysis

After the estimates for principals, items, and regions were obtained, it was possible to conduct interaction analyses between pairs of facets in order to explore the degree to which the relative ordering of the elements within one facet is invariant across those of another facet. Interaction analyses were used to explore the degree to which the relative ordering of school disciplinary climate was invariant across regions. Specifically, an interaction term was added to the model that represents the combined effect of items (δ) and regions (γ) as follows:

$$\ln \frac{P_{nij(k=x)}}{P_{nij(k=x-1)}} = q_n - d_i - g_j - t_k - (\delta_i \gamma_j), \quad (2)$$

where all of the terms are defined as above, and $(\delta_i \gamma_j)$ represents the interaction between items and regions.

When interactions are added to a Many-Facet Rasch model, the results were evaluated utilizing two indices: (1) an overall omnibus test for the interaction; (2) individual pairwise interaction terms. The omnibus test provided an overall answer to the question: *Is the relative ordering of the disciplinary climate items invariant across the four selected regions?* The pairwise interaction terms provide more details about the interaction at the level of individual items and regions. These terms address the following question: *For which regions are items more-difficult or easier than expected?*

Source of data

This study utilized a large-scale dataset collected and published by the International Association for the Evaluation of Educational Achievement (IEA). IEA is a non-profit educational organization that is dedicated to collect educational data worldwide. More specifically, this organization collects high-quality, international large-scale data from various educational stakeholders, such as school administrators, teachers, students, and parents from more than 60 countries and regions. Their exemplar large-scale datasets are Progress in International Reading Literacy Study (PIRLS), and Trends in International Mathematics and Science Study (TIMSS) are available for free download. Reading, math, and science are used as the student outcomes in these international datasets. Due to the fact that these datasets are publicly available, the confidentiality was guaranteed, and no participants' personal information can be identified. For this study, our data was a subset derived from the Progress in International Reading Literacy Study (PIRLS) 2021 package using a free software IEA IDB Analyzer (5.0).

In total, there were 57 countries and regions participated in PIRLS 2021, including some distinct education systems within countries that historically participated separately (e.g., Georgia, Hong Kong SAR, Macao SAR, the French- and Dutch-speaking regions of Belgium). For the

comparative nature of our research, I selected principals' responses regarding their school disciplinary climate from Chinese Taipei, China, the United States, and Canada. As aforementioned, cultural context contributes to educational policies, which in turn impacts school disciplinary climate. This study investigated how the differences in geographical locations and cultural contexts help shape various learning environments. The researchers were particularly interested in comparing the patterns between Asia and North America. China and Chinese Taipei were chosen to represent Asia. Since China mainland did not participant in the PIRLS data collection, Hong Kong Special Administrative Region (SAR) and Macao SAR were selected to represent China. For North America, I also chose two regions, namely the United States and Canada. More specifically, I used data from the United States (general) and Georgia collectively for USA. In terms of Canada, data from Alberta, British Columbia, Quebec, and Newfoundland and Labrador were included in this study. Initially, I obtained a subset of data from 1,199 principals coming from these areas, however, after excluding completely empty responses, the final sample consisted of valid responses from a total of 1,099 principals from the four chosen regions (184 from Chinese Taipei, 205 from China SAR, 256 from USA, and 454 from Canada).

Instrumentation

School disciplinary climate was measured by the Disciplinary Discipline and Safety subscale, which was derived from the School Questionnaire in the PIRLS 2021 package. This subscale is consisted of 10 items and are rated on a 4-point Likert type scale. The overarching question is "To what degree is each of the following program among <4th grade> students in your school?" Principals can choose from 1 = not a program, 2 = minor problem, 3 = moderate problem, to 4 = series problem. It is worth noting that the higher the value assigned to each

category, the less positive the disciplinary climate is, hence, the original responses from the principals were reverse coded. After the reverse coding, the higher the rating, the better the school disciplinary climate. The 10 discipline related statements are provided as follows:

1. Arriving late at school;
2. Absenteeism (i.e., unjustified absences);
3. Classroom disturbance;
4. Cheating;
5. Profanity;
6. Vandalism;
7. Theft;
8. Intimidation or verbal abuse among students (including texting, emailing, etc.);
9. Physical fights among students; and
10. Intimidation or verbal abuse of teachers or staff (including texting, emailing, etc).

Findings

Summary statistics. It was theorized that meaningful patterns of differential severity emerge for individual principals when rating disciplinary climate across China's SAR (Hong Kong and Macao data combined), Chinese Taipei, the United States, and Canada. Table 1 is the summary statistics from the first model for Disciplinary Climate scale. The item facet was centered to provide reference for the interpretation of the logit-scale locations across the principal, item, and country facets. Chinese Taipei was fixed to zero logit like always for reference convenience. The average principal location was 2.98 logits ($SD = 1.47$ logits), which is noticeably higher than the item location (0.00 logits, fixed to the 0.00 logits to provide a reference for other facet locations). Principal facet having higher location on the logit-scale suggested that principals interpreted the school disciplinary climate as relatively more positive. Items of the Disciplinary Climate scale had a medium range of locations on the logit scale with a standard deviation of 0.56 logits—indicating some differences regarding providing high ratings across items. The region facet had a slightly larger standard deviation (0.58 logits) than the item

facets, meaning that the perception differences of principals on school disciplinary climate were comparably small across the four countries and economies.

In terms of the model-data fit statistics, the average values for all four fit statistics demonstrated good fit to the Rasch model overall (the average values of *MSE* should be around 1.00). All but two of the standard deviation values for all three facets exceeded the -2 and +2 range, which indicated deviations from the model expectation relative to the regions. Chi-square values for all three facets were statistically significant at $p < 0.001$ level. Reliability of separation values ranged from 0.47 to 0.94, with the item facet situated in the middle. The higher the values of the reliability of separation, the more distinct locations there are within the facets. In this case, the region facet displayed the highest level of distinction among all three facets, and the principal facet demonstrated the lowest level of divergence among the four regions selected.

Table 1

Summary Statistics

	Principal (N=1,099)	Item (N = 10)	Region (N = 4)
<i>Calibrations</i>			
Measure (Logits)			
<i>M</i>	2.98	0.00	-0.27
<i>SD</i>	1.47	0.56	0.58
Standard Error			
<i>M</i>	1.64	0.19	0.14
<i>SD</i>	0.48	0.05	0.06
<i>Model-Data Fit</i>			
Infit <i>MSE</i>			
<i>M</i>	0.97	0.98	1.07
<i>SD</i>	0.25	0.27	0.21
Std. Infit			
<i>M</i>	0.00	-0.21	0.30
<i>SD</i>	0.44	1.87	2.80
Outfit <i>MSE</i>			
<i>M</i>	0.98	0.92	1.02
<i>SD</i>	0.31	0.37	0.22
Std. Outfit			
<i>M</i>	0.01	-0.55	-0.12
<i>SD</i>	0.46	1.94	2.49
<i>Separation Statistics</i>			
Reliability of Separation	0.47	0.89	0.94
Chi-Square	1398.8*	142.8*	41.7*

Note. * $p < 0.001$

Variable map. Figure 1 is a *variable map* for the Disciplinary Climate scale. The first column displays the logit scale on which the principals, items, and regions were measured. The location of the 1,099 principals on the logit scale was depicted in the second column. Each asterisk represents 58 principals, a period mark represents between one and 57 principals. Principals with higher locations on the logit scale perceived disciplinary climate in their school to be better. The logit locations of the principals were relatively widespread with a shape of a

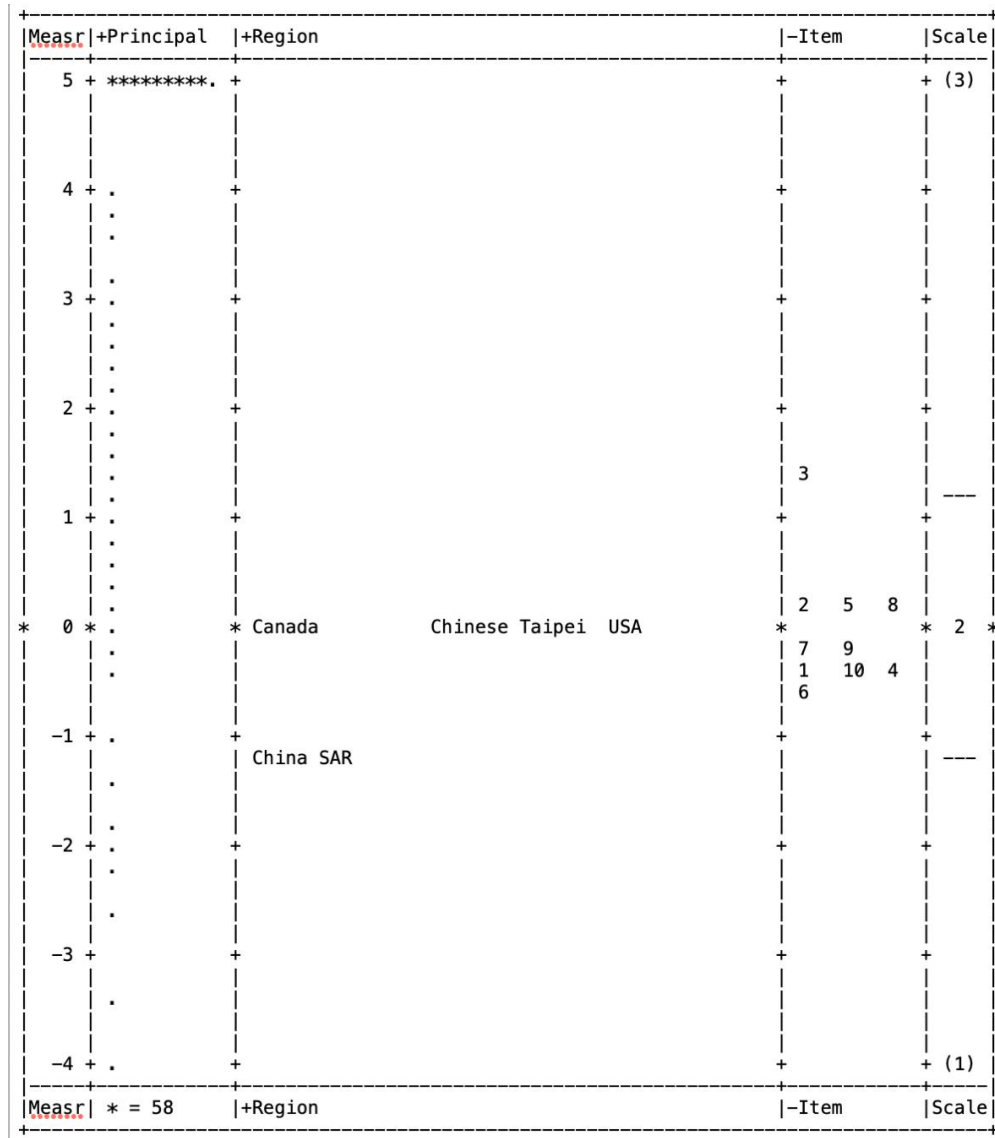
vertical line, however, there was also a cluster of principal locations at the top of the logit scale (approximate locations next to 5.00 logits).

The third column presents the locations of the four countries and regions on the logit scale. Countries and regions with higher locations required better school disciplinary climate. With the logit location of Canada fixed to zero logits. China' SAR ranked in the last place in terms of principals' perceptions concerning the disciplinary climate in their schools. Canada, together with Chinese Taipei, and the United States visually had the same level of average disciplinary climate level, the actual average DC locations were presented further in this paper. It is worth noticing that the locations of all the regions were close, the range of logit-scale location (slightly more than between 0.00 logits to 1.00 logits) of the countries and regions was rather small compared to the differences across principals. The fourth column measures the item facet in the Disciplinary Climate subscale. The direction of this facet is opposite from the other two facets in the model. Items with higher logit locations indicated more difficulty to endorse. Item 3 (*classroom disturbance*) had the highest position on the logit-scale, which means it was the most difficult item for the principals to endorse, suggesting that classroom disturbance was the most serious problems in terms of student behavior. The easiest item to endorse was Item 6 (*vandalism*), suggesting that stealing among students was hardly a problem. The remaining items resided in between item 3 and Item 6. Items 2, 5, and 8, and Items 1, 4, and 10 presented the roughly same levels of item difficulty on the logit-scale, respectively. The logit-scale locations for most of the items resided between -0.5 logits and +1.5 logits. The last column in the variable map shows the calibration of the three-threshold rating scale (4-point Likert scale creates three thresholds). The horizontal lines represent the location on the logit-scale at which the difficulty

of assigning a rating in the category just below the line was equal to the difficulty of assigning a rating in the category just above the line.

Figure 1

Variable map for Disciplinary Climate



Overall region calibrations. Table 2 displays how principals perceived the level of disciplinary climate in their schools. The overall locations of principals on the construct were presented by the locations of the region facet. Higher measure values in the region facet

indicated principals within this country or region perceived this construct easier to endorse. On the contrary, lower values in measure means principals perceive their disciplinary climate to be less desirable. Chinese Taipei had the highest value in the region measure and China’s SAR located at the bottom on the logit scale. The largest measure difference among all the selected countries was between China’s SAR and the United States (1.17 logits). Chinese Taipei and the United States demonstrated the closest gap in terms of the difference in the country measure (0.01 logits).

Table 2

Differences in the Difficulty of Principal Perceptions of Disciplinary Climate across Countries

Country	Measure	Mean Differences in Disciplinary Climate			
		Chinese Taipei	China’s SAR	United States	Canada
Chinese Taipei	0.04	--	1.18	0.01	-0.04
China’s SAR	-1.14	-1.18	--	-1.17	-1.14
United States	0.03	-0.01	1.17	--	0.03
Canada	0.00	-0.04	1.14	-0.03	--
<i>Chi-Square</i>	41.7*				
<i>df</i>	3				

Note. * $p < 0.001$

Note. Differences are calculated using the country shown in the column minus the country shown in the row.

Interaction analysis. The overall omnibus test for the interaction analysis on disciplinary climate was significant, $\chi^2(52) = 106.6, p < 0.001$. Table 3 is a summary for pairwise interactions. Interaction statistics suggested that there were differences in the difficulty ordering the 10 disciplinary climate items across countries. Put simply, the principals’ cognition on the difficulty ordering of these student disciplinary behaviors was variant among the four countries. Therefore, a further pairwise interaction analysis was conducted. Of all the 40 pairwise interactions (10 items across 4 countries/regions), 8 (20%) interactions were statistically

significant. Table 4 is a detailed illustration of all the items within each region that demonstrated significant reactions from the pairwise interaction analysis.

Table 3

Summary of Pairwise Interaction Terms

Count of Pairwise Interaction Terms	40
$ Z \geq 2.0$	8
% Statistically Significant	20%
Chi Square	106.6*
<i>df</i>	3

Note. * $p < 0.001$

Table 4

Summary of Differential Item Functioning Statistics (Item Interactions) for Selected Countries/Regions Exhibiting $|t| \geq 2.0$

Country	Item	<i>t</i>
China's SAR	1	3.47
	10	-2.71
USA	3	3.70
	4	-3.33
Canada	3	-2.26
	4	2.32
	7	2.20
	10	2.52

Note. All interaction terms shown in this table are significant at $p < 0.001$.

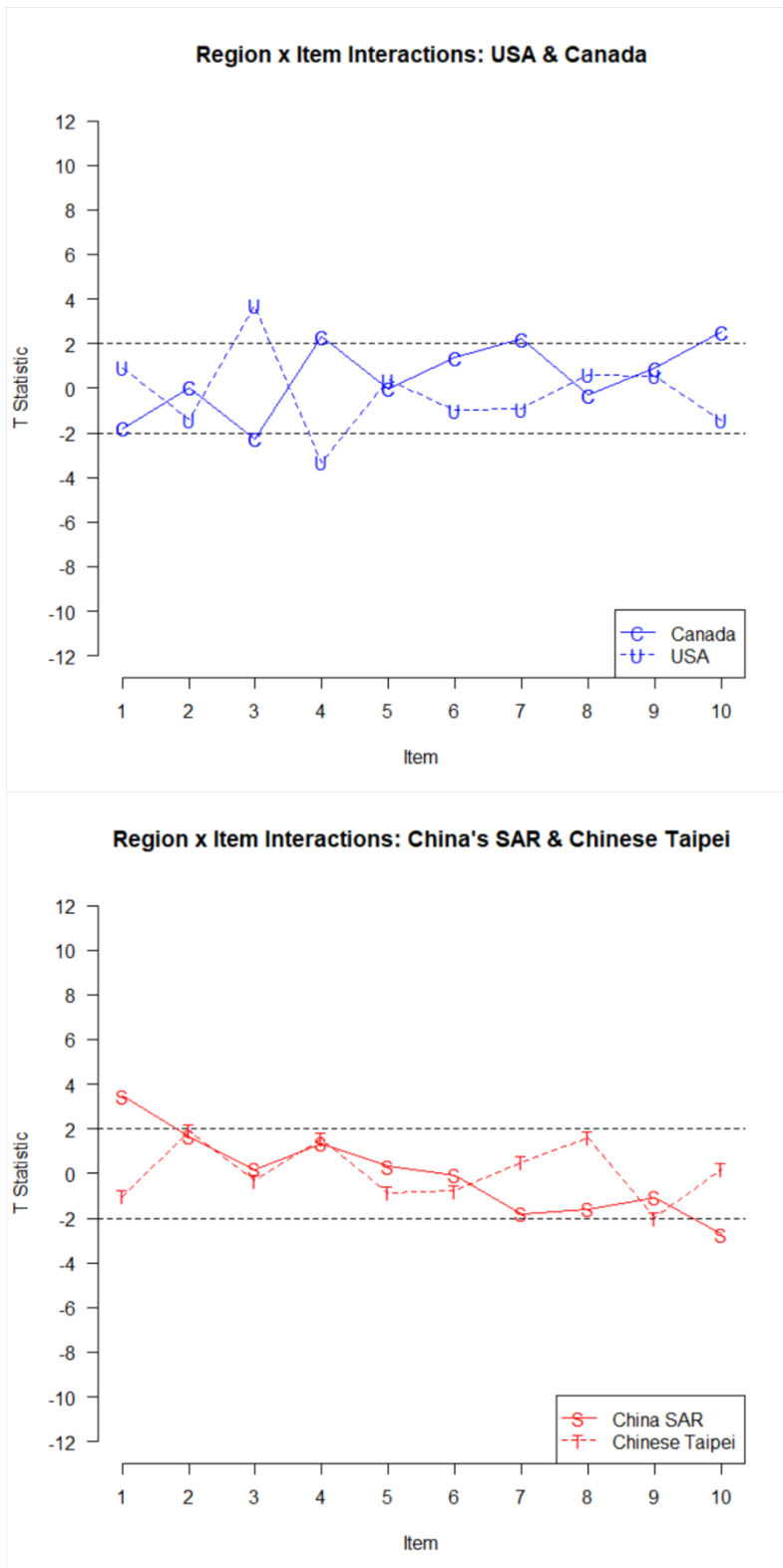
Figure 2 is a graphical summary for the pairwise interaction tests between item and region. The results were presented in two separate plots that reflect the two continents, with results for Canada and the United States presented in the first plot, and Chinese Taipei and China's SAR presented in the second plot. Within each plot, the *x*-axis shows the 10 school disciplinary items, and the *y*-axis shows values of the *t*-test for the pairwise interaction. Separate lines and plotting symbols are used for each country/region. The overall patterns between

Chinese Taipei and China's SAR suggested more similarities, whereas the general trends between the United States and Canada indicated more diversity. In short, the general trend of *t*-statistics across the 10 items appeared more similar within each continent than across the two continents.

Across the region and item facets, the biggest pairwise interaction statistics were related to Item 3 (*Classroom disturbance*), Item 4 (*Cheating*), and Item 10 (*Intimidation or verbal abuse of teachers or staff [including texting, emailing, etc]*). For item 3, perceptions of principals from Canada and the United States showed a relatively big divergence. More specifically, principals rated item 3 to be slightly higher than the model estimation, while the Canadian principals showed lower than expected perceptions on classroom disturbance. The remaining regions (China's SAR and Chinese Taipei) reported no statistically significant difference than the model estimation, and their *t*-statistics were almost identical. For item 4, *t*-statistics from the United States and Canada exhibited an opposite trend. While there was a relatively obvious difference, the American principals showcased a lower than model expected perception on this item, whereas the Canadian principals' overall perceptions on this item was slightly above the model expectation. A similar situation also applied to Item 10, where the intimidation and verbal abuse issues showed relatively moderate differences among two comparisons (Canada vs. the United States, and China's SAR vs. Chinese Taipei). However, within each region comparison, only one region/country had *t*-statistic that was outside the -2 to +2 range (Canada and China's SAR).

Figure 2

Pairwise interaction terms for disciplinary climate



Discussion

Extensive research has been done on providing an enabling learning environment to promote students' academic performance in various ways. A positive school disciplinary climate reduces disruptive student behaviors, teacher burnout and turnover (Buchanan, 2010; Dicke et al., 2014; Haydn, 2014). The goal of this study was to explore how school disciplinary climate was perceived by principals from different geographical locations, and whether meaningful differential patterns would be detected. One unique contribution of this research study is that it provides a unique lens to look at the question by using Rasch Measurement Theory.

Rasch Partial Credit Model was used to answer the question if there existed meaningful differential severity patterns in how principals from the selected countries and economies would rate their school disciplinary climate. The findings indicated that meaningful differential rating patterns did exist across region. The model-data fit statistics suggested satisfying fit tested with the mean square error (*MSE*) values all close to 1. The variable map provides a better visual understanding with the logit locations of the three facets for the Disciplinary Climate subscale. For principal and region facets, higher logit locations suggested higher levels of perceived school disciplinary climate. On the contrary, for Item facet, items high on the logit scale showcased higher item difficulty, hence an indication of less likelihood of high perceptions from the principals. The Rasch interaction analysis revealed the differences between the actual situation and the model expectation. The graphical summary for the pairwise interaction tests on the Disciplinary Climate subscale displayed general trends of the individual items. If values of the *t*-statistics exceed $|2|$, that means the certain item either have higher-than-expected or lower-than-expected rating. The overall patterns within each continent were more similar than across continent. In terms of disciplinary climate scale, the overall patterns between China's SAR and

Chinese Taipei were more similar than the patterns demonstrated between Canada and the United States. However, most of the items resided within the -2 to +2 range.

China's SAR, Chinese Taipei, the United States, and Canada are leading economies in Asia and North America. Within each continent, the selected regions share a similar tradition and culture but have their own distinctive social norms and education systems. The overall principals' perceptions on school disciplinary climate were very similar across region, with principals from Chinese Taipei, the United States, and Canada having almost the same level of perceptions. The overall principal's disciplinary climate perception was almost 3.00 logits higher than the average item facet location on the logit scale, suggesting that the principals from these economies, in general, had a relatively high confidence that they were able to provide their students with safe and orderly learning environments.

Limitations and Recommendations for Future Research

There exist several limitations exist in the current study. First, school discipline and safety were measured by principals' perceptions, however, in general, it should be measured by subordinates. It is possible that school administrators' and subordinates' perceptions on the same issues and concerns might have some noticeable biases. I suggest future researchers to collect school disciplinary data from other stakeholders, such as teachers and students, or design a comparative study, collecting data from both the administrators and teachers. Second, the data utilized in this study were drawn from an international large-scale dataset with 57 participating countries and regions, and I only chose four countries and regions to represent Asia and North America. It is possible that the results may not be fully generalizable to other countries and regions. Also, data from Hong Kong SAR and Macao SAR, rather than the Mainland, were used to represent China. Correspondingly, it is recommended that future research with similar

interests may include more geographically diversified data and identify international datasets that have Mainland China as one of the participating countries. Furthermore, school leaders' perceptions on disciplinary climate evolve overtime, it is likely that their perceptions may be influenced by time, and other related contexts (e.g., a specific time such as COVID pandemic). As a result, studies that examine how school disciplinary climate changes longitudinally are highly welcomed. Last, this study only compared relatively high-performing countries and regions, it may be intriguing to explore the similarities and differences between high-, medium-, and low-performing countries.

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