Similarities and Differences in Social and Emotional Profiles Among Students in Canada, USA, China, and Singapore: PISA 2015

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Abstract

Although previous research showed that discrete social-emotional skills such as empathy, motivation, and social relationships in school significantly predict academic achievement, students tend to use various social-emotional skills in combination. As such previous investigations cannot comment on how different combinations or profiles of students' social-emotional skills predict achievement relative to discrete skills. Likewise, little is known about cross-national comparisons of social-emotional skill profiles (SESP), and the extent to which SESP differ on their academic achievement. The purposes of this study were three-folded: 1) to determine whether a four-factor social-emotional skills model could be used for cross-national comparisons; 2) to identify social-emotional profiles in 15-year old students from four different countries—Canada, the United States, China, and Singapore; and 3) to evaluate how different profiles predict students' reading, math, and collaborative problem-solving (CPS) test scores as measured in the Programme for International Student Assessment's (PISA). Our results showed multigroup measurement invariant in the structure, loadings, and thresholds of the four-factor social-emotional skills model. We identified three profiles labeled Sociable, Reserved and Withdrawn in Canada, Singapore, and the United States; whereas, we found three profiles labeled Solitary, Team-oriented, and Reserved in students in China. Finally, the way each profile associated with PISA's reading, math and CPS in each country appeared to align with the cultural expectations of learning.

Keywords: social-emotional skills, latent profile analysis, cross-cultural comparison, standardized international student achievement

Introduction

Most of the social-emotional studies have focused on how discrete variables, such as self-efficacy, motivation, feelings toward school, and social connections (Davis, Solberg, de Baca, & Gore, 2014; Murray-Harvey, 2010), predict future academic success. Although previous research showed that students' social-emotional skills were regarded as a generic construct that significantly predict academic achievement, students tend to use social-emotional skills in combination rather than isolation. As such, previous studies on discrete skills cannot comment on how different combinations or profiles of students' social-emotional skills function in predicting achievement, even though this may be a more realistic approximation of what students do. Specifically, the Collaborative for Academic, Social, and Emotional Learning (CASEL, 1994-2018) has delineated the intertwined sets of social-emotional skills, namely self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Looking at these types of groupings empirically, has been greatly facilitated by advances in latent analyses. For example, research on emotion has begun to focus on uncovering latent, homogeneous groups of students (e.g., Tze, Daniels, Buhr, & Le, 2017; Orri et al., 2017) who experience similar patterns of emotions, so that educators can provide more direct and tailor-made remediation or intervention plans for each group of students, respectively. Recently, Collie, Martin, Nassar, and Roberts (2018) began the momentum to shed light on the social-emotional behaviour profiles among kindergarteners and to identify the relationship with achievement outcomes. Despite their important advancement in terms of profiles, Collie and colleagues did not consider the role of culture.

CASEL acknowledges the impact of home and communities influence on the development of social-emotional skills, which can be extended to a broader context, culture.

Cultures determine which social behaviours and emotional responses are considered appropriate (e.g., Cole, Bruschi, & Tamang, 2002). According to Rubin (1998), culture shapes whether a social-emotional response should be exhibited and would be considered an adaptive behaviour for favourable learning outcomes. For instance, shyness carries the same social-emotional meaning, and yet western culture views this social-emotional response as an uncooperative and socially inadequate behaviour; whereas, in a Chinese culture shyness is perceived as a meritorious and desirable social response (Rubin, 1998). More specifically, culture differs on what the society values regarding emotional experiences and social expression (e.g., Lim, 2016). In spite of this, a population-representative cross-national comparison of social-emotional skill profiles is still lacking. Therefore, the purpose of this study is to incorporate both a cultural perspective and a latent profile perspective in examining social-emotional skill profiles in Canada, China, Singapore, and the United States.

Definition of Social-Emotional Skills

Social-emotional skills include a wide range of competencies, such as managing psychological stress (Davis et al, 2014; Polan, Sieving, & McMorris, 2013), interpersonal skills (Polan et al, 2013), emotion understanding (Nix, Bierman, Domitrovich, & Gill, 2013), social relationships and connections (Davis et al, 2014; Nix, et al, 2013), and problem solving (Low, Cook, Smolkowski, & Butain-Ricklefs, 2015). In particular, social-emotional skills are conceptualized as “the ability to understand, process, manage, and express social and emotional aspects of our lives” (Cohen 2001, p.5). Denham (2006) also attempted to define social-emotional skills as having “positive interactions with teachers, positive representations of self, derived from attachment relationships, emotion knowledge, emotion regulatory abilities, social skills, and nonrejected peer status” (p.59). However, others felt that there is no consistency in the

definition and conceptual understanding of social and emotional skills (e.g., Humphrey, Kalamboula, Wigelsworth, Lendrun, Deighton, & Wolpert, 2011).

As was discussed in Merrell et al. (2008), while there appears a lack of a consensual definition on social-emotional skills, the CASEL (1994-2018) has been an influential organization in social-emotional research and programming. As evidence of their influence in practice, CASEL (2018) is in partnership with at least 20 US school districts, has been integrated into curriculum in various Canadian provinces, and has even expanded into Eastern countries such as Singapore which adopted the CASEL curriculum in 2008 (Liem, Yvonne, Seng, Kamarolzaman, & Cai, 2017). CASEL delineates four core social-emotional competencies (https://casel.org/core-competencies/) listed in Table 1.

These four sets of skills are considered the precursors to develop a fifth core competency (e.g., Gardner, M., & Steinberg, 2005; Lerner & Keltner, 2000) called responsible decision-making, which "involves the ability to make constructive choices about personal behavior and social interactions based on ethical standards, safety concerns, and social norms. The realistic evaluation of consequences of various actions, and a consideration of the well-being of oneself and others." Brackett, Mayer, and Warner (2004) found that the lower the ability boys have to recognize their emotions, the greater the likelihood of making irresponsible choices, including illegal drug use, intoxication, and deviance behaviours. Similarly, Berhenke, Miller, Brown, Seifer and Dickstein (2012) revealed children's mastery motivation, especially persistence, significant predicted their self-regulation skills in schools. When adolescent boys were able to show perspective-taking skills and empathic concerns, they were less likely to demonstrate pro-bullying behaviours and more likely to defend the victims (Gini, Albiero, Benelli, & Altoè, 2007). Gillies (2004) also researched junior high school students working together in a structured

team. These teenagers reported more responsible behaviours, such as listening to each other, helping team members, not interrupting, and sharing ideas. Hence, it seems that responsible decision-making builds on successful development of self-awareness, self-management, social awareness, and relationship skills. For this reason, we view social-emotional skills as having four primary competencies and use these as the framework for our conceptualization of social-emotional skills through the rest of this research.

Relationship between Social-Emotional Skills and Academic Achievement

In the literature, researchers have found important and significant relationships between social-emotional skills and various indicators of academic success. Doctoroff et al. (2016) found that as early as preschool, teacher ratings of a composite of students' social-emotional skills including aggression, withdrawal, and social skills negatively predicted (standardized slope; β = -.24, $p < .001$) their math skills. Sung and Chang (2010) used discriminant function analysis to determine which social-emotional skills—approaches to learning, self-control, interpersonal skills, externalizing problems and internalizing problems—had a greater predictive effect on high-, typical- and low-achieving students. They found that approaches to learning as a single construct was the most significant predictor.

Most social-emotional skills research focuses on early grades. Approximately 56% of the published papers focus on elementary years, 31% on middle years, and 13% examining the relationship between social-emotional skills and achievement in high school settings (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). For example, Davis, Solberg, de Baca, and Gore (2014) studied ninth graders' social-emotional skills and found a small effect of five social-emotional skills (i.e., importance to attend college, motivation, self-efficacy in classroom, distress, and stress) on explaining the credits earned for graduation.

While the aforementioned results revealed how social-emotional skills predict academic skills and discriminate students who attained high versus low achievement, there is still a lack of understanding regarding how students may use different combinations of social-emotional skills in school in order to achieve in academic settings. Identifying groups of students who share similar social-emotional characteristics is known as a person-centered approach (Muthén & Muthén, 2000). As far as we know, there are only two studies (Thomson, Guhn, Richardson, Ark, & Schoveller, 2017; Collie, Martin, Nassar, & Roberts, 2018) that take a person-centered approach to identify homogenous groups of individuals using similar patterns and/or combination of social-emotional skills.

Thomson et al.'s (2017) study focused on kindergarteners in Canada. The authors identified six different social-emotional profiles based on latent profile analysis (LPA), a person-centered statistical technique, of eight subscales: overall social skills, responsible and respectful behaviours, appropriate learning behaviours, readiness to play, prosocial behaviours, negative emotions, aggressiveness, hyperactivities and inattention. More than half of their participants (58.1%) belonged to the *overall high social–emotional functioning* group, who showed high rating scores on adaptive social-emotional skills and low rating scores on maladaptive ones. The second largest profile, named as *uninhibited-adaptive*, consists of 17.1% kindergarteners, who were eager to engage but did not show the necessary social skills, such as showing respect and helping others. The third largest *inhibited-adaptive* (p.5) profile contains 8.8% kindergarteners, who were responsible and respectful and had self-management skills (i.e., non-aggressive nor hyperactive) but were less ready to explore social situations and help others. Thomson et al. elaborated that although the remaining three profiles showed unique combination of social-emotional skill patterns, all of them had lower than average social-emotional skill scores. While

Thomson et al.'s study advanced the current social-emotional literature on social-emotional skill profiles, the lack of achievement or learning skills data was the major limitation. Without knowing how these profiles differed on measures of academic outcomes, the profiles serve largely a descriptive function.

By contrast, Collie and her colleagues (2018) also investigated kindergarteners' social-emotional profiles found four distinctive groups in Australia. The authors also utilized LPA to identify homogeneous profiles based on five social-emotional indicators, which can be mapped onto five of the eight measures used in Thomson et al. (2017). Collie et al.'s first profile, *Social-Emotional Prosocial (SE-Prosocial)*, was similar to Thomson's et al.'s (2017) overall high social-emotional functioning group. Seventy percent of kindergarteners in Collie et al.'s study belonged to this profile. The second profile, *SE-Anxious* in Collie et al. is similar to Thomson et al.'s inhibited-adaptive profile, in which children showed average responsible social behaviours and yet demonstrated lower than average prosocial behaviours and social skills. The third profile found in Collie et al. is considered an additional group that is distinctive from Thomson et al.'s six different profile. The authors labelled it as *SE-Aggressive* which demonstrated moderate aggressive and mild anxiety, while having lower than average adaptive social capacities. The fourth profile, *SE-Vulnerable*, in Collie et al.'s study mimicked the smallest group identified in Thomson et al (i.e., "*overall low social–emotional functioning*", p. 5). As the label suggested, this group of kindergarteners scored very low on adaptive social-emotional measures while demonstrating high level of aggression and anxiety. In particular, Collie et al. revealed significant differences among the four social-emotional profiles, with SE-Prosocial performing better than SE-Anxious, followed by SE-Aggressive, and SE-Vulnerable on almost all reading and math outcomes. These two papers make important contributions to understanding social-

emotional profiles in kindergarten, and highlight the need for similar investigations with other age groups and cultures.

Social and Emotional Behaviours Across Cultures

Cross-cultural studies (e.g., Kitayama, Mesquita, & Karasawa, 2006; Yoo & Miyamoto, 2018; Scollon, Koh, & Au, 2011) have shown differences in emotions among people from different nations. As Yoo and Miyamoto (2018) discuss, culture, as a set of values, beliefs, and norms, provides meaning for interpretation, expression, and regulation of an emotion. Guided by Hofstede Insights (n.d.), countries tend to differ on six important cultural dimensions: Power Distance, Individualism, Masculinity, Uncertainty Avoidance, Long Term Orientation, and Indulgence (Hofstede, 2011). In general, Canada and the United States, in comparison to East Asian countries, have a stronger individualistic orientation, a more short-term orientation, a lower power distance and a stronger attitude toward enjoyment of life. Hence, researchers typically find cultural differences in emotions between the West and the East because of these underlying cultural differences (Jose, Huntsinger, Hutsinger, & Liaw, 2000; Leu et al., 2010). In general, expression of positive emotions is encouraged in Western cultures; whereas, positive emotions should be regulated and negative emotions are perceived to be important to attain a balance in East Asian cultures (Yoo & Miyamoto, 2018).

Likewise, there is an increasing evidence on cross-cultural disparities between the East and West on social behaviours. Zhang and colleagues (2013) found that Chinese students put greater emphasis on in-group harmony than American students. The former group valued more about their friendship and the latter emphasized fairness when both groups were exposed to an ethical dilemma. Similarly, given the importance of maintaining social harmony, it predicted

Chinese individuals' verbal and nonverbal forgiveness, while social harmony did not predict any forgiveness styles among Americans (Merolla, Zhang, & Sun, 2012).

Given that social-emotional skills are rooted in emotional and social engagement, differences in these competencies may also exist culturally. In spite of accumulated evidence on cross-cultural differences in emotion expression and social engagement separately, minimal research on social-emotional competencies has been conducted across cultures. Nelson, Leerkes, Perry, O'Brien, Calkins, and Marcovitch (2013), as far as we know, is the only comprehensive work exploring the effects of culture on children's displays of social-emotional competence; however, their work focused on cultural groups within the United States. They used a multi-rater longitudinal research design to evaluate the difference in social-emotional competencies between African-American and European-American children. Specifically, the authors found that encouraging African-American children to express their emotions impeded the development of their social-emotional skills. This highlighted the pressing need to incorporate cultural perspectives in understanding the association between social-emotional skills and academic achievement.

Purpose of This Study

International large-scale assessments, such as Programme for International Student Assessment (PISA), provide cross-national comparisons on adolescents' academic achievement in key areas (e.g., reading, mathematics, and collaborative problem solving). Educational researchers have accessed PISA to conduct investigations on the antecedents of students' academic achievement (e.g., Lee, 2016; Martin, Liem, Mok, & Xu, 2012; Leino, Linnakyla, & Malin, 2004). Traditionally, most studies have taken a variable-centered approach (e.g., correlation, regression and structural equation modelling) to examine how individual variables,

such as effort, self-efficacy, and attitude predict achievement outcomes (e.g., Lee, 2016; Eklöf, Pavešič, & Grønmo, 2014). Recently, there are emerging empirical studies taking a person-centered approach (e.g., cluster analysis and LPA) to identify groups who show similar patterns of variables (e.g., Fan, Hambleton, & Zhang, 2019; Saarela & Kärkkäinen, 2015). PISA also provides researchers with opportunities to consider the role of culture in their research questions, which we have already described as an important consideration in the area of social-emotional skills.

Our first objective was to determine whether CASEL's four social-emotional competencies could be used for cross-national comparisons. We expected the PISA items selected as proxies for the CASEL social-emotional competencies to produce a four-factor solution in each country. However, we were uncertain if strong evidence of invariance across countries would emerge due to the underlying cultural beliefs related to social and emotional expression. Our second objective was to identify social-emotional profiles in four different countries—Canada, USA, China[1], and Singapore. We expected profiles to be most similar between (1) Canada and the USA and (2) China and Singapore and different between those pairs of countries. Our final objective was to evaluate how different profiles predict students' reading, math and collaborative problem solving (CPS) test scores in PISA.

Method

Data

The Organization for Economic, Cooperation, and Development (OECD) Programme for International Student Assessment (PISA) 2015 was used in this study. In PISA 2015, more than half million of 15-year-old students from 72 OECD and partner countries participated. These students completed 2 hours of academic assessment, followed by a student questionnaire[2] which

required about 35 minutes to finish. Optional questionnaires of Information and Communication Technology (ICT) familiarity and Educational Career, as well as assessment of financial literacy were offered (for detailed procedure, see OECD, 2017a, 2017c). Further details about the PISA data and survey design can be obtained from OECD (2017a).

Given the focus of the present study, we used two OECD countries sample data (Canada: n = 20,058 and United States: n = 5,712) and two partner countries sample data (China: n = 9,841 and Singapore: n = 6,115) (OECD 2017c). These four sampling countries were involved in the computer-based assessment mode (CBA) and participated in the newly developed Collaborative Problem-Solving (CPS) skill assessment (OECD 2017b).

Participants

PISA participants in the four selected countries were born in 1999-2000 making them approximately 15 years old. In the Canadian sample, 50% of participants were female and 50% were male, with 83.2% of participants born in Canada. Likewise, in the US sample, 50% of participants were female and 50% were male, with 88.7% of participants born in the United States. In the Chinese sample, 47.6% of participants were female and 52.4% were male. Almost all participants (97.9%) were born in China. In the Singaporean sample, 48.6% of participants were female and 51.4% were male, with 82.6% of participants born in Singapore.

Variables

All variables used in this study were obtained from OECD PISA 2015 data. All students completed the student questionnaire. There was no pre-determined or set measure of social-emotional skills in PISA and therefore we identified discrete items that could be combined to reflect the CASEL competencies. The interested questionnaire variables required students to select one of the four Likert scale options: (1) strongly agree, (2) agree, (3) disagree and (4)

strongly disagree or in the reverse order: (1) strongly disagree, (2) disagree, (3) agree, and (4) strongly agree (OECD, 2017d).

Indicators of CASEL Social-Emotional Competencies. CASEL's four primary social-emotional competencies are *self-awareness, self-management, social awareness,* and *relationship skills*. Due to the limitations of working with a pre-existing dataset, we were unable to fully capture the description of each of the four competencies, but rather aimed to measure at least one focus in the competency well. See Table 1 for the specific items chosen for each competency and Table 2 for all descriptive information by country.

PISA test scores. In each domain—reading, math, and CPS, OECD provided 10 plausible values for each student. The mean is scaled to 500 and standard deviation is 100 (OECD, 2017c). We used the mean of the 10 plausible values to derive a composite score for each student. Each student thus has a composite score in reading, math, and CPS respectively. Marchant (2015) found that the use of averaged values is a feasible option, as results obtained from the use of averaged scores were comparable to those obtained from the use of plausible values. The reliabilities of PISA test scores in reading (Canada $\alpha = .83$; USA $\alpha = .88$; China $\alpha = .90$; Singapore $\alpha = .88$), math (Canada $\alpha = .83$; USA $\alpha = .87$; China $\alpha = .90$; Singapore $\alpha = .87$), and CPS (Canada $\alpha = .74$; USA $\alpha = .81$; China $\alpha = .83$; Singapore $\alpha = .79$) were in the acceptable range (OECD, 2017c).

Plan of Analyses

Confirmatory Factor Analysis (CFA). We used CFA to evaluate the structural validity of the four social-emotional competencies in each country. Two goodness-of-fit indexes[3]—Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA)—were used to assess whether the model shows a good model fit. When a CFI index score is larger than

.90 and a RMSEA index score is less than .10, the model is considered reasonable; when a CFI index score is greater than .95 and a REMSEA index score is less than .05, the model is deemed as a good-fitting model (e.g., Blunch, 2008; Hu & Bentler, 1999 cited in Hooper, Couglan & Mullen 2008). Next, we conducted multigroup CFA (MGCFA) to test measurement invariance of the CFA model across countries. In MGCFA, we evaluated whether configural invariance, factor loadings invariance and thresholds invariance were held across the four sampling countries. Changes in CFI (ΔCFI) of less than .01 after each successive increase in the constraint indicate multigroup invariance (Cheung & Rensvold, 2002).

Latent Profile Analysis (LPA) and BCH Approach. After confirming the measurement invariance across countries, we used a person-centered analytical technique, LPA in Mplus (Muthén & Muthén, 1998-2018), to identify the number of distinctive social-emotional profiles in each country while at the same time evaluating the differences in PISA scores[4] among profiles using BCH approach.

Selection of optimal number of profiles. In each country, the selection was based on a thorough consideration of theoretical support, interpretability of profiles, and LPA results (Lo et al., 2001; Zhao & Karypic, 2004). Nylund, Asparouhov and Muthén (2007) revealed that Bootstrap Likelihood Ratio Test (BLRT) and Bayesian Information Criterion (BIC) are the two best indicators to identify the number of profiles. When comparing *k* and *k*-1 profiles, a significant BLRT and a smaller BIC indicate a better fitting solution of the *k* profile. In addition, when the entropy value is closer to 0.8 (Muthen 2008), it is considered acceptable in identifying *k* profiles. Furthermore, we examined whether there might be less than 1% of cases in each profile (Marsh et al. 2009). Stanley, Kellermanns, and Zellweger (2017) discussed the

importance of having enough number of participants to derive substantive meaning in each profile.

Evaluation of differences in PISA scores. The advantage of using a BCH approach to compare means on PISA reading, math, and CPS was the utilization of a pseudo maximum likelihood and weighting assigned to estimate profile memberships, while avoiding any shifts in profile membership by including the outcome variables in the estimation (Asparouhov & Muthén, 2014; Bakk & Vermunt, 2016). We followed Asparouhov and Muthén's (2014) automatic BCH syntax to generate profile-specific means on PISA reading, math and CPS as well as to obtain Wald test results of mean differences among profiles (Bakk & Vermunt, 2016).

Results

Descriptive Statistics and Correlations

Table 2 shows the descriptive statistics and reliabilities of self-awareness, self-management, social awareness, and relationship skills for the student samples in Canada, the United States, China, and Singapore. The self-awareness (αs = .724 - .811) and relationship skills measure (αs =.822 - .838) showed good internal reliability. The measure of self-management (αs = .690 - .756) and social awareness (αs = .642 - .751) also showed an adequate internal consistency. Table 3 shows the correlation matrix. All correlation coefficients are significant at $p < .01$. The magnitudes of correlations are mostly within the small range (rs = .051 - .320), while correlations between social awareness and relationship skills show a moderate effect (rs = .449 - .530), but they are still considered measuring distinct constructs.

Validity of the Four-Factor Social-Emotional Skill Model

Factor Structure. Table 4 shows the results of CFA and MGCFA. The four social-emotional competencies showed a good fit to the data in each country: CFIs: .991 - .994 and

RMSEAs: .048 - .059. This means that the social-emotional competencies are valid constructs to be used separately in Canada, United States, China, and Singapore.

Cross-cultural Invariance. To test cross-cultural invariance, we first established an unconstrained four-factor model across the four sampling countries. The unconstrained configural model showed a good model fit (CFI = .992, RMSEA = .054 [90% CI: .052 - .055]) with a minimal change of CFI (ΔCFI = .001). This supports the common structure across the four different countries. When the model was constrained by factor loadings, the CFI was .991, while the ΔCFI was within the acceptable range, coupled with an improved RMSEA = .053 (90% CI: .052 - .055). This establishes the factor loadings equivalence. Constraining the thresholds to be equivalent, the CFI dropped to .990 and yet the RMSEA improved to .051 (90% CI: .050 - .052). The change is minimal (ΔCFI = .001), and the goodness of fit indexes suggest a good fit of the data. These results indicated a strong measurement invariance, with configural, loadings, and thresholds invariance, of social-emotional skills across the four different countries of adolescents.

Validity of Social-Emotional Skill Profiles.

Profiles in Canada. Table 5a shows the criteria values in the Canadian sample. Although the lower BIC value and significant BLRT result would suggest a more complex four-class solution than a more parsimonious (or simpler) three-class solution, one of resulting profiles in the four-class solution contained only 1.1% of cases, and its pattern is very similar to another resulting profile. The three-class solution not only has a lower BIC and significant BLRT compared to the two-class solution, it also shows an acceptable entropy value of .887 and neither of the profiles has less than 1% of cases. Considering all these criteria values and interpretability of profiles, we preferred to interpret the three-class solution for the Canadian sample.

Profiles in the United States. Table 5b shows the criteria values in the American sample. When considering all likelihood-base results (i.e., Luong-Lo-Mendell-Rubin, Adjusted LMR, and BLRT), it becomes evident that the three-class solution is a better model. In addition, the entropy in the three-class solution shows the highest value.

Profiles in China. The five-class solution showed a lower BIC value and a significant BLRT than the four-class solution, and the same pattern of criteria values was also observed between the four-class and three-class solutions (see Table 5c). However, in both five-class and four-class solutions, one of the resulting profiles contained very few cases (1.05% and 0.84% in the five- and four-class solution respectively). As Stanley et al. (2017) discussed, a substantive understanding of the profile could not be made when there is insufficient number of cases. In light of this, we preferred the three-class solution which demonstrates a low BIC (compared to the two-class solution), a significant BLRT, and a second highest entropy value.

Profiles in Singapore. Given the fact that the four-class solution was considered uninterpretable, the comparison made between five- and four-class solutions would suffer interpretation difficulties (see Table 5d). With a lower BIC, significant BLRT, and a high entropy value, the three-class solution shows a better solution than a more parsimonious two-class solution.

Cross-cultural Similarities and Differences among Profiles. Standardized scores on each of the four social-emotional competencies were calculated to identify latent profiles in each country differ from one another. Figure 1 shows the standardized scores of each identified profile in Canada, the United States, China, and Singapore.

One profile is found in all four different countries. This group of students showed a mild negative standardized score on self-awareness (Canada: -.029; China: -.083; Singapore: -.065;

US: -.07), self-management (Canada: -.079; China: -.182; Singapore: -.13; US: -.10), social awareness (Canada: -.22; China: -.30; Singapore: -.367; US: -.275), and relationship skills (Canada: -.123; China: -.294; Singapore: -.233; US: -.167). We labelled this group of students as *Reserved* because students' responses suggest that they have relatively lower self-awareness, self-management, social awareness, and relationship skills. The profile is the largest classification in each country: 76.53% in Canada, 75.28% in US, 65.87% in China, and 68.9% in Singapore). Western countries have nearly 10% more adolescents being classified into the Reserved profile compared to Eastern countries.

A second largest group was found in three countries: Canada (19.1%), the United States (21.33%), and Singapore (27.68%). This profile shows a modest positive self-awareness (*M*s range between .23 and .318) and self-management (*M*s range between .338 - .482), while reporting strong social awareness (> 1 SD). This group of individuals were also keen on group work, with high relationship skills (*M*s range between .769 - .806). Hence, we named this profile as *Sociable*, given the pattern of four social-emotional skills. In China, the second largest group (27.65%) reported strong relationship skills ($M = 1.207$) coupled with a moderate social awareness ($M = .902$). In addition, this group has positive self-awareness ($M = .355$) and shows moderate self-management ($M = .473$). We therefore labelled this particular profile as *Team-oriented*.

A third group, showing a similar pattern of social-emotional skills, was found in Canada (4.37%), the United States (3.39%), and Singapore (3.41%). Not only did adolescents in the profile report low self-awareness (*M*s range between -.558 and -.74) and low self-management (*M*s range between -.255 and -.969), they also showed a very high negative score on social awareness (*M*s > -2.5) and relationship skills (*M*s range between -1.511 and -1.783). We labelled

this profile as *Withdrawn*. Contrasting to the Withdrawn profile, the third group found in China exhibited a milder yet negative view on self-management (M = -.191), and a moderately negative perspective on self-awareness (M = -.68) and social awareness (M = -.831). This profile, however, reported very low relationship skills (M = -2.205), and thus we named this group as *Solitary*.

Differences in PISA Test Scores

The goal of identifying social-emotional profiles was to then allow us to examine which groups would obtain higher PISA test scores in reading, math, and CPS. In addition, the investigation of cross-national social-emotional profiles was to further evaluate if the countries produced the same pattern of results in PISA achievement. We expected that adolescents with adaptive social-emotional profile (e.g., the Social profile) will obtain higher scores on PISA tests than those with less adaptive social-emotion profile (e.g., the Withdrawn profile).

Table 7 shows the differences in PISA tests scores in reading, math and CPS among profiles within each sampling country. Significant overall differences in PISA reading, math, and CPS were found among Sociable, Reserved, and Withdrawn profiles in Canada, Singapore and United States. To identify where the actual differences lie, pair-wise comparison was used. Given the multiple comparisons made, a more stringent approach (i.e., $p < 0.0167$ instead of 0.05) to interpreting the pair-wise profile comparisons was used by adjusting the total numbers of comparison to control for inflated Type 1 error. Across all three sampling countries with SESP, the Sociable profile consistently obtained higher scores in reading and math than the Reserved profile as well as the Withdrawn profile, ps < .01. In addition, the Reserved profile performed better than the Withdrawn profile on the PISA test of reading and math. A similar pattern was found on PISA's CPS test scores, in which the Sociable profile did better than the

Reserved profile and the Withdrawn profile, and the Reserved profile obtained higher score than the Withdrawn profile, while this pattern was shown only in Western sampling countries—Canada and United States. There was no significant difference between Sociable and Reserved profiles (Wald χ^2 (1) = 3.621, p = .057) in the Singaporean sample. In spite of this, the difference in CPS scores between the Sociable and Withdrawn profiles (Wald χ^2 (1) = 28.161, p < .0001) and between the Reserved and Withdrawn profiles (Wald χ^2 (1) = 21.698, p < .0001) were still observed.

In China, the Team-oriented profile outperformed the Reserved profile on all three PISA tests (Reading: Wald χ^2 (1) = 52.473, p < .000; Math: Wald χ^2 (1) = 41.495, p < .0001; CPS: Wald χ^2 (1) = 48.032, p < .0001). However, there were no significant differences between the Team-oriented and Solitary profiles on two of the three PISA tests—math (Wald χ^2 (1) = 3.727, p = .054) and CPS (Wald χ^2 (1) = 3.121, p = .077), More interestingly, the Solitary profile obtained higher PISA reading scores than Team-oriented profile, Wald χ^2 (1) = 15.398, p < .0001. The Solitary profile also did better on all three PISA tests than the Reserved profile (Reading: Wald χ^2 (1) = 59.485, p < .0001; Math: Wald χ^2 (1) = 28.184, p < .0001; CPS: Wald χ^2 (1) = 29.338, p < .0001).

Discussion

Studying social-emotional competencies is important because of the positive impact on students' social behaviours and academic attainment while minimizing conduct problems and emotional distress (e.g., Durlak et al., 2011). Furthermore, investigating social-emotional competencies across cultures allows researchers to evaluate possible differences rooted in distinct national values and beliefs toward emotional expression, management, and social engagement. Our study was conducted to explore the measurement invariance of four social-

emotional competencies using samples from Western and East Asian countries, to identify person-centred social-emotional profiles in each country—Canada, United States, China, and Singapore, and to examine how profiles differed on performance in an international assessment of reading, mathematics, and collaborative problem-solving (CPS). We address the measurement issue first and then turn to the substantive contribution made by the profiles, their relationships with outcomes, and differences by country. In this vein, we consider Canada, the United States, and Singapore together and then China separately. In our discussion we also describe the implications of our results for theory, research, and practice.

Measurement Invariance

The definitions and scales used to assess social-emotional skills are diverse and often thought to lack specificity (e.g., Halle & Darling-Churchill, 2016). From a practical perspective, CASEL has been an influential organization in social-emotional research and programming and offers four core social-emotional competencies that give rise to a fifth competency related to decision making. As such, we turned to CASEL for structure when selecting items from PISA to measure social-emotional skills. Our results provide evidence about the reliability and validity of the four social-emotional competencies model forwarded by CASEL. Although our factors represent only a portion of the each of competencies named by CASEL, their factor structure and indicators of internal reliability are strong and suggest that this is a viable way for researchers to operationalize a more applied framework in their empirical work.

In addition, this model showed strong measurement invariance in factor structure, loadings, and thresholds across the four countries. This means that adolescents in Canada, United States, China, and Singapore responded to items related to social-emotional competencies in a highly similar way despite being from nations with distinct cultural beliefs. An examination of the

correlation matrix shows that the average difference in *r* amongst the social-emotional factors was -.02 for Canada and the US and .06 for China and Singapore. In other words, these associations only began to differ at the second or third decimal point. In fact, even between Canada/US and China/Singapore, the differences in correlations were fairly small. Our finding of strong scalar invariance is a critical step forward in allowing cross-cultural comparisons of mean levels of social-emotional skills related to self-awareness, self-management, social awareness, and relationship skills.

Despite the strong evidence we provide for the four-factor model of social-emotional competencies and the invariance of these items across cultures, our work remains somewhat fragmented like the rest of the social-emotional literature. For example, our items and even number of factors differ from those used by Thomson et al. (2017) and Collie et al. (2018). While we advance the study of social-emotional skills by latent profile modeling and cultural considerations, without a strong and consistent measure of social-emotional skills to be included in assessments such as PISA, the work will progress more slowly than is desirable.

Canada, the United States, and Singapore: Similarities and Differences

We found the same three social-emotional skills profiles in respondents from Canada, the United States, and Singapore. Three profiles is fewer than was found in the other two LPA studies on social-emotional skills and may be a by-product of the fact that our profiles were extracting from combinations of four competencies rather than eight and five as used in Thompson et al. (2017) and Collie et al. (2018) respectively. Another important difference is that we did not have any factors that dealt with negative aspects of social-emotional skills such as aggression (Collie et al., 2018), and again this can be traced back to the positive nature of the items selected from PISA.

As mentioned at the outset, all three of these countries have integrated social-emotional competencies into their curriculum to some extent. In the United States, Dusenbury and Weissberg (2018) identified that 17 states have posted resources and guidelines regarding how to implement social-emotional learning, and CASEL (2018) has partnerships with 20 school districts to support development of social-emotional competencies. In Canada, social-emotional competencies are found in British Columbia's curriculum (2018), in Alberta Education's supporting documents (2016), and in Manitoba's guidelines (2017). The CASEL curriculum was introduced in Singapore in 2008 (Liem, Yvonne, Seng, Kamarolzaman, & Cai, 2017). Hence, despite the differences on the Hofstede's (2011) six cultural dimensions between Singapore as an Eastern country and Canada and the United States as Western countries, the discovery of similar social-emotional profiles may reflect similar exposure to social-emotional curriculum. Although not directly assessed, this also implies that social-emotional curriculum can bring about similar results in different culture contexts. This would be an interesting direction for future research.

Despite exposure to social-emotional curriculum, the largest profile for all three countries was labeled Reserved and had students with largely average scores on all four indicators of the social-emotional competencies. Nearly 70% of participants from each of the three countries were classified as Reserved. Students in the second profile had higher scores than students in the Reserved profile and were labeled Sociable. About 20%-27% of students from each country were in this profile and appeared to have a social-emotional advantage over their peers. The remaining 3-4% of students were classified in a profile characterized by a dislike for the social or collaborative components of social-emotional skills. As such we considered them Withdrawn. In terms of predicted beneficial outcomes, after discovering the profiles we expected the following pattern: Sociable > Reserved > Withdrawn.

We largely found this pattern for students in Canada and the United States. In the Canadian and US samples students in the Sociable profile outperformed both Reserved and Withdrawn profiles and students in the Reserved profile outperformed the Withdrawn on all three achievement outcomes. This adds to the evidence that in Western countries higher levels of social-emotional competencies are positively related to students' academic achievement (e.g., Nix, Bierman, Domitrovich & Gill, 2013; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014). Furthermore, it shows that performance in math, reading, and problem solving can be equally impacted by developing social-emotional competencies.

In Singaporean students in the Sociable profile did not differ significantly in terms of CPS performance from students in the Reserved profile. Both profiles of students, however, outperformed students in the Withdrawn profile on all three academic outcomes. In other words, academic advantage to being classified as Sociable compared to Reserved in the Singapore sample is more pertinent to traditional subjects—math and reading.

Another important distinction in performance can be identified with a closer look at the mean scores on the academic outcomes between countries. Singapore students in all three profiles, including Withdrawn, obtained higher average mean scores on all three indicators of success than students in the comparable profile from Canada and the US. In other words, even if being classified as Sociable did advantage them relative to similarly classified students from the Western countries. Deng and Gopinathan (2016) specifically discussed Singaporean students' success in international assessment. The authors attributed top performance to the country by ensuring high teacher quality, effective school leadership, productive system to promote academic expectations and monitoring, as well as educational reform to focus on aspects that are typically missed in collectivistic and Confucian societies, such as critical thinking. In addition,

outside school support (e.g., private tutoring) which is prominent education enrichment in East Asian countries also play a role in securing the top spots in PISA (Deng & Gopinathan, 2016).

Overall, although Canada, the United States, and Singapore produced the same three profiles of students' social-emotional skills, the effect of those combinations of skills on objective indicators of performance differed to some extent between countries. This suggests that perhaps there is a cultural influence that requires further research. One area for investigation may be to explore what cultural considerations contribute to the different functioning of social-emotional skills between the countries.

China: Profiles and Performance

The largest profile in the Chinese sample was the same Reserved profile as identified in the other three countries. However, then two different profiles emerged. The Team-oriented profile showed a strong interest in team work that aligns well with the Chinese value of social harmony. In contrast, the Solitary profile could be in part related to tradition value of achievement and knowledge gained (Chen & Uttal, 1988). In particular, Yang, Zheng, and Li (2006) discussed that traditional Chinese culture emphasizes the importance of accurately retaining previous information over the critical thinking of a problem in education. Hence, a strong social awareness might be deemed secondary in a learning context and less adherent to these tradition values among this group of adolescents.

In terms of differences in performance, students classified in the Solitary profile performed better than students in the Reserved profile in math, reading and problem solving and the Team-oriented profiles in reading. This runs contrary to Western findings in which higher social-emotional competencies are typically associated with higher academic achievement (Nix, Bierman, Domitrovich & Gill, 2013; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014) and

reinforces the need for cultural lenses in this sort of research. As Yoo and Miyamoto (2018) discuss, when there is a fit between an individual's emotional expression (and by extension social engagement) and the cultural normative expectations, more adaptive outcomes are expected because it is easier to access psychological and social resources. This cultural fit model could possible explain the strong results in favor of Chinese students in the Solitary profile. The focus on examination and competition in China (Dello-Iacovo, 2009) might be better matched with the Solitary profile. Furthermore, focusing on obtaining high scores was found to be positively associated with students' well-being in China (Tian, Yu & Huebner, 2017). This may explain why the Solitary profile obtained higher scores, as students in this profile fit in the cultural expectation for success.

As was noted by Chen, Fu, Liu, Wang, Zarbatany, and Ellis (2018), students in urban Chinese regions are exposed to more westernized values, coupled with their traditional value on maintaining group harmony (e.g., Zhang et al. 2013), this might explain why the Solitary profile and Team-oriented profile did not differ in CPS and math. Being more attuned to oneself (in terms of self-awareness and self-management) and showing a strong interest in relationship skills, students in the Team-oriented profile had advantages over students in the Reserved profile: they achieved higher scores on the measure of math, reading and collaborative problem solving.

Overall, not only were the profiles of social-emotional competencies somewhat different for the Chinese sample relative to the Canada, the United States, and Singapore, but the effects of the profiles were—to some extent—contrary to typical Western results. In China, it seems that more social-emotional competence, at least in the form of social awareness and relationships, is not associated with heightened achievement. Thus, although the four social-emotional

competencies were similar at conceptual and measurement levels, the function of social-emotional competencies were impacted by the cultural perspectives of the country that value individual effort and harmony.

Limitations and Implications

The results of this study need to be considered in light of the following two limitations. First, this study suffers from several limitations inherent to the use of pre-existing data; these include some important variables not being available, limited items available for a construct, scales of measurement were predetermined (e.g., Cheng & Philips, 2014; Hofferth, 2005; Trzesniewski et al., 2011). Specifically, secondary datasets typically have significant breadth of content, rather than depth of measurement (i.e., constructs often only have an item or two; Trzesniewski et al., 2011) and this is certainly true of the coverage of social-emotional skills in PISA in our study. In particular, we were only able to identity two items that captured a narrow scope of what CASEL proposed in the competency of self-awareness. Because there were only a small number of items (i.e., two to four items) loaded on each social-emotional competency factor, this might limit the generalizability of the measurement model. Nevertheless, guided by CASEL's framework we selected items to group together and analyzed a measurement model to examine the fit between our items and the constructs of interest. The face validity of the individual items selected was appropriate, and the relationships found in our study are consistent with others who have examined similar constructs. Despite this, we were only able to capture a small portion of the description of each social-emotional competency and did not measure the fifth competency. This may have resulted in fewer latent profiles than existing LPA research has produced (Collie et al. 2018, Thompson et al., 2017). Future research may consider developing a social-emotional competencies scale and collecting representative data to replicate the findings

in present study. Indeed, given the increasing global awareness of the benefits of social-emotional skills (e.g., Hecht & Shin, 2015; You & Kim, 2016; Van Huynh, Tran-Chi, & Nguyen, 2018), PISA would greatly benefit from having a free-standing scale included in its administration. Although these limitations are substantial, they are offset by the fact that PISA allowed us to access a representative and large sample of students from several countries that would not have been otherwise possible.

Second, despite the inclusion of students from four culturally distinct countries, our results may not generalize well to other nations, such as Japan and Germany. While PISA has data available from many more countries, more comprehensive statistical tests are currently limited by laborious computations in latent analyses. In a similar vein, although country is a good marker of culture, the two are not synonymous. This may be particularly true for the portion of each sample that was not born in their affiliated country. For PISA to look more acutely at the impact of culture rather than differences between countries, it may way to include a self-report measure of cultural beliefs (e.g., Chiu, Chia, & Wan, 2015).

Conclusions

Cross-cultural studies have consistently demonstrated differences between the East and the West. Findings from the present study further reiterate the importance of taking cultural perspective in promoting social-emotional skills in countries embracing values, beliefs and norms that are distinctive from western individualistic ideology. The results presented herein should remind researchers to not overgeneralize their results beyond the cultural boundaries of their participants. Our results should also challenge theorists to produce conceptual models in which social-emotional skills are balanced with the cultural values related to social and emotional behaviours. Finally, teachers and interventionists, need to make sure that messages

and curriculum about social-emotional skills are designed and delivered in a way that is consistent with the values and priorities of the country.

While more social-emotional competence resulted in better outcomes for students in Canada and the US, the benefits of "more" were less pronounced in Singapore and simply not found in China. Cultural fit should be taken into consideration when promoting skills to countries. With that in mind, this research only looked at the effect of social-emotional skill profiles on academic outcomes. Although these are highly important outcomes, we cannot generalize our results to non-academic indicators of success or wellbeing, which are becoming increasingly important for educators and students alike. Future research is needed with a broader range of outcomes to test the cultural benefit of social-emotional profiles beyond achievement.

Footnote

[1]It should be noted that in China, participants represented adolescents living in Beijing, Shanghai, Jiangsu and Guangdong.

[2]PISA 2015 student background questionnaire was distributed to all student participating in the assessment (OECD, 2017). This means that all participants filled out the questionnaire. Missing data were handled using MPlus' default estimation—Full Information Maximum Likelihood—a widely employed approach that is used in many statistical packages and has been found to be more superior than other techniques (e.g., listwise deletion; Enders, 2001)

[3]CFI and RMSEA were chosen to evaluate the model fit, because they were the two most commonly (78.4% and 64.9%) reported fit indices in confirmatory factor analysis (Jackson, Gillaspy, Jr., & Purc-Stephenson, 2009).

[4]We also conducted LPA with BCH separately for 10 plausible values in each subject area for each country. Given that there was no significant practical difference and the averaged values offered a practical avenue for interpretation on how students belong to different profiles did on these subject areas, we decided to use the results from averaged values for interpretation.

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Table 1
Description of each CASEL Competency and Items selected from PISA as proxies to measure the competencies

CASEL label	Description of Competency	Items from PISA
Self-awareness	The ability to accurately recognize one's own emotions, thoughts, and values and how they influence behavior. The ability to accurately assess one's strengths and limitations, with a well-grounded sense of confidence, optimism, and a "growth mindset."	1. I feel like an out things) at schoo 2. I feel lonely at s
Self-management	The ability to successfully regulate one's emotions, thoughts, and behaviors in different situations — effectively managing stress, controlling impulses, and motivating oneself. The ability to set and work toward personal and academic goals.	1. I want to be able among the best available when I 2. I want to be the 3. I see myself as a person.
Social awareness	The ability to take the perspective of and empathize with others, including those from diverse backgrounds and cultures. The ability to understand social and ethical norms for behavior and to recognize family, school, and community resources and supports.	1. I take into accou interested in 2. I enjoy seeing m successful 3. I enjoy consider perspectives
Relationship skills	The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. The ability to communicate clearly, listen well, cooperate with others, resist inappropriate social pressure, negotiate conflict constructively, and seek and offer help when needed.	1. I prefer working to working alone 2. I find that teams decisions than in 3. I find that teamw own efficiency 4. I enjoy cooperat

Note. CASEL description is obtained from https://casel.org/core-competencies/

Table 2.
Reliabilities and Descriptive Statistics

	Canada			USA			China		
	α	Mean	SD	α	Mean	SD	α	Mean	SD	α

Self-awareness	0.811	6.095	1.585	0.803	6.126	1.536	0.724	5.955	1.393	0.781
Self-management	0.750	9.835	1.747	0.756	10.387	1.585	0.697	9.704	1.563	0.718
Social awareness	0.751	9.334	1.484	0.715	9.397	1.435	0.642	9.368	1.342	0.665
Relationship skills	0.836	11.618	2.592	0.838	11.773	2.524	0.837	12.652	2.144	0.822

Table 3. Correlations

	Self-awareness	Self-management	Social awareness	Relationship skills	PISA reading	PISA math	PIS CP
Self-awareness	1	.117	.169	.227	.050	.102	.00
Self-management	.193	1	.261	.110	.178	.172	.13
Social awareness	.142	.281	1	.470	.130	.137	.13
Relationship skills	.242	.215	.449	1	-.171	-.127	-.17
PISA reading	.003	.100	.162	-.165	1	.869	.87
PISA math	.029	.097	.132	-.129	.891	1	.79
PISA CPS	-.029	.086	.170	-.117	.879	.849	1

	Self-awareness	Self-management	Social awareness	Relationship skills	PISA reading	PISA math	PIS CP
Self-awareness	1	.116	.193	.255	.120	.147	.09

Self-management	.051	1	.320	.232	.117	.119	.05
Social awareness	.147	.199	1	.530	.167	.156	.16
Relationship skills	.190	.145	.497	1	-.020	-.009	.00
PISA reading	.072	.033	.101	-.151	1	.903	.84
PISA math	.094	.029	.099	-.104	.897	1	.83
PISA CPS	.058	.028	.106	-.111	.873	.833	1

Note. The top panel includes coefficients for the Canadian sample above the diagonal and the US sample below the diagonal. The bottom panel includes coefficients for the Chinese sample above the diagonal and the Singaporean sample below the diagonal.
Coefficients greater than |.033 |are significant at $p < .01$, |.020 |coefficients < |.033 | are significant at $p < .05$

Table 4. DWLS Confirmatory Factory Analysis and Test of Invariance (Four-Factor Model)

Models	χ^2	df	RMSEA	90% CI RMSEA		TLI	CFI	Δ C
Four-factor model								
Canada	3093.152	48	.059	.057	.061	.987	.991	
USA	641.261	48	.048	.045	.052	.992	.994	
China	1163.156	48	.050	.047	.052	.991	.993	
Singapore	673.002	48	.047	.044	.050	.990	.993	
Baseline (combined)	4531.704	48	.049	.048	.050	.991	.993	
Test of invariance								
Configural	5570.571	192	.054	.052	.055	.989	.992	
Weak (loadings)	6204.008	216	.053	.052	.055	.989	.991	.00
Strong (loadings and thresholds)	7236.961	276	.051	.050	.052	.990	.990	.00

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA= Root Mean Square Error of Approximation

Table 5a.
Latent Profile Analysis Indicators (Canada)

	Class 2	Class 3	Class 4	Class 5
df	13	**18**	23	*28*
Loglikelihood	-105965.26	**-103109.11**	-101769.29	*-101406.06*
Loglikelihood Scaling Correction factor	1.9431	**1.5827**	1.414	*1.4498*
AIC	211956.52	**206254.21**	203584.58	*202868.11*
BIC	212058.87	**206395.93**	203765.67	*203088.57*
Adjusted BIC	212017.56	**206338.73**	203692.57	*202999.59*
Entropy	0.907	**0.887**	0.931	*0.886*
Luong-Lo-Mendell-Rubin (p-value)	0	**0**	0	*0*
Adjusted LMR (p-value)	0	**0**	0	*0*
BLRT (p-value)	0	**0**	0	*0*

Note. Bolded numbers indicated selected model. Italicized indices were not trustworthy.

Table 5b.
Latent Profile Analysis Indicators (USA)

	Class 2	Class 3	Class 4	Class 5
df	13	**18**	23	28
Loglikelihood	-30608.609	**-29971.382**	-29757.85	-29551.844
Loglikelihood Scaling Correction factor	2.0775	**1.7569**	1.7439	1.6536
AIC	61243.219	**59978.764**	59561.7	59159.688
BIC	61329.42	**60098.12**	59714.211	59345.352
Adjusted BIC	61288.11	**60040.922**	59641.124	59256.377
Entropy	0.493	**0.86**	0.809	0.829
Luong-Lo-Mendell-Rubin (p-value)	0.0039	**0.0001**	0.004	0.0273
Adjusted LMR (p-value)	0.0044	**0.0001**	0.0045	0.029
BLRT (p-value)	0	**0**	0	0

Note. Bolded numbers indicated selected model.

Table 5c.
Latent Profile Analysis Indicators (China)

	Class 2	Class 3	Class 4	Class 5
df	13	**18**	23	28
Loglikelihood	-52813.614	**-51718.081**	-51124.2	-50654.813
Loglikelihood Scaling Correction factor	1.4681	**1.5984**	1.8911	1.7552
AIC	105653.228	**103472.16 1**	102294.4	101365.62 7
BIC	105746.683	**103601.56**	102459.74 2	101566.91 3
Adjusted BIC	105705.371	**103544.35 9**	102386.65 2	101477.93 4
Entropy	0.8	**0.891**	0.919	0.889
Luong-Lo-Mendell-Rubin (p-value)	0	**0**	0.0067	0
Adjusted LMR (p-value)	0	**0**	0.0073	0
BLRT (p-value)	0	**0**	0	0

Note. Bolded numbers indicated selected model.

Table 5d.
Latent Profile Analysis Indicators (Singapore)

	Class 2	Class 3	Class 4	Class 5
df	13	**18**	*23*	28
Loglikelihood	- 33530.917	**- 32789.166**	- *32555.502*	- 32387.789
Loglikelihood Scaling Correction factor	1.3689	**1.6874**	*1.59*	2.1261
AIC	67087.834	**65614.333**	*65157.003*	64831.577
BIC	67175.124	**65735.195**	*65311.438*	65019.585
Adjusted BIC	67133.813	**65677.996**	*65238.351*	64930.609
Entropy	0.637	**0.861**	*0.869*	0.855
Luong-Lo-Mendell-Rubin (p-value)	0	**0**	*0.0052*	0.1973
Adjusted LMR (p-value)	0	**0**	*0.0057*	0.2016
BLRT (p-value)	0	**0**	*0*	0

Note. Bolded numbers indicated selected model. Italicized indices were not trustworthy.

Table 6
Scores of each latent profile identified

	Self-awareness	Self-management	Social awareness	Relationship skills
	Z Score	Z Score	Z Score	Z Score
		Canada		
Sociable (3707)	0.275	0.452	1.393	0.806
Reserved (14854)	-0.029	-0.079	-0.22	-0.123
Withdrawn (848)	-0.74	-0.69	-2.512	-1.511
		USA		
Sociable (1195)	0.318	0.482	1.309	0.802
Reserved (4217)	-0.07	-0.1	-0.275	-0.167
Withdrawn (190)	-0.558	-0.969	-2.544	-1.587
		China		
Team-oriented (2706)	0.355	0.473	0.902	1.207
Reserved (6447)	-0.083	-0.182	-0.3	-0.294
Solitary (634)	-0.68	-0.191	-0.831	-2.205
		Singapore		
Sociable (1686)	0.23	0.338	1.172	0.769
Reserved (4197)	-0.065	-0.13	-0.367	-0.233
Withdrawn (208)	-0.622	-0.255	-2.517	-1.783

Table 7.
BCH results

	Sociable			Reserved			Withdrawn			Ove	
						Canada					
	Min	Max	Est.	Min	Max	Est.	Min	Max	Est.	Min	*p*
CPS	533.36	538.44	535.64	526.53	529.78	527.96	480.00	489.73	484.21	103.55	0.00
Math	514.09	517.64	516.06	502.50	506.79	504.44	466.31	474.39	469.95	143.40	0.00
Reading	522.10	527.78	524.40	513.08	517.11	515.36	475.18	481.96	478.63	104.05	0.00
						USA					
CPS	538.31	544.29	540.52	517.53	521.81	519.99	455.43	479.63	469.54	41.94	0.00
Math	474.92	480.01	478.17	467.83	471.31	469.74	419.86	435.23	428.77	26.16	0.00
Reading	509.14	517.07	514.06	495.03	497.04	496.05	449.82	460.40	457.21	35.04	0.00
						Singapore					
CPS	558.44	561.66	560.16	553.25	556.04	554.73	510.25	528.82	520.28	13.11	0.00
Math	560.32	566.28	563.59	554.59	557.92	555.45	522.76	531.08	525.71	22.14	0.00
Reading	531.62	536.18	533.80	523.83	526.98	526.00	494.10	507.06	499.81	14.31	0.00
	Team-oriented			Reserved			Solitary			Overall Chi	
						China					
	Min	Max	Est.	Min	Max	Est.	Min	Max	Est.	Min	*p*
CPS	511.94	517.78	514.73	498.93	500.94	500.10	515.87	524.60	522.13	31.19	0.00
Math	547.79	554.09	551.02	534.27	538.58	535.99	553.43	565.29	559.97	42.89	0.00
Reading	512.66	519.60	516.41	498.16	500.60	499.22	526.54	538.46	535.11	62.03	0.00

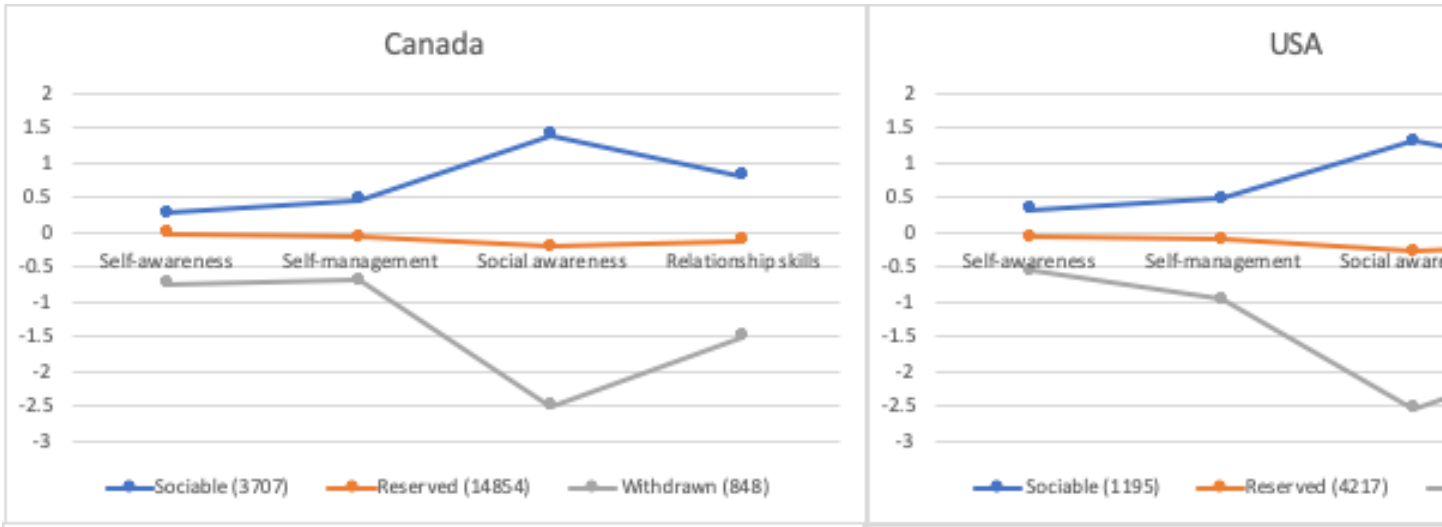
Note. Est. was the value derived from BCH on the averaged 10 plausible values.

	Reserved vs. Withdrawn	Withdrawn vs. Sociable	Reserved vs. Soci
		Canada	

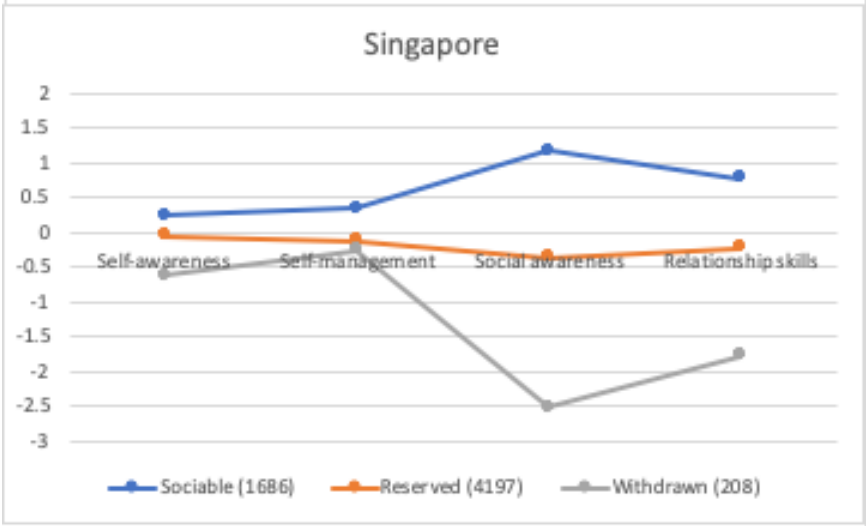
	SC1	SC2	Chi-Square#	*p*#	SC1	SC2	Chi-Square#	*p*#	SC1	SC2	Chi-Square
CPS	10	10	141.52	0.000	10	10	174.23	0.000	9	9	17.06
Math	10	10	115.66	0.000	10	10	184.74	0.000	10	10	52.01
Reading	10	10	107.75	0.000	10	10	150.11	0.000	10	10	26.94
						USA					
CPS	10	10	31.34	0.000	10	10	59.24	0.000	10	10	34.32
Math	10	10	27.49	0.000	10	10	37.98	0.000	7	7	7.63
Reading	10	10	18.99	0.000	10	10	39.00	0.000	10	10	28.94
						Singapore					
CPS	10	10	21.70	0.000	10	10	28.16	0.000	1	2	3.62
Math	10	10	17.33	0.000	10	10	27.04	0.000	6	7	7.72
Reading	10	10	12.08	0.001	10	10	19.65	0.000	4	6	6.62
		Solitary vs. Reserved				Solitary vs. Team-oriented				Reserved vs. Team-o	
						China					
	SC1	SC2	Chi-Square#	*p*#	SC1	SC2	Chi-Square#	*p*#	SC1	SC2	Chi-Square
CPS	10	10	29.34	0.000	1	2	3.12	0.077	10	10	48.03
Math	10	10	28.18	0.000	3	5	3.73	0.054	10	10	41.50
Reading	10	10	59.49	0.000	9	9	15.40	0.000	10	10	52.47

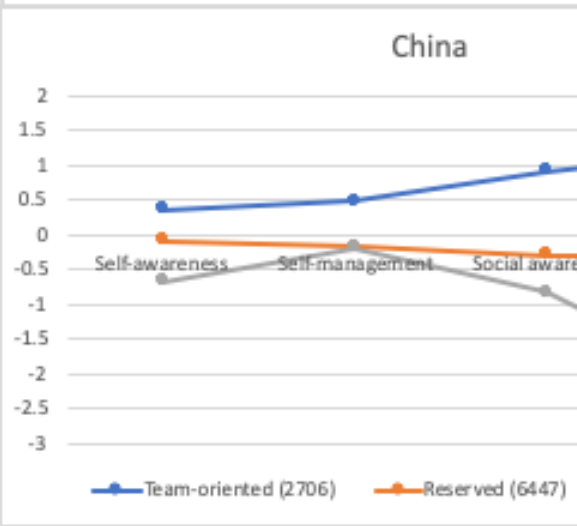
Note. SC1 indicates the number of significant comparisons at $p < .0167$ when 10 plausible values were analyzed separately. SC2 indicates the number of significant comparisons at $p < .033$ when 10 plausible values were analyzed separately. #Chi-Square test was performed on the averaged 10 plausible values to derive one single estimate.

Figure 1. Three-class solution in each country


Canada
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Self-awareness
Self-management
Social awareness
Relationship skills
Sociable (3707)
Reserved (14854)
Withdrawn (848)

USA
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Self-awareness
Self-management
Sociable (1195)
Reserved (4217)


Singapore
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Self-awareness
Self-management
Social awareness
Relationship skills
Sociable (1686)
Reserved (4197)
Withdrawn (208)


China
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Self-awareness
Self-management
Team-oriented (2706)
Reserved (6447)