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# Variability in Asian parents' English and mathematics skills: A family-based study

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What explains parental English word reading and mathematics performance? The present study examined whether parent-, family-, and child-related variables explain parents' English word reading and mathematics performances among two groups of Asian parents. The data were collected from 152 Hong Kong and 280 Cebu City (Philippines) parents who learn English as a second language. The academic performances of their children (Hong Kong: Mean age = 8.72 years; Cebu City; Mean age = 6.59 years) were also measured. Regression analysis results suggested that, across both groups, parents with higher education levels tended to perform better in English word reading. In addition, in Hong Kong, but not the Philippines, family income was a unique correlate of parental English word reading performance, whereas in the Philippines, but not Hong Kong, the parent's own mathematics skill and the child's own English word reading skill were also uniquely associated with parental English performance. Across both groups, parents' mathematics skills were associated with better literacy skills. In addition, in Hong Kong, more positive attitudes toward mathematics were additionally predictive of better mathematics performance, as were children's own mathematics performances. In the Philippines only, mothers tended to be poorer in mathematics than fathers. Such results underscore the complexity of family related literacy and mathematics, including family status and intergenerational effects.

## KEYWORDS

family status, intergenerational effect, parental academic performance, Philippines, Hong Kong

## Introduction

Both individual and family related characteristics have been widely recognized as important correlates of academic performance in children and adolescents across cultures (e.g., Chiu and McBride-Chang, 2006, 2010; Dearing et al., 2006; Friend et al., 2009; Chiu, 2010; Chung et al., 2017; Dulay et al., 2019a). However, variability

in parents' own academic skills is less well understood. Understanding variability in parents' actual academic skills is important since such skills play important roles in their children's development (e.g., [Dulay et al., 2019a](#); [Cheung et al., 2020](#)). Moreover, there is a bidirectional association between parents and children that is recognized but underexplored (e.g., [De Mol and Buysse, 2008](#)).

The correlates of academic skills may change across the lifespan. Factors that are important for achievement in children or young adults may be irrelevant in older adults. For example, grades in high school were found to be a significant predictor of academic attainment in young adults, but not for mature-age college students ([Power et al., 1987](#)). Research on the significant correlates of academic skills in adults has typically focused on young adults (university students) aged between 18 and 30 (e.g., [McKenzie and Schweitzer, 2001](#); [Clifton et al., 2008](#); [Sheard, 2009](#)) or older adults over the age of 50 (e.g., [Imlach et al., 2017](#)). Findings in these studies cannot directly generalize to parents of young children.

According to Bronfenbrenner's ecological system theory (1994), human development results from the interaction of individuals and their vibrant, complex environments. The environment is largely defined by a nested series of systems, including both the microsystem, which includes bidirectional associations within the family, and the macrosystem, which, in part, includes cultural background. In the present study, we examined correlates of parents' own mathematics and English word reading skills in Hong Kong and in Cebu City, the Philippines. We sought to determine what parent-, family-, and child-related variables would explain academic achievement in these two very different Asian societies. In both societies, competitive English skills are useful for better-paying jobs; English is a foreign language that is taught in school from primary school onward in both places. In addition, basic mathematics skills are important for all families, both for work and for everyday life, which often involves shopping and paying bills. Simultaneously, these two societies are very different in socioeconomic status (SES), educational policies, and local cultures. Therefore, we sought to explore the similarity and uniqueness in correlates of parents' academic performance in the two Asian societies. Below, we review the individual, general family, and child-specific variables tested in the present study to explain parents' own academic achievement in L2 English and in mathematics.

## Parent-related factors

We anticipated that among the strongest correlates of English and mathematics performances in parents would be their individual characteristics. Along with general demographic factors such as gender and age, the present study also focused on parents' education level, as well as their own

academic skills as correlates of performances in L2 English and mathematics. Parents in both Hong Kong and Cebu had learned English as a second language (L2). In general, adults who acquire better L2 English skills often achieve higher status and education in their respective societies (e.g., [Cheung and Ng, 2003](#)). Education level may be an important factor of their general academic performance, not only in English but also mathematics.

In addition, we reasoned that those who are relatively good at one academic skill often tend to be better at another academic skill across development ([Wong and Chia, 1996](#); [Lu et al., 2011](#); [Karchach et al., 2013](#)). For example, research on a sample of 334 adolescents in Germany showed that g, or general intelligence, was the strongest predictor of academic achievement across domains ([Karchach et al., 2013](#)). Moreover, those adolescents' achievements in German and math were closely associated. Similar results were documented in a study carried out by [Lu et al. \(2011\)](#) among Chinese primary school children, wherein children's performance in Chinese and mathematics were moderately associated. Another study of Hong Kong undergraduate students found that their proficiency in mathematics was significantly associated with their English performance ([Wong and Chia, 1996](#)). Other studies also have found that individual performance in language dictates mathematics achievement in children ([Henry et al., 2014](#); [Prediger et al., 2015](#)), typically developing young adults ([Neville-Barton and Barton, 2005](#)), and even deaf college students ([Kelly and Gaustad, 2007](#)).

Moreover, parents' attitudes toward English and mathematics learning were included in the Hong Kong data collection; each parent's self-reported practice with English or mathematics was included in Cebu. These variables were conceptualized as indicators of English or mathematics interest. There are few, if any, studies investigating the associations between adults' interest in English or mathematics and their corresponding performance in that skill. However, there are relevant studies indicating that adults' adverse emotional responses to performing mathematics calculations, referred to as math anxiety, tend to be negatively associated with their mathematics performance ([Ferguson et al., 2015](#); [Hart and Ganley, 2019](#)). Therefore, we sought to examine whether parents' interest in English or mathematics would also be uniquely associated with their respective performance in this study.

## General family related characteristics

English serves as a foreign language that is useful for some work-related or societal goals in both Hong Kong and the Philippines. We hypothesized that SES factors such as family income and household size would be uniquely

associated with parents' L2 English reading attainments. SES factors tend to be a particularly sensitive predictor of L2 English reading, at least in children (Li et al., 2012; McBride-Chang et al., 2012; Chung et al., 2017). Similarly, given the importance of mathematics skills in the labor market in this historical period of the information society (Koedel and Tyhurst, 2011), we expected a possible close association between parents' SES factors and their own mathematics performance. This might be universal across different cultures. Therefore, family income and household size (the number of individuals living in one household) were included as indicators of family characteristics to investigate their associations with parental academic performance across both groups.

## Intergenerational effects from child to parent

In addition to the aforementioned general family related factors, children's own academic performance was also included as a potential correlate of parents' academic performance in this study. Traditional intergenerational effects have focused on how parents influence their children (e.g., Chiu and McBride-Chang, 2010; Karbach et al., 2013; Maloney et al., 2015; Dulay et al., 2019a,b; Cheung et al., 2020; de la Rie et al., 2020). The converse effect from children to parents was of interest in the current study.

Indeed, sociologists of childhood and family have demonstrated that children play an active role in family processes (Corsaro, 1997; Quadlin, 2015). However, this perspective has not yet been applied to matters of adults' academic performance. In contrast, for parental language performance, studies have demonstrated that children's characteristics tend to influence maternal speech (Huttenlocher et al., 2010; Schick et al., 2017; Mimeau et al., 2019). One study followed a large cohort of twins from infancy, along with their mothers, longitudinally, and found a bidirectional association between maternal speech and child characteristics, including language. Specifically, they demonstrated that infants influenced how their mothers spoke to them, which in turn affected the number of words the children could produce and comprehend later (Mimeau et al., 2019). Comparable results were also found in older children over 2 years old. In a longitudinal study of 47 parent-child pairs of diverse socio-economic status backgrounds from 14 to 46 months, not only did mothers' word diversity predict their children's subsequent word diversity, but children's word diversity also conversely affected mothers' later word diversity (Huttenlocher et al., 2010). Another study investigating maternal elaboration during story-telling found that children's language comprehension and production at 42 months predicted maternal elaboration half a year later

(Schick et al., 2017). Importantly, in another area, sociologists used longitudinal fixed-effects models to analyze the data from the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K) and found that children's academic performance in school affected parents' involvement in children's academic learning (Quadlin, 2015).

We sought to examine a similar child-parent association in this cross-cultural study with the following logic: Parents invest various resources in children's learning. Patterns of parental investment are largely consistent among children whose achievement is consistent over time (i.e., relatively steep vs. more gradual upward trajectory) (Quadlin, 2015). Young children who show better academic performance are likely to be given more parental resources such as parent-child interaction time which may associate with academic performance in both parents and children. Given that active effects from children to parents have been found in different fields and across different age groups during parent-child interactions, we tested for a similar effect in parents' skills in English as a second language and in simple mathematics skills in the present study.

## The present study in Hong Kong and Cebu

The present study includes data from two distinct groups of parents from Hong Kong and Cebu City, Philippines, respectively, with particular attention to patterns across groups. They were all parents of young children. In our Hong Kong sample, the children aged from 6 to 11 years, while in our Philippines sample, the children aged from 5 to 8 years. Parent-related variables and basic family characteristics were collected from self-reported parental questionnaires in both groups. These studies were conducted separately within a couple of years of one another but were planned separately, so the measures included were similar but not identical.

The link between family characteristics and literacy learning differs somewhat across cultures (Chiu and McBride-Chang, 2006, 2010). Similarly, it was hypothesized that the associations of parent-, family- and child-related factors and parents' academic performance might be different across the cities in different levels of SES. The GDP per capita of Hong Kong is approximately 15 times greater than that of the Philippines (World Bank, 2019). In general, socioeconomic gaps tend to introduce differences in home learning environment with regard to accessibility to learning resources and the frequency of engagement in home literacy or numeracy activities, such as shared-book reading, online vocabulary game playing, or practicing number concepts (Leseman and de Jong, 1998; Aikens and Barbarin, 2008; Huang et al., 2017; Dulay et al., 2019b). More frequent home learning activities in developed locations imply more parent-child interactions, which may lead to a closer association between children's and parents' academic

performance. In addition, the relationship between economic development and education in the Philippines is different from that in Hong Kong (Maca and Morris, 2012). Generally, economic development and educational performance in society are mutually reinforcing. However, although the Philippines has among the highest rates of adult literacy and a high education participation rate (United Nations Development Programme Human Development Reports, 2019), the country has failed to achieve rapid economic growth, a different situation from that in some of its Asian neighbors (Maca and Morris, 2012), such as Hong Kong.

In summary, this paper aimed to examine how different personal and family related characteristics including children's academic performance explained parents' own academic skills and different patterns of the relationships were expected across two different Asian cultural contexts.

## Materials and methods

### Participants and procedures

In Hong Kong, participants were parents with their children who have participated in a longitudinal twin study on literacy and mathematics development in Hong Kong from 2013 to the present (Wong et al., 2017). Parents in this sample were aged 29–58 years old ( $M = 43.49$ ,  $SD = 5.19$ , 66% mothers). Children in this sample ranged in age from 6 to 12 years old ( $M = 8.72$ ,  $SD = 1.07$ , 51% girls). They were recruited by randomly selecting one child from each pair of twins. Participants lived in relatively small households consisting of approximately 4 family members in a given household ( $M = 3.72$ ,  $SD = 1.00$ ). Over 60% of participating parents had attained a post-secondary (associate degree or higher diploma) level of education or above. All participants were native Chinese speakers and spoke English as a second language. Parent participation was voluntary in the course of child participation in the broader study.

In Cebu, Philippines, participants were recruited from four adjacent communities with a low- to middle-income profile. These parents and children participated in a longitudinal intervention study in Cebu from 2015 to 2018 (Dulay et al., 2018). Parents in this sample were aged 22–54 years old ( $M = 32.95$ ,  $SD = 6.74$ , 89% mothers). Children in this sample ranged in age from 5 to 8 years old ( $M = 6.59$ ,  $SD = 0.87$ , 50% girls). Participants reported living in relatively large families, with approximately 7 family members in one home on average ( $M = 7.21$ ,  $SD = 3.55$ ) and about 84.6% of participating parents had reached a high school level of education or above. All participants were native Cebuano speakers and spoke English as a second language.

Ethics approval was granted by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong. Written consent was obtained from parents for

both their own and their children's testing. In Hong Kong, children and parents were tested individually at home or at school or in a university center depending on parents' convenience. The duration of the tasks was about 20 min for child testing including English word reading and mathematics. It also took about 30 min for parent testing including a parent questionnaire and parents' own performances in Chinese dictation (in Hong Kong only, we additionally tested native language writing/spelling skill), English word reading, and mathematics. Testing was administered by trained research assistants or undergraduate student helpers majoring in Psychology.

In Cebu, tasks were conducted in participants' homes by trained Cebuano-speaking research assistants with undergraduate psychology degrees. Due to various concerns within the communities, data collectors were accompanied by teachers of a collaborating non-government organization. Teachers were also trained to help with administering all tasks to parents; teachers read out items on the parent questionnaire upon request. The duration of the tasks was about 15 min for child testing, including English word reading and mathematics. It took about 40 min for parent testing, including a parent questionnaire and their own performances in English word reading and mathematics.

### Measures in Hong Kong

#### Hong Kong parent questionnaire

Parents were required to fill in a parent questionnaire which includes two subscales regarding some demographic information, family characteristics in one subscale, and their attitudes toward learning in the other one. Specifically, in one subscale, their education levels on a scale from 1 to 7, with 1 = "Form 3 or below," 2 = "Form 4 to Form 5," 3 = "Form 6 to Form 7," 4 = "Post-secondary (Associate Degree or Higher Diploma)," 5 = "Bachelor's Degree," 6 = "Master's Degree," 7 = "Doctoral Degree." In addition, they were also asked to report their household size (no. of residents in the household) and monthly household income on a scale from 1 to 6, with 1 = "Less than \$10,000," 2 = "\$10,001–\$20,000," 3 = "\$20,001–30,000," 4 = "\$30,001–\$40,000," 5 = "\$40,001–\$50,000," and 6 = "\$50,001 or above."

Another subscale, including two sections of self-reported items, was developed by referring to one administered in a previous study (LeFevre et al., 2009). In one section of this questionnaire, parents were asked to indicate on a scale of 1 to 5 their attitudes toward English learning (e.g., the importance of reading English books for children, the importance of learning English, and the desire for their children to have good English attainment). This section included 6 items. In the other section, parents were asked to indicate on a scale of 1 to 5 regarding their attitude toward learning mathematics (e.g., their interest

or ability in mathematics when they themselves were in school, as well as their interest in mathematics-related activities). This section included 5 items. The scores in two sections were used to assess their attitudes toward learning English and mathematics, respectively.

### Parents' Chinese dictation

A Chinese dictation task was administered to assess parents' Chinese writing ability. This test was conducted in either Cantonese or Mandarin, depending upon parents' preferences (writing is the same in both). It includes ten two-character words which were selected from the dictionary to be relatively difficult such that not all parents would know how to write these words following pilot testing with some university students. The words were orally represented in increasing difficulty. One word was presented twice. One mark was given for each correctly written character. Thus, the maximum possible score was 20.

### Parents' English word reading

An English silent word reading was administered to measure parents' word identification fluency in English (Kalindi et al., 2015). The test consists of two subtests, namely, individual word reading and contextualized word reading. In the individual one, participants were presented with 25 chains of unrelated words. For the contextualized word reading subtest, participants were presented with 20 sentences in a word chain. The chains in the two subtests are all printed in lowercase letters without spaces between letters. They were asked to separate the words using lines in each subtest, each of which lasted 4 min. One mark was given for each correctly segmented word. The maximum possible score for individual word reading was 314 while the one for contextualized word reading was 208. The sum of these two scores was used to represent parent's English word reading skill.

### Parents' mathematics skills

The adjusted calculation test of the WJ-III Research Edition (Woodcock et al., 2001) was used to measure parents' mathematics skills. The test comprised two operand (e.g.,  $54 \times 2$ ) and three operand (e.g.,  $467 - 32 \times 8$ ) multi-digit arithmetic tasks including addition, subtraction, multiplication and division problems. Parent participants were given 4 min for the 26 questions, and one point was awarded for each correct answer. The maximum possible score was 26.

### Children's English word reading

The test used to test children's English word reading skill was the same as the one used to measure their parents' English word reading.

### Children's mathematics skills

The test used to test children's mathematic skill was the same as the one used to measure their parents'. One minor difference was that children were given 7 min for the 26 questions.

## Measures in Cebu

### Cebu parent questionnaires

Parents were required to fill in a parent questionnaire which includes two subscales regarding some demographic information, family characteristics in one subscale, and parents' self-practices in the other one. In one subscale, parents were invited to report their education levels on a scale from 1 to 8, with 1 = "elementary level," 2 = "elementary graduate," 3 = "high school level," 4 = "high school graduate," 5 = "vocational graduate," 6 = "university level," 7 = "university graduate," and 8 = "professional/postgraduate degree." In addition, they were also asked to report their monthly income in Philippine pesos and their household size (no. of residents in the household; Dulay et al., 2018).

In another subscale, parents were asked to report their own literacy and mathematics practices during leisure time on a 6-point scale, with 1 = "never," 2 = "rarely," 3 = "once a week," 4 = "several times a week," 5 = "once a day," and 6 = "several times a day" (e.g., Dulay et al., 2019a; Cheung et al., 2020). The questionnaire includes 7 items on literacy practice and 6 items on mathematics practice. For example, the self-reported frequencies of listing family/personal expenses, using calculators, making use of maps and measuring tools, playing number puzzles, reading religious texts, reading the newspaper and sending texts or emails were all included. These scores in two parts were used to represent self-practice of literacy and numeracy.

### Parents' English word reading

The English word reading test used by Cebuano parents was the same as the one used by parents in Hong Kong.

### Parents' mathematics skill

A two-operand arithmetic problem task (Cheung et al., 2020) was used to measure parents' mathematics skill. There were 180 arithmetic problems equally distributed across addition (e.g.,  $1 + 3$ ,  $42 + 7$ ,  $28 + 13$ ), subtraction (e.g.,  $4 - 1$ ,  $28 - 5$ ,  $89 - 60$ ) and multiplication (e.g.,  $3 \times 2$ ,  $73 \times 8$ ). Ninety of them were generated by the researcher-generated questions and the remaining 90 questions were derived from the Calculation Fluency Test by Sowinski et al. (2014). Parents were given 2 min to complete each type of operation. One mark was given for each correct answer, and the possible maximum score was 180.

### Children's English word reading

A 14-item English word reading task was administered to measure child participants' English word reading (Dulay et al., 2019a). This researcher-generated task comprised monosyllabic English words with 3-4 letters each. Half were words that could be reasonably decoded using Cebuano letter-sound correspondences (e.g., van, plan) and the other half were words that contained non-native letters, digraphs, and consonant

blends (e.g., zip, what, and skip). One point was awarded for each correct answer and the possible maximum score was 14. No stopping rule was applied on the task.

### Children's mathematics skill

A 6-item addition task was administered to children (Dulay et al., 2019b). The children were asked to give an oral response for the sum of each of 2 numbers. Testing was stopped when the child provided 3 incorrect answers consecutively. One mark was given for each correct answer, so the maximum possible score was 6.

## Results

Ranges, means, standard deviations, kurtosis statistics and reliability coefficients for each measure among Hong Kong parents and children are shown in Table 1, and all measures among Cebuano parents and children are shown in Table 2. All data are presented as raw scores. All measures showed acceptable or good reliabilities at 0.73–0.98.

Correlations among variables assessed in Hong Kong parents and children are shown in Table 3. Table 3 indicates that Hong Kong parental education was significantly associated with their performance in English word reading ( $r = 0.69, p < 0.01$ ) and mathematics ( $r = 0.42, p < 0.01$ ) respectively. In addition, the correlations among parents' Chinese dictation, English word reading, and mathematics skill were all significant ( $r_s > 0.43,$

TABLE 1 Descriptive statistics of all variables for Hong Kong parents and children.

Variables	Mean	SD	Range	Kurtosis	$\alpha$
Parents' age	43.49	5.19	29.73–58.59	0.69	–
Parents' education <sup>a</sup>	4.03	1.54	1–7	–1.15	–
Parents' Chinese dictation	9.26	3.80	0–20	–0.05	0.79
Parents' English word reading	192.63	73.52	28–314	–0.67	0.82
Parents' mathematics	19.79	3.48	10–26	0.66	0.82
Parents' attitude toward English learning	25.06	2.86	16–30	–0.25	0.83
Parents' attitude toward mathematics learning	16.19	3.91	7–25	–0.64	0.79
Family income <sup>b</sup>	4.61	1.56	1–6	–0.53	–
Household size <sup>c</sup>	3.72	1.00	1–7	0.48	–
Child's English word reading	154.07	79.72	10–375	–0.04	0.95
Child's mathematics	12.05	5.83	0–26	–0.50	0.92

$N = 152$ .

<sup>a</sup>Parental education level: 1 = "Form 3 or below," 2 = "Form 4 to Form 5," 3 = "Form 6 to Form 7," 4 = "Post-secondary (Associate Degree or Higher Diploma)," 5 = "Bachelor's Degree," 6 = "Master's Degree," 7 = "Doctoral Degree."

<sup>b</sup>Family income: 1 = "Less than \$10,000," 2 = "\$10,001–\$20,000," 3 = "\$20,001–30,000," 4 = "\$30,001–\$40,000," 5 = "\$40,001–\$50,000," and 6 = "\$50,001 or above."

<sup>c</sup>Household size = no. of residents in the household.

TABLE 2 Descriptive statistics of all variables for Cebuano parents and children.

Variables	Mean	SD	Range	Kurtosis	$\alpha$
Parents' age	32.95	6.74	22–54	–0.25	–
Parents' education <sup>a</sup>	3.68	1.56	1–8	–0.15	–
Parents' English word reading	162.07	84.32	0–396	–0.59	0.97
Parents' mathematics	82.08	27.27	15–154	–0.01	0.98
Parents' literacy practice	2.60	1.03	1–6	0.01	0.78
Parents' numeracy practice	2.47	1.02	1–6	0.67	0.73
Family income (Philippine pesos)	9471.03	8192.12	600–84000	34.90	–
Household size <sup>b</sup>	7.21	3.55	2–35	14.26	–
Child's English word reading	3.91	5.30	0–14	–0.95	0.94
Child's mathematics	3.85	2.15	0–6	–1.14	0.97

$N = 280$ .

<sup>a</sup>Parental education level: 1 = "elementary level," 2 = "elementary graduate," 3 = "high school level," 4 = "high school graduate," 5 = "vocational graduate," 6 = "university level," 7 = "university graduate," and 8 = "professional/postgraduate degree."

<sup>b</sup>Household size = no. of residents in the household.

$p_s < 0.01$ ). Moreover, parents' attitudes toward learning English ( $r = 0.24, p < 0.01$ ) and mathematics ( $r = 0.36, p < 0.01$ ) were, respectively, associated with their English word reading and mathematics fluency.

Family income was also significantly associated with parents' English word reading ( $r = 0.64, p < 0.01$ ) and mathematics fluency ( $r = 0.33, p < 0.01$ ). However, household size was not significantly correlated with other variables in Hong Kong. Furthermore, the correlation between parents' and children's English word reading was significant ( $r = 0.24, p < 0.01$ ); the correlation between parents and children's mathematics was also significant ( $r = 0.16, p < 0.05$ ).

Correlations among variables assessed in Cebuano parents and children are shown in Table 4. This table shows that parental age was significantly correlated with their English word reading ( $r = -0.15, p < 0.05$ ), but not with their mathematics performance. In addition, parental education was significantly associated with their performance in English word reading ( $r = 0.43, p < 0.01$ ) and mathematics performance ( $r = 0.34, p < 0.01$ ). Parents' own performance in English word reading and mathematics were also significantly associated ( $r = 0.61, p < 0.01$ ). Moreover, parents' reported literacy practice was significantly associated with English word reading ( $r = 0.22, p < 0.01$ ). In contrast, the association of parents' reported mathematics practice and of mathematics skill was not significant.

Both family income and household size were not significantly correlated with parents' English or Mathematics performance in Cebu. In addition, the correlations of parents' and children's English word reading ( $r = 0.23, p < 0.01$ ) and of their mathematics performance ( $r = 0.13, p < 0.05$ ) were both significant.

TABLE 3 Correlational analyses of all variables among Hong Kong children and parents.

Variables	1	2	3	4	5	6	7	8	9	10	11
1 Parents' age	–										
2 Parents' education	0.11	–									
3 Parents' Chinese dictation	0.03	0.39**	–								
4 Parents' English word reading	–0.04	0.69**	0.43**	–							
5 Parents' mathematics	0.02	0.42**	0.48**	0.44**	–						
6 Parents' attitude toward English learning	–0.01	0.25**	0.29**	0.24**	0.20*	–					
7 Parents' attitude toward mathematics learning	–0.02	0.24**	0.16	0.18*	0.36**	0.18*	–				
8 Family income	0.19*	0.66**	0.36**	0.64**	0.33**	0.24**	0.07	–			
9 Household size	0.02	0.04	0.04	0.02	0.06	0.01	0.08	0.03	–		
10 Child's English word reading	0.22**	0.22**	0.08	0.24**	0.25**	0.16*	0.04	0.36**	–0.02	–	
11 Child's mathematics	0.17*	0.04	–0.08	0.05	0.16*	0.01	0.03	0.14	0.01	0.61**	–

$N = 152$ . \* $p < 0.05$ . \*\* $p < 0.01$ .

TABLE 4 Correlational analyses of all variables among Cebuano children and parents.

Variables	1	2	3	4	5	6	7	8	9	10
1 Parents' age	–									
2 Parents' education	0.11	–								
3 Parents' English word reading	–0.15*	0.43**	–							
4 Parents' mathematics	–0.02	0.34**	0.61**	–						
5 Parents' literacy practice	–0.12	0.20**	0.22**	0.21**	–					
6 Parents' numeracy practice	–0.08	0.07	0.06	0.02	0.62**	–				
7 Family income	–0.03	0.19**	0.05	0.02	–0.05	0.10	–			
8 Household size	0.01	–0.04	–0.04	–0.07	0.03	0.00	0.06	–		
9 Child's English word reading	–0.01	0.12*	0.23**	0.16**	0.08	0.01	–0.09	0.01	–	
10 Child's mathematics	–0.03	0.06	0.18**	0.13*	0.05	0.06	–0.14*	0.05	0.54**	–

$N = 280$ . \* $p < 0.05$ . \*\* $p < 0.01$ .

## Regression analyses explaining Hong Kong parents' English and mathematics performances

One primary purpose of the present study was to investigate which factors contribute to parental performance in English word reading and mathematics performance in Hong Kong. To this end, hierarchical multiple regression equations were conducted with parent-related factors entered in the first step (Table 5). Parents' gender, age, education level, parental performance in the other two subjects (including Chinese dictation), and their attitude toward their own learning were all entered to explain parents' English word reading and mathematics performance, respectively. Results showed that age ( $\beta = -0.16$ ,  $p < 0.05$ ), but not gender, explained parental English word reading. Parent education ( $\beta = 0.40$ ,  $p < 0.001$ ) also explained variability in parents' English word reading. For understanding the variability in mathematics performance, neither parental age nor gender was associated with Hong Kong parents' mathematics performance; Both parental attitude toward learning mathematics ( $\beta = 0.23$ ,  $p < 0.01$ ) and parental Chinese dictation ( $\beta = 0.34$ ,  $p < 0.001$ ) were unique correlates.

In the second step, general family related variables were entered. Only family income ( $\beta = 0.31$ ,  $p < 0.001$ ), but not household size was associated with parents' English word reading. In contrast, neither family income nor household size was a unique correlate of parental mathematics performance.

Children's English word reading and mathematics performance were entered in the final step to explain parents' performance in the same subject, respectively. Results suggested that children's English word reading was not significantly associated with parental English word reading. However, children's mathematics fluency additionally explained parental mathematics fluency ( $\beta = 0.17$ ,  $p < 0.05$ ).

## Regression analyses explaining Cebuano parents' English and mathematics performances

Another main purpose of the present study was to investigate the unique correlates of parental academic performance in Cebu. Table 5 also presents hierarchical multiple regression analysis results conducted on the Cebuano parents.

Parental gender, age, educational level, their performance in the other subject and parental literacy or mathematics practice were entered in the first step. Results showed that parents' age was associated with their English word reading ( $\beta = -0.17, p < 0.001$ ) and gender ( $\beta = -0.11, p < 0.05$ ) was uniquely associated with parents' mathematics performance. In addition, parental education ( $\beta = 0.27, p < 0.001$ ) and parents' mathematics fluency ( $\beta = 0.49, p < 0.001$ ) explained unique variance in parental English word reading. However, only parents' own English word reading ( $\beta = 0.58, p < 0.001$ ) accounted for unique variance in mathematics performance.

In the second step, general family related variables were entered. Neither family income nor household size were significant correlates of parental English word reading or mathematics fluency. Children's English word reading and mathematics were entered in the last step. Children's English word reading significantly explained parental English word reading ( $\beta = 0.12, p < 0.01$ ); But children's mathematics was not significantly associated with parental mathematics fluency.

## Discussion

This study aimed to explore the parent-, family- and child-related factors associated with parents' own academic performance among families in Hong Kong and Cebu City,

Philippines. Results highlight the relative importance of these factors for explaining parental English word reading and mathematics fluency across these two groups. However, the patterns varied in some ways in English reading and mathematics performance across the two groups of families in different sociocultural contexts. Specifically, parents' age was negatively associated with parental English word reading in both Hong Kong and Cebu. The younger the parents were, the better they performed in English word reading. In addition, parental education level also explained performance in English word reading significantly across both groups. This is consistent with previous observations (e.g., Cheung and Ng, 2003). Parents who had a higher level of education performed better in English word reading.

Overall, parental academic performances between literacy and mathematics domains were positively associated. Across both groups, parental performances in English and mathematics were significantly associated, implying that parental academic skills may be relatively consistent across domains. This was in line with the findings in previous studies of other age groups (Wong and Chia, 1996; Lu et al., 2011; Karbach et al., 2013). In addition, Hong Kong parents who rated mathematics learning more positively performed better in this skill. It is possible that their positive attitude toward mathematics learning motivates them to spend more time in their own mathematics activities and home numeracy activities such as teaching their

TABLE 5 Hierarchical regressions explaining Parents' English word reading, mathematics skill in Hong Kong and Cebu.

Steps		Parents' English word reading			Parents' mathematics		
		$\Delta R^2$	$\beta$	<i>t</i> (sig.)	$\Delta R^2$	$\beta$	<i>t</i> (sig.)
<b>Hong Kong (N = 152)</b>							
1	Parents' gender	0.53***	-0.01	-0.17	0.37***	0.03	0.42
	Parents' age		-0.16	-2.60*		-0.01	-0.12
	Parents' education		0.40	5.15***		0.14	1.34
	Parents' mathematics/English word reading		0.11	1.69		0.17	1.73
	Parents' Chinese dictation		0.11	1.64		0.34	4.49***
	Parents' attitude toward English/mathematics learning		0.01	0.15		0.23	3.43**
2	Family income	0.06***	0.31	4.00***	0.00	-0.03	-0.30
	Household size		-0.01	-0.24		0.02	0.30
3	Child's English word reading/mathematics	0.00	0.04	0.68	0.03*	0.17	2.58*
<b>Cebu (N = 280)</b>							
1	Parents' gender	0.46***	0.06	1.39	0.39***	-0.11	-2.26*
	Parents' age		-0.17	-3.73**		0.06	1.13
	Parents' education		0.27	*5.51***		0.07	1.34
	Parents' mathematics/English word reading		0.49	10.22***		0.58	10.50***
	Parents' literacy/mathematics practice		0.03	0.61		-0.01	-0.18
	2	Family income	0.00	-0.00	-0.08	0.00	-0.02
	Household size		0.01	0.14		-0.05	-1.07
3	Child's English word reading/mathematics	0.01**	0.12	2.65**	0.00	0.01	0.22

\* $p < 0.05$ . \*\* $p < 0.01$ . \*\*\* $p < 0.001$ .

children to learn arithmetic, which results in better mathematics performance. This assumption cannot be examined in the present study because we did not include the variable of numeracy activity frequency, but this is an interesting possibility for subsequent family studies to consider.

In contrast, Cebuano parents' self-rated engagement in more literacy-related activities and/or math-related practices for their own leisure was not a significant correlate of their performance in English or mathematics, respectively. Parents' own literacy practice was significantly correlated with their English word reading, but it was no longer uniquely associated with it when other stronger predictors such as education attainment were included in the regression model. In addition, a previous study on the same sample using a similar, but not identical, measure to test parents' own math activities also found that it was not significantly associated with their mathematics fluency (Cheung et al., 2020). It is true that our measures of their English word reading and mathematics performance in the current study were rather specific. Perhaps these selections of measures, focused especially on the speed of processing, limited the exploration of practices in English and mathematics in relation to actual performance. For example, perhaps parents who enjoy completing Sudoku or completing puzzles in their leisure time might perform better in overall mathematics achievement, but not necessarily in mathematics fluency itself.

## Language skills in mathematics performance

Another interesting finding from this study was language skills were relatively strong and significant correlates of parental mathematics skills in both societies. This extends previous findings on children, teenagers, and college students (e.g., Wong and Chia, 1996; Henry et al., 2014; Prediger et al., 2015) to young parents in demonstrating that language proficiency is likely to be an important factor in explaining mathematics performance. Language has a communicative function (Prediger et al., 2015). Language also has an epistemic function, which means that language is a cognitive tool in thinking and learning (Pimm, 1987). People who acquire better language skills are perhaps better able to think and learn about a variety of topics, including mathematics skills. We speculate that the language correlates of mathematics fluency across societies fit well with patterns of counting in each. In Hong Kong, mathematics reasoning takes place mostly in Chinese for native Hong Kong Chinese speakers such as the parents in the present study. Moreover, the number naming system is more linguistically transparent in Chinese than English, which may lead them to prefer to count in Chinese. In contrast, in Cebu, it is common for parents to count in English since math is taught in English as mandated by the bilingual education policy (Tupas and Lorente, 2014). Thus, English emerged as a unique correlate of mathematics performance in this culture.

## General family characteristics were relatively less important in Cebuano parents' academic skills

Family income was a significant correlate of parental English word reading in Hong Kong, but not for Cebuano families. Due to its long history as a colony of the United Kingdom, Hong Kong maintains English as one of its official languages. Its prestige is well reflected in government, law, education system, and business settings (Li, 2018). Almost all office-based jobs in the white-collar workplace, which often are accompanied by a high salary, require English skills (Li, 2018). Therefore, it is not surprising that family income in Hong Kong was a significant correlate of parental English performance. Notably, in Hong Kong, both education and socioeconomic status uniquely explained English performance. Such results reflect the phenomenon of English skills in Hong Kong being a correlate of prestige and the emphasis on English as the medium of instruction in higher education (Evans, 2017). Importantly, however, this was not the case in Cebuano families since their family income was not a significant correlate of parental performance in English word reading or mathematics. To some extent, this reflects the phenomenon discussed previously by Filipino scholars: Despite a relatively high level of academic achievement, Filipinos are not economically as well off as might be predicted based on such achievement (Maca and Morris, 2012). Notably, education level significantly explained their own English word reading skill in Cebuano parents. This is likely because of the prevalent use of English as a medium of instruction across primary and tertiary education in the Philippines before 2009 (Tupas and Lorente, 2014).

## Children as reinforcements?

Perhaps the most interesting finding from this study was that children's academic performances significantly explained that of parents beyond other family related factors and parents' own educational achievement in Hong Kong and in Cebu. Despite the fact that there are some studies suggesting a bidirectional relationship between children and parents in speech or vocabulary diversity (Huttenlocher et al., 2010; Schick et al., 2017; Mimeau et al., 2019), traditional understanding of parent and child interactions in academic performance mainly focuses on how parents influence their children's academic achievement (e.g., Downey, 1995; Braham and Libertus, 2017). There are also some findings suggesting that children's academic performance affects parental investment, such as homework assistance (Silinskas et al., 2013; Quadlin, 2015). The current study measured parents' and children's English word reading and mathematical skills with similar tests and found that children's academic performance was uniquely associated with parental performance. The children in this study were in either preschool or early primary school, developmental time

periods when they are in need of parents' help in developing their academic performance. Among the families in Cebu, children were overall younger and lived in communities with fewer educational resources (Dulay et al., 2019a). Our findings introduced the possibility that parents' help with children's academic development facilitates both parents' and children's academic performance. Children who perform better in academic skills might in some ways promote their parents' superior performance in similar tasks. This idea is quite intriguing, though largely speculative in the present study.

Moreover, the associations between children's academic performances and those of their parents were not consistent in English and mathematics across the two societies. In Hong Kong, children's mathematics fluency significantly explained parental performance on the same mathematics test. One possible explanation for this finding is that mathematics education in Hong Kong tends to be emphasized very early at home and in schools (Zhang, 2016). The home parent-child formal and informal numeracy activities may not only facilitate children's mathematics skill (e.g., Huang et al., 2017), but also improve parental mathematics performance. Children's performance in calculation fluency implicitly reinforces parental performance on the same task. In contrast, Hong Kong children's English word reading was not a strong correlate of parental English word reading, compared to parental education and family income. This finding may imply that Hong Kong parents' English skills are mainly learned from their educational or job experience rather than from interactions with their children. They possibly prefer to encourage their young children to learn to read English from native English speakers in their schools or in extra-curricular English classes.

In contrast, in Cebuano families, children's English word reading significantly explained parental English performance. Dulay et al. (2019a) found that parental English word reading skills were significantly related to children's language skills with other family related factors statistically controlled in Cebu. Our finding suggests that the relationships between children and parents' English word reading could be reciprocal, given that it is not uncommon among Filipino families to use English to teach child some numeracy skills (Dulay et al., 2019b), to tell stories and to practice writing in English, and for family members to help children with English homework (Tatel-Suatengco and Florida, 2018). In this process, perhaps both parents' and children's English reading skills can be strengthened simultaneously. However, in Cebu, the children's mathematics skills were not unique correlates of the parents' mathematics skills. The inconsistency of this relationship across two cities may be attributable to the fact that early mathematics education in Hong Kong tends to be emphasized much more so than in the Philippines. Our study was not in any way a direct comparison between cultures, but this general trend of a relatively higher level of mathematics in Hong Kong Chinese children was noted.

## Limitations and future work

This study was among the first to consider the question of what explains parents' own academic skills from a family perspective. Our data came from two different extensive studies in two Asian contexts, and the studies included similar, but not identical measures. This study had some limitations that are important to mention. First, given that the tests in this study were measured at the same time point, the results are correlational only and cannot reveal causal relations. Future longitudinal or intervention studies may be helpful in interpreting the potential bidirectional relationships between children and parents' academic performance. Second, even though we discussed potential differences in L1 and L2 skills in adults' mathematics performance in Hong Kong, we just used a single test to measure children's Chinese and English skills, respectively, and we did not use parallel measures (e.g., word reading skills) across L1 and L2. With a larger sample, more stringent controls of measures and statistical analyses might be conducted to test for a broader pattern of language skills and mathematics performance in adults. Finally, we would like to have better measures of attitudes and practices in literacy and mathematics among parents. Our current measures may be too much of a mixture of attitudes including ideas about goals and practices for children.

## Conclusion

Despite these limitations, however, this study provides both converging and diverging empirical evidence of various family related correlates of parental academic performance across two distinct cultural contexts. Overall, traditional environmental correlates, such as parental education, are important to explain parental English performance. Language skills are also apparently critical for mathematic performance. Intergenerational effects were found from children to parents on academic performances in different aspects across cultural contexts as well. These results motivate a closer look at how, in addition to education levels and income within a household, parents and children may affect one another, even in academic achievement, across cultures. In the future, researchers should consider more of a focus on possible child-driven effects in parent training programs and research family studies.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by Survey and Behavioral Research Ethics Committee, the Chinese University of Hong Kong. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## Author contributions

CM, SC, and KD conducted the project and collected the data. DP, XY, and YK were mainly responsible for conceptualizing the idea, data analysis, and preparing the draft. CM, KD, PW, SC, and CH reviewed and commented on the manuscript. CM edited the final draft. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer AL declared a shared affiliation with the author KD to the handling editor at the time of review.

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## References

- Aikens, N. L., and Barbarin, O. (2008). Socioeconomic differences in reading trajectories: the contribution of family, neighborhood, and school contexts. *J. Educ. Psychol.* 100, 235–251. doi: 10.1037/0022-0663.100.2.235
- Braham, E. J., and Libertus, M. E. (2017). Intergenerational associations in numerical approximation and mathematical abilities. *Dev. Sci.* 20:e12436.
- Bronfenbrenner, U. (1994). "Ecological models of human development," in *The International Encyclopedia of Education*, 2nd Edn, Vol. 3, eds T. N. Postlethwaite and T. Husen (Oxford: Elsevier), 1643–1647.
- Cheung, H., and Ng, L. K. H. (2003). "Chinese reading development in some major Chinese societies: an introduction," in *Reading Development in Chinese Children*, eds C. McBride-Chang and H. C. Chen (Westport, CT: Praeger), 3–18.
- Cheung, S. K., Dulay, K. M., and McBride, C. (2020). Parents' characteristics, the home environment, and children's numeracy skills: How are they related in low- to middle-income families in the Philippines? *J. Exp. Child Psychol.* 192:104780. doi: 10.1016/j.jecp.2019.104780
- Chiu, M. M. (2010). Effects of inequality, family and school on mathematics achievement: country and student differences. *Soc. Forces* 88, 1645–1676.
- Chiu, M. M., and McBride-Chang, C. (2006). Gender, context, and reading: a comparison of students in 43 countries. *Sci. Stud. Read.* 10, 331–362.
- Chiu, M. M., and McBride-Chang, C. (2010). Family and reading in 41 countries: differences across cultures and students. *Sc. Stud. Read.* 14, 514–543. doi: 10.1080/10888431003623520
- Chung, K. K. H., Liu, H., McBride, C., Wong, A. M. Y., and Lo, J. C. M. (2017). How socioeconomic status, executive functioning and verbal interactions contribute to early academic achievement in Chinese children. *Educ. Psychol.* 37, 402–420. doi: 10.1080/01443410.2016.1179264
- Clifton, R. A., Perry, R. P., Roberts, L. W., and Peter, T. (2008). Gender, psychosocial dispositions, and the academic achievement of college students. *Res. High. Educ.* 49, 684–703. doi: 10.1007/s11162-008-9104-9
- Corsaro, W. A. (1997). *The Sociology of Childhood*. Sage: Thousand Oaks, CA.
- de la Rie, S., van Steensel, R. C. M., van Gelderen, A. J. S., and Severiens, S. (2020). Level of abstraction in parent-child interactions: the role of activity type and socioeconomic status. *J. Res. Read.* 43, 140–159. doi: 10.1111/1467-9817.12294
- De Mol, J., and Buysse, A. (2008). The phenomenology of children's influence on parents. *J. Family Ther.* 30, 163–193.
- Dearing, E., Kreider, H., Simpkins, S., and Weiss, H. B. (2006). Family involvement in school and low-income children's literacy: longitudinal associations between and within families. *J. Educ. Psychol.* 98, 653–664. doi: 10.1111/j.1467-8624.2004.00742.x
- Downey, D. B. (1995). When bigger is not better: family size, parental resources, and children's educational performance. *Am. Sociol. Rev.* 60, 746–761.
- Dulay, K. M., Cheung, S. K., and McBride, C. (2018). Environmental correlates of early language and literacy in low- to middle-income Filipino families. *Contemp. Educ. Psychol.* 53, 45–56. doi: 10.1016/j.cedpsych.2018.02.002
- Dulay, K. M., Cheung, S. K., and McBride, C. (2019a). Intergenerational transmission of literacy skills among Filipino families. *Dev. Sci.* 22, 1–14. doi: 10.1111/desc.12859
- Dulay, K. M., Cheung, S. K., Reyes, P., and McBride, C. (2019b). Effects of Parent coaching on Filipino children's numeracy, language, and literacy skills. *J. Educ. Psychol.* 111, 641–662. doi: 10.1037/edu0000315
- Evans, S. (2017). English in Hong Kong higher education. *World Engl.* 36, 591–610.
- Ferguson, A. M., Maloney, E. A., Fugelsang, J., and Risko, E. F. (2015). On the relation between math and spatial ability: the case of math anxiety. *Learn. Individ. Differ.* 39, 1–12. doi: 10.1016/j.lindif.2015.02.007
- Friend, A., Defries, J. C., Olson, R. K., Pennington, B., Harlaar, N., Byrne, B., et al. (2009). Heritability of high reading ability and its interaction with parental education. *Behav. Genet.* 39, 427–436. doi: 10.1007/s10519-009-9263-2

- Hart, S. A., and Ganley, C. M. (2019). The nature of math anxiety in adults: prevalence and correlates. *J. Numer. Cogn.* 5, 122–139.
- Henry, D., Nistor, N., and Baltes, B. (2014). Examining the relationship between math scores and english language proficiency. *J. Educ. Res. Pract.* 4, 11–29.
- Huang, Q., Zhang, X., Liu, Y., Yang, W., and Song, Z. (2017). The contribution of parent-child numeracy activities to young Chinese children's mathematical ability. *Br. J. Educ. Psychol.* 87, 328–344. doi: 10.1111/bjep.12152
- Huttenlocher, J., Waterfall, H., Vasilyeva, M., Vevea, J., and Hedges, L. V. (2010). Sources of variability in children's language growth. *Cogn. Psychol.* 61, 343–365.
- Imlach, A.-R., Ward, D. D., Stuart, K. E., Summers, M. J., Valenzuela, M. J., King, A. E., et al. (2017). Age is no barrier: predictors of academic success in older learners. *Npj Sci. Learn.* 2:13. doi: 10.1038/s41539-017-0014-5
- Kalindi, S. C., McBride, C., Chan, S., Chung, K. H. K., Lee, C.-Y., Maurer, U., et al. (2015). A short test of english silent word reading for english language learners. *Child Stud. Asia Pac. Contexts* 5, 95–105. doi: 10.5723/csac.2015.5.2.095
- Karbach, J., Gottschling, J., Spengler, M., Hegewald, K., and Spinath, F. M. (2013). Parental involvement and general cognitive ability as predictors of domain-specific academic achievement in early adolescence. *Learn. Instruct.* 23, 43–51.
- Kelly, R. R., and Gaustad, M. G. (2007). Deaf college students' mathematical skills relative to morphological knowledge, reading level, and language proficiency. *J. Deaf Stud. Deaf Educ.* 12, 25–37. doi: 10.1093/deafed/enl012
- Koedel, C., and Tyhurst, E. (2011). Math skills and labor-market outcomes: evidence from a resume-based field Experiment. *Econ. Educ. Rev.* 31, 131–140.
- LeFevre, J. A., Skwarchuk, S. L., Smith-Chant, B. L., Fast, L., Kamawar, D., and Bisanz, J. (2009). Home numeracy experiences and children's math performance in the early school years. *Can. J. Behav. Sci.* 41, 55–66. doi: 10.1037/a0014532
- Leseman, P. P. M., and de Jong, P. F. (1998). Home literacy: opportunity, instruction, cooperation and social-emotional quality predicting early reading achievement. *Read. Res. Q.* 33, 294–318. doi: 10.1598/rrq.33.3.3
- Li, D. C. S. (2018). Two decades of decolonization and renationalization: the evolutionary dynamics of Hong Kong English and an update of its functions and status. *Asian Engl.* 20, 2–14. doi: 10.1080/13488678.2017.1415517
- Li, T., McBride-Chang, C., Wong, A., and Shu, H. (2012). Longitudinal predictors of spelling and reading comprehension in Chinese as an L1 and English as an L2 in Hong Kong Chinese children. *J. Educ. Psychol.* 104, 286–301. doi: 10.1037/a0026445
- Lu, L., Weber, H. S., Spinath, F. M., and Shi, J. (2011). Predicting school achievement from cognitive and non-cognitive variables in a Chinese sample of elementary school children. *Intelligence* 39, 130–140. doi: 10.1016/j.intell.2011.02.002
- Maca, M., and Morris, P. (2012). The Philippines, the East Asian "developmental states" and education: a comparative analysis of why the Philippines failed to develop. *Compare* 42, 461–484. doi: 10.1080/03057925.2011.652814
- Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., and Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and anxiety. *Psychol. Sci.* 26, 1480–1488. doi: 10.1177/0956797615592630
- McBride-Chang, C., Liu, P. D., Wong, T., Wong, A., and Shu, H. (2012). Specific reading difficulties in Chinese, English, or both: longitudinal markers of phonological awareness, morphological awareness, and RAN in Hong Kong Chinese children. *J. Learn. Disabil.* 45, 503–514. doi: 10.1177/0022219411400748
- McKenzie, K., and Schweitzer, R. (2001). Who succeeds at university? Factors predicting academic performance in first year Australian university students. *High. Educ. Res. Dev.* 20, 21–33. doi: 10.1080/07924360120043621
- Mimeau, C., Cantin, É, Tremblay, R. E., Boivin, M., and Dionne, G. (2019). The bidirectional association between maternal speech and child characteristics. *J. Child Lang.* 47, 435–456. doi: 10.1017/S0305000919000539
- Neville-Barton, P., and Barton, B. (2005). *The Relationship between English Language and Mathematics Learning for Non-Native Speakers*. Wellington: Teaching Learning and Research Initiative.
- Pimm, D. (1987). *Speaking Mathematically: Communication in Mathematics Classrooms*. London: Routledge.
- Power, C., Robertson, F., and Baker, M. (1987). *Success in Higher Education (No.94)*. Colombo: National Institute of Labour Studies.
- Prediger, S., Wilhelm, N., Büchter, A., Gürsoy, E., and Benholz, C. (2015). Sprachkompetenz und Mathematikleistung – Empirische Untersuchung sprachlich bedingter Hürden in den Zentralen Prüfungen 10. *J. Math. Didaktik* 36, 77–104.
- Quadlin, Y. N. (2015). When children affect parents: children's academic performance and parental investment. *Soc. Sci. Res.* 52, 671–685.
- Schick, A. R., Melzi, G., and Obregon, J. (2017). The bidirectional nature of narrative scaffolding: latino caregivers' elaboration while creating stories from a picture book. *First Lang.* 37, 301–316. doi: 10.1177/0142723716689692
- Sheard, M. (2009). Hardiness commitment, gender, and age differentiate university academic performance. *Br. J. Educ. Psychol.* 79, 189–204. doi: 10.1348/000709908X304406
- Silinskas, G., Niemi, P., Lerkkanen, M. K., and Nurmi, J. E. (2013). Children's poor academic performance evokes parental homework assistance-but does it help? *Int. J. Behav. Dev.* 37, 44–56. doi: 10.1177/0165025412456146
- Sowinski, C., Dunbar, K., and LeFevre, J. (2014). *Calculation Fluency Test*. Ottawa: Carleton University.
- Tatel-Suatengco, R., and Florida, J. S. (2018). Family literacy in a low-income urban community in the Philippines. *J. Early Child. Liter.* 20, 327–355.
- Tupas, R., and Lorente, B. P. (2014). "A 'new' politics of language in the Philippines: bilingual education and the new challenge of the mother tongues," in *Language, Education and Nation-Building*, eds P. Sercombe and R. Tupas (London: Palgrave Macmillan), 165–180. doi: 10.1057/9781137455536\_9
- United Nations Development Programme Human Development Reports (2019). *Beyond Income, beyond Averages, beyond Today: Inequalities in Human Development in the 21st Century*. Available online at: <http://hdr.undp.org/en/2019-report> [accessed on December 10, 2019].
- Wong, D. S. N., and Chia, Y. M. (1996). English language, mathematics and first-year financial accounting performance: a research note. *Account. Educ.* 5, 183–189.
- Wong, S. W. L., Ho, C. S. H., McBride, C., Chow, B. W. Y., and Wayne, M. M. Y. (2017). Less is more in Hong Kong: investigation of biscriptal and trilingual development among Chinese twins in a (Relatively) small city. *Twin Res. Hum. Genet.* 20, 66–71. doi: 10.1017/thg.2016.90
- Woodcock, R. W., McGrew, K. S., and Mather, N. (2001). *Woodcock-Johnson III Tests of Achievement*. Itasca, IL: Riverside Publishing.
- World Bank (2019). *GDP per Capita (current US\$)*. Washington, DC: World Bank.
- Zhang, X. (2016). Linking language, visual-spatial, and executive function skills to number competence in very young Chinese children. *Early Child. Res. Q.* 36, 178–189. doi: 10.1016/j.ecresq.2015.12.010