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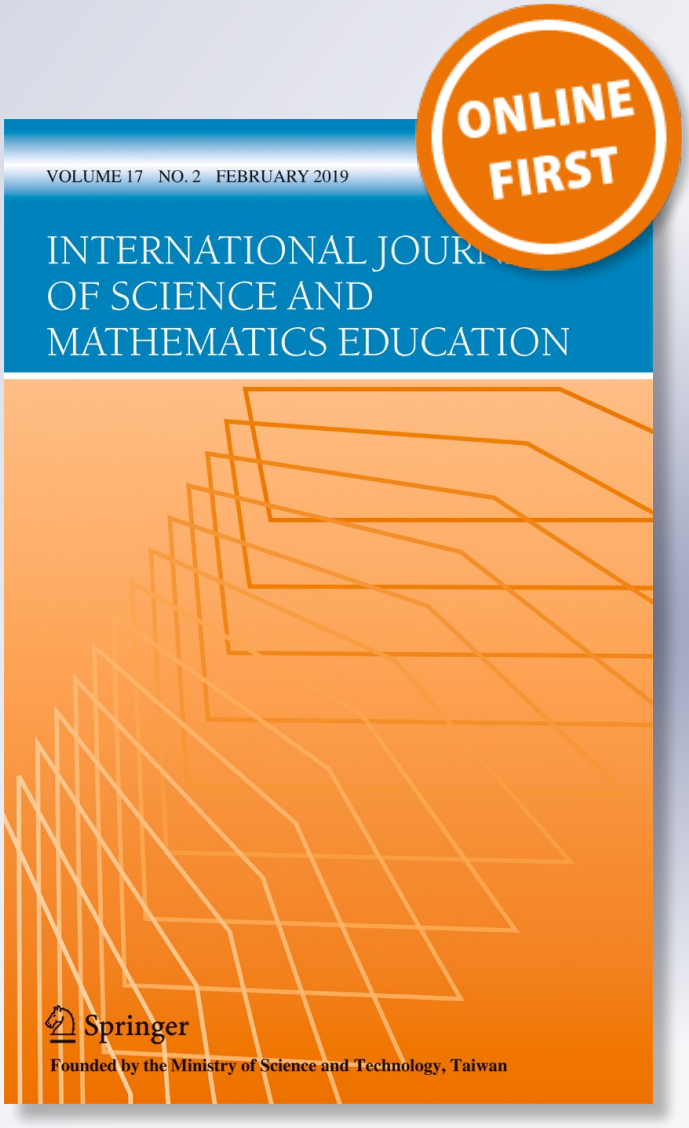

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Multiple Appearances of Parental Interactions and Math Achievement on TIMSS International Assessment

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Abstract

This study aims to explore the different appearances of parental interactions based on principal, teacher, and student reports of the 8th grade Trends in International Mathematics and Science Study 2011 assessments in Israel and how the appearances of parental interactions relate to math achievements. We conducted a multilevel SEM on 147 principals, 147 teachers, and 4304 students nested in 147 schools. Different appearances of parental interactions emerged such as "parental involvement in student learning," "direct communication on student progress," and "providing general information of school principles and activities" based on student, teacher, and principal reports respectively. Significant negative relationships were found between these appearances that can be explained by compensation relationships. We found a positive relationship between student reports of parental involvement and student achievements. The negative relationships we found between teacher and principal reports of parental interactions and student achievements may reflect situations where teachers and principals interact with parents mostly in problematic cases. We also found that girls perceive their parents' involvement higher than boys, immigrant students had lower achievements than native-born students, and children whose parents have higher educational levels had higher achievements. While most studies examined parental interactions from the teacher's, student's, or principal's perspectives, this study is unique in that it applies an integrative approach that considers all the appearances simultaneously. Thus, this study leads to a broader view of parental interactions and can contribute to developing programs for encouraging parental interactions in school routines.

Keywords Academic achievements · International assessment tests · Parental interactions · TIMSS

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Introduction

A variety parental interaction appearances exist in educational systems, such as parental involvement in their children learning, parent–teacher meetings to discuss the student's progress, and principals' activities of informing parents regarding school performances (e.g. Addi-Raccah & Ainhoren, 2009; Borup, Graham & Davies, 2013; Jeynes, 2012). These appearances contribute to student academic achievements and improve student self-esteem and attendance (e.g. Cripps & Zyromski, 2009). Some studies have also shown that teachers and principals perceive parental interactions in school context as interfering with educational and pedagogic processes, reflecting a lack of confidence in the teachers' training and professionalism (e.g. Addi-Raccah & Ainhoren, 2009).

Drawing on the Trends in International Mathematics and Science Study TIMSS, 2011 database (Foy, Arora & Stanco, 2013), this study used an integrative approach to examine parental interactions from the principal, teacher, and student perspectives, and explore how these perceptions are related to student math achievements. TIMSS data is mainly used for cross-national comparisons. We however decided to focus on Israel as a case study, as a first step toward understanding the effect of perceptions of parental interactions among teachers, students, and principals.

Theoretical Background

Parental Interactions

Appearances of parental interactions vary from study to study, and include several features: (1) *communication*—having efficient channels of interaction between schools and parents; (2) *volunteering*—parental participation in classroom and social activities; (3) *learning at home*—parental interactions with their children to provide them with support, skills, and knowledge; (4) *decision-making*—interactions between school principals, teachers, and parents in school decision-making processes; and (5) *community*—using community resources to strengthen interactions between the school, home, and student to promote learning processes (e.g. Addi-Raccah & Dana, 2015; Epstein, Galindo & Sheldon, 2011; Jeynes, 2012). Cotton and Wikelund (1989) found that appearances of parental interactions also vary according to *involvement type* (e.g. assisting with homework), *level of involvement* (e.g. frequent visits to school), and *manner of involvement* (e.g. active involvement, such as participating in decision-making in schools).

Multiple Appearances of Parental Interaction and Their Internal Relationships

Very few studies have simultaneously examined different appearances of parental interaction, such as those of school principals, teachers, and students. For example, Hill and Taylor (2004) and Miedel and Reynolds (2000) found weak relationships between the appearance of parental interactions among students, teachers, and parents. They argued that such weak relationships are traced to different definitions held by each party. They concluded that parental interaction is in the eye of the beholder, reflecting different points of view.

Here, we focused on different appearances of parental interaction based on principal, teacher, and student reports, as extracted from their responses to TIMSS questionnaires. The variety of parental interactions from different points of view (principals, teachers, students), reflected by different items from different sources of questionnaires, seems to support the study integrative approach. Principals focused on organizational aspects of parental interactions in relation to general information of school principles and activities (e.g. "Inform parents about the educational goals and pedagogic principles of the school," "Discuss parents' concerns or wishes about the school's organization"). For teachers, the focus of parental interaction pertains to *communication with parents* (e.g. "Meet or talk individually with student's parents to discuss his/her learning progress," "Send home a progress report on the student's learning"). The focus of student reports regarding parental interaction is on parental involvement in their child's learning (e.g. "My parents check if I do my homework;" "My parents ask me what I am learning in school").

Thus, based on the studies mentioned above, we assume that:

> H1. Significant relationships will be found between different appearances of parental interactions among students, teachers, and principals, as reflected in their responses to the TIMSS questionnaires.

Appearances of Parental Interaction and Their Relationships to Academic Achievements

Hill and Taylor (2004) found that different appearances of parental interactions among students, teachers, and parents are significantly related to student achievements. For example, students' perceptions of parental involvement were more significantly related to academic achievements than were the perceptions of teachers or parents. Similarly, another study (Sui-Chu & Willms, 1996) found that student perceptions of their parents' involvement were the strongest predictor of academic achievements, followed by parents' educational level and relationship with the school.

While many studies have shown a positive relationship between different appearances of parental interactions and student academic achievements (e.g. Epstein & Sanders, 2006; Jeynes, 2012), several studies found negative relationships or relationships dependent on the source of parental interactions. For example, when examining student reports of their parents' assistance in homework, Patall, Cooper and Robinson (2008) found that monitoring styles were negatively related to student achievements. In contrast, styles that involved guidance and support were positively related to achievements.

A meta-analysis (Fan & Chen, 2001) of relationships between different appearances of parental interactions and student achievements revealed a moderate, positive relationship. The strength of the relationship varied according to the perceived style of parental involvement. For example, perceptions of parental monitoring at home (such as setting rules about leisure time and doing homework) were weakly related to achievements. Further research (e.g. Hoover-Dempsey, Walker, Jones & Reed, 2002) found that teachers' perceptions of parental interactions significantly

influence their efforts to solicit such involvement. Positive teachers' perceptions can lead to higher parental interactions which can bring about greater academic achievements. Previous studies indicate that fears among teachers and principals of excessive parental interactions result in limited school initiatives to encourage parental involvement (Gonzalez-DeHass & Willems, 2003), despite the school's perceptions of the contributions of parental involvement to student achievements (Epstein et al., 2011; Lawson, 2003).

In sum, previous studies have found different relationships between parental interactions and student achievements depending on the circumstances. Therefore, our hypothesis focuses on the different relationships between the TIMSS reports of principals, teachers, and students and students' achievements.

> H2. Relationships in different directions (e.g. positive, negative) will be found between parental interaction reports by students, teachers, and principals and student academic achievements.

The Relationship Between Background Factors, Parental Interaction, and Academic Achievements

Previous studies indicated that student background factors, such as origin, socio-economic status, gender, and parents' educational level, also have a significant relationship to parental interactions and academic achievements. For example, minority students (Latinos from urban Chicago schools) perceived lower parental involvement levels than other students, according to teacher reports. This is mostly accounted for by the parents' lower socio-economic status and educational level (Marschall, 2006).

Turney and Kao (2009) also indicate that teachers' perceptions of parents are sometimes negative because of their limited acquaintance with minority student parents and limited experience communicating with them. Similarly, Goldsmith and Glickman (2012) indicate that immigrant students have lower achievements than native-born students. Hill and Taylor (2004) argue that lower socio-economic parents often have a low educational levels and harbor negative feelings about schools. Such parents feel that they lack the skills to interact with school staff and are therefore less involved in their children's studies.

Another study (Theodorou, 2008) found that low-income parents interact less because their economic situation requires them to work long hours, whereas parents of high socio-economic backgrounds perceive that their children can gain more from the educational system, since the parents are more aware of existing options. Regarding gender differences and academic achievements, studies have shown that parents monitor their sons' homework and interact with schools more often than for their daughters (e.g. Hong, Yoo, You & Wu, 2010). In contrast, these parents express higher academic expectations and discuss school-related matters more with their daughters. In other words, they verbally interact more with their daughters, while manifesting higher educational monitoring with their sons.

Based on this literature review, we assumed that background factors appearing in the TIMSS, such as parental educational levels, and students' socio-economic status,

national origin, and gender, might explain different appearances of parental interactions and student achievements. Thus, we hypothesize that:

> H3. Significant relationships will be found between background factors (socio-economic status, gender, parental education and student's country of origin) and (1) perceptions of parental interactions among principals, teachers, and students and (2) students' math achievements, as reflected in responses to the TIMSS questionnaires.

The Israeli Context

Israel's population is comprised of 80% Jews (6.6 million), mostly descendants of immigrants from Europe, North Africa or other Middle Eastern countries, or immigrants themselves. Of the remaining 20%, the largest minority is composed of Arabs (about 1.7 million residents). This diverse population is marked by large income gaps and child poverty levels (35%) that exceeds most Western country levels. Government expenditure in education as a percentage of the GDP is high compared to the OECD average (8.3% vs. 6.2%, respectively), but this is offset by the high proportion of school-aged children, making the per-student investment lower than the OECD average (Ben David-Hadar, 2017).

Israel's educational system, most of which is public, is divided into three levels: elementary, middle, and high school. This system is centralized under the authority of the Ministry of Education, which issues national curricula, determines compulsory studies and their curricula, and also oversees national and international testing policies (Nir, Ben-David, Bogler, Inbar & Zohar, 2016). The curricula for core subjects, such as math, the sciences, and English, are intended to apply to all students equally (Mullis, Martin, Goh & Cotter, 2016). The educational system conducts extensive nationwide testing to assess progress, including *bagrut* (matriculation) exams given toward the end of high school and *meitzav* exams that assess school efficacy and growth. Schools also participate in international exams, such as TIMSS and the Programme for International Student Assessment (PISA). PISA test results show Israel to be close to the OECD average (Nir et al., 2016) and above average in the TIMSS tests (Mullis, Martin & Loveles, 2016).

However, it should also be noted that the achievement gap between high- and low-performing students is high compared to OECD countries (OECD, 2012). This finding corresponds to Israel's ranking as 11th of the 45 participating TIMSS 2011 countries, in terms of gaps in student achievements, and sixth place in terms of its "advanced" students (Mullis & Martin, 2013).

Math Achievements: an International Perspective of the Israeli Case

In the present study, mathematical achievements are based on TIMSS data for 8th graders in Israel. TIMSS examines achievements in math and sciences, including the perceptions of principals, teachers, and students of school climate, discipline, and school conditions and resources. The TIMSS 2011 report also presents the results of the study conducted in Israel, including Israel's rank among other countries. Israel's average math score was 511, placing it seventh among the 45 participating countries. The average score for all countries was 467 (Mullis & Martin, 2013).

Methodology

Study Data and Sample

The present study used 2011 TIMSS data stored in the National Center for Educational Statistics (NCES). The TIMSS data includes schools randomly selected in 45 participating countries. This study focuses on the Israeli sample, which included 147 principals, 147 teachers, and 4304 students nested in 147 schools. The ratio between the students (boys and girls) was 50:50. Of these, 91.2% were native Israelis, while the rest were immigrants. Sixty percent reported fathers with high school education or less, 20% reporting fathers with a bachelor degree, and 20% reporting fathers with higher degrees. Twenty percent had mothers with a bachelor degree, 15% had mothers with advanced degrees, and the rest reported mothers with high school education or less. In this sample, we also integrated teacher level data. Women were the majority of teachers (75%), which resembles the national proportion between male and female teachers (Israel Central Bureau of Statistics, 2011). Israeli teachers reported 18 years of experience on average with a 10-year standard deviation. The principals were not requested to report their socio-demographic details. Therefore, this data is not available based on TIMSS questionnaires.

Study Factors and Indexes

The main TIMSS study factors investigated here included perceptions of parental interactions among principals, teachers, and students, student background characteristics (gender, parents' educational level, students' country of origin and socio-economic status), and students' math achievements. Our study focuses on the three TIMSS 2011 questionnaires completed by school principals, teachers, and students.

Preparing the Study Measures

The authors and three research assistants independently reviewed the TIMSS items in each questionnaire (principals, teachers and students) and divided them into two main categories: "appearances of parental interaction"[1] and "student background factors." Using the inter-rater reliability procedure[1] (Gwet, 2014), we all ranked the items in the "appearances of parental interaction" category on a five point Likert scale, as relevant to study parental interactions. After comparing our results, we chose only items with high rankings (4–5). Each dimension of parental interactions is thus composed of a different number of items, corresponding to the number of relevant items in each questionnaire (principals, teachers, students).

Data Analysis

In the Israeli context, the TIMSS 2011 data are best described at two levels: the student level (the measurement or level one) and the school level (level two), which include variables based on reports by principals and teachers. As there is usually one teacher from each school, the second level reflects both teachers and principals (Raudenbush & Williams, 2014).

Data Analysis Procedure

We used the Mplus v.7.02 (Muthen & Muthen, 2012) program, which facilitates complex hypotheses examinations related to both the multilevel structure of the data and to the possibility of constructing different latent factors, based on different items in the sample (Brown, 2015). To examine the hypotheses, we built a regression equation model composed of two steps. The first examines the item loading by confirmatory factor analysis (CFA). The outcomes of this stage measures goodness of fit and measures composite reliability (CR). The second step is the equation model for checking the model hypothesis.

The latent factors are composed of several observable items. For example, the latent factor "parental involvement in their child's learning" (FW11, item 11 in the student questionnaire) includes the students' answers to the question: "How often do things take place at home: 'My parents ask me what I am learning at school', "my parents check if I do my homework." This factor is observed at the student level and has a latent expression at the school level (FB11). The observed item is a specific answer of a student, but since each group of students belongs to another school, this is "taken into account" in building the two factors (at the student and school levels).

In constructing each variable, both the student level and the school level were examined. The list of variables at level 2 includes two factors at the school level. These included the latent variable "direct communication on student progress" (FBT06, statement 6 in the teacher questionnaire), which consists of observed items (e.g. for the typical student in your class, how often do you do these things: "meet or talk individually with the student's parents to discuss his/her learning progress"), and "general information of school principles and activities" (PFB10, item 10 in the principal questionnaire), which consists of observable items (e.g. "how often does your school do the following for parents in general: inform parents about the rules of the school"), and the variable "Socio-Economic-Status-SES" (item 3 in the principal questionnaire—"Approximately, what percentage of students in your school have the following background: come from economically disadvantaged homes").

Although the questionnaires expressed different appearances of parental interactions (students, teachers, and principals), they all dealt (according to the inter-rater reliability step) with the core category of parental interactions divided to three main factors: (a) The principals' report to parents, which focused on the general information of school principles and activities; (b) teacher communications with parents as part of reporting on the students' learning progress; and (c) student reports on parental involvement in their schooling at home and at school.

The list of variables at level 1 (student level) includes the parents' education (FSESW, statement 6 in the questionnaire per student), the background variable "gender" (male or female), and student's "place of birth" (Israel or other country). These last two variables were defined from the outset as level 1 variables, meaning that they are not affected by the students' school affiliation.

The two-level analysis required examination of the two main dependent factors: parental involvement in student learning (based on student reports) and student math achievements. The appropriate measure for the two-level data was the intra-class correlation (ICC) measure (Heck, Thomas & Tabata, 2013). We found that the ICC for parents' involvement was 0.07, and the ICC for student math achievement was

0.42. This indicated that higher math grades were found in certain schools, whereas the between-school variation in parents' involvement was smaller. The math achievement score was partially measured and was imputed to generate five plausible values for each student (von Davier, Gonzalez & Mislevy, 2009). We integrated these five scores, as well as the school weight and a resampling approach (Jackknife) based on the TIMSS stratification variable (Yamamoto & Kulick, 1999). Thus, all reported model estimates were subject to these additional considerations.

Results

Because we undertook a multilevel analysis in which factors could appear at both the student and school levels, internal consistency was based on variances stemming from the two levels. Therefore, we used composite reliability (CR) as a measure of internal consistency (Geldhof, Preacher & Zyphur, 2014). The study's CR is shown in Table 1. In contrast to the relatively low CR level for the dimension of parental interaction "parental involvement in student learning" at the student level (CR = .59, $p < .001$, based on students' reports), the school level of the parental interaction dimensions indicates a higher CR ("Parental involvement in student learning," CR = .87, $p < .001$; "Direct communication on student progress", CR = .84, $p < .001$; "providing general school information to the parents," CR = .74, $p < .001$ for students', teachers', and principals' reports of parental interactions, respectively).

Therefore, student reported parental interaction is homogeneous at the school level (given, as described above, that the latent factor has two expressions—at the student level and at the school level) and supports the possibility that schools are homogeneous, but vary in the level of reported parental interaction. Goodness of fit measures, appearing at the bottom of the Table 1, are also reasonable (Raudenbush & Williams, 2014).

Testing the Study's Hypotheses

Our first hypothesis stated that there would be significant relationships between different appearances of parental interaction among students, teachers, and principals. This hypothesis was confirmed. Table 2 assesses the relationships between different reports of parental interactions (principals, teachers, students), as well as relationships between background factors among the student, teacher, and principal levels.

Direct communication on student progress (based on teachers' reports) was negatively correlated with parental involvement in student learning (based on students' reports) ($\beta = -0.31$, SD = 0. 16, $p < .05$): Teachers with higher reports of direct communication on student progress were negatively associated with lower students' perception of parental involvement. This tendency is preserved even when considering the principals' perceptions of providing information concerning school principles and activities ($\beta = -0.32$, SD = 0.11, $p < .01$). Thus, in schools where teachers and principals perceive parental interaction as high, students have lower perceptions of parental involvement. In addition, we found a negative relationship between principal reports of providing information concerning school principles and activities and teacher reports of direct communication on student progress ($\beta = -0.25$, SD = 0. 11, $p < .05$; see Table 4).

Table 1 Confirmatory factor analysis for the study variables

	Unstandardized	Standardized
Level 1—student		
Parental educational level:		
Mother's educational level	1.37*** (0.35)	0.74*** (0.19)
Father's educational level	1.69*** (0.43)	0.92*** (0.23)
CR	0.81*** (0.01)	–
Parental involvement in student learning (students' reports):		
My parents ask me what I am learning in school	0.49*** (0.02)	0.57*** (0.02)
My parents make sure I set aside time for my homework	0.62*** (0.02)	0.70*** (0.02)
My parents check if I do my homework	0.75*** (0.02)	0.64*** (0.02)
CR	0.59*** (0.01)	–
Level 2—school		
Parental involvement in student learning (students' reports):		
My parents ask me what I am learning in school	0.14*** (0.03)	0.86*** (0.11)
My parents make sure I set aside time for my homework	0.21*** (0.03)	0.70*** (0.10)
My parents check if I do my homework	0.30*** (0.04)	0.89*** (0.10)
CR	0.87*** (0.04)	–
Direct communication on student progress (teachers' reports):		
Meet or talk individually with the students' parents to discuss their learning progress	0.62*** (0.07)	0.88*** (0.07)
Send home a progress report on the students' learning	0.60*** (0.07)	0.83*** (0.08)
CR	0.84*** (0.03)	–
General information of school principles and activities (principals' reports):		
Inform parents about the overall academic achievement of the school (e.g. results of national tests)	0.49*** (0.08)	0.49*** (0.08)
Inform parents about school accomplishments (e.g. tournament results, facility improvements)	0.44*** (0.07)	0.57*** (0.08)
Inform parents about the educational goals and pedagogic principles of the school	0.61*** (0.08)	0.78*** (0.10)
Inform parents about school rules	0.68*** (0.07)	0.81*** (0.07)
Discuss parents' concerns or wishes about the school's organization (e.g. rules and regulations, timetables, safety measures)	0.39*** (0.10)	0.45*** (0.11)
Provide parents with additional learning materials (e.g. books, computer software) for their child to use at home	0.45*** (0.10)	0.44*** (0.09)
Organize workshops or seminars for parents on learning or pedagogical issues	0.24* (0.11)	0.25* (0.11)
CR	0.74*** (0.04)	–

CFI = 0.991, TLI = 0.986, RMSEA = 0.013, $\chi^2 = 81.52$, df = 48, $p = .002$; the numbers in parentheses represent standard error of the estimate

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

Our second hypothesis stated that relationships in different directions (e.g. positive, negative) would be found between parental interaction reports by students, teachers, and principals and students' academic achievements. This hypothesis was confirmed. Table 3

Table 2 The relationships between the study dimensions. Parental involvement in student learning

		Unstandardized	Standardized
Level 1			
Sex	Gender	0.10** (0.04)	0.05** (0.02)
Origin	Origin	0.02 (0.07)	0.004 (0.02)
FSESW	Parental educational level	− 0.04 (0.07)	− 0.04 (0.06)
	R^2		0.01 (0.01)
Level 2			
LSES	Percentage of low socio-economic students at school	− 0.51*** (0.13)	− 0.41*** (0.10)
FBT06	Direct communication on student progress (teachers' reports)	− 0.41 (0.23)	− 0.31* (0.16)
PFB10C	Providing information concerning school principles and activities (principals' reports)	− 0.42* (0.17)	− 0.32** (0.11)
	R^2		0.42*** (0.11)

CFI = 0.973, TLI = 0.958, RMSEA = 0.019, χ^2 = 165.47, df = 63, p = <.001. The numbers in parentheses represent standard error of the estimate; gender: male = 0, female = 1; country of origin: immigrants = 0, native-born = 1.

*p < .05; **p < .01; ***p < .001

shows that parental involvement in student learning as reported by the students relates to math achievements (β = 0.12, SD = 0. 02, p < .001, level 1; β = 0.44, SD = 0. 13, p < .001, level 2). In other words, students who perceive high parental involvement in their studies are more successful in mathematics compared to students who perceived lower parental

Table 3 The relationship between background variables, appearances of parental interactions and math achievements

		Unstandardized	Standardized
Level 1			
Sex	Gender	4.45 (3.50)	0.03 (0.02)
Origin	Origin	42.93*** (5.89)	0.16*** (0.02)
FSESW	Parental educational level	26.23*** (2.05)	0.34*** (0.02)
FW11	Parental involvement in student learning (students' reports)	9.43*** (1.74)	0.12*** (0.02)
	R^2		0.15*** (0.02)
Level 2			
LSES	Percentage of low socio-economic students at school	− 8.86 (5.16)	− 0.18 (0.10)
FB11	Parental involvement in student learning (student reports)	23.13** (7.05)	0.44*** (0.13)
FBT06	Direct communication on student progress (teacher reports)	− 14.15* (5.90)	− 0.27* (0.11)
PFB10C	Providing information concerning school principles and activities (principal reports)	− 3.71 (4.74)	− 0.07 (0.09)
	R^2	–	0.54*** (0.08)

CFI = 0.971, TLI = 0.953, RMSEA = 0.019, χ^2 = 197.56, df = 75, p = <.001. The numbers in parentheses represent standard error of the estimate; gender: male = 0, female = 1; country of origin: immigrants = 0, native-born = 1

*p < .05; **p < .01; ***p < .001

involvement. In level 2, we see a significant negative relationship between direct communication on student progress as reported by the teachers and math achievements ($\beta = -0.27$, $p < .05$), meaning, the higher the direct communication on student progress as reported by teachers, the lower the math achievements.

A further analysis of this negative association revealed that the highest negative correlations were found across schools that exhibited lower math test results (mean math achievement smaller than 525, $r = -.527$), whereas among the stronger schools (mean math achievement greater than 525), this correlation was lower ($r = -.259$). No significant relationship was found between providing information concerning school principles and activities, as reported by the principals, and math achievements.

Our third hypothesis proposed that significant relationships would be found between background factors (socio-economic status, gender, parental education level and student's country of origin) and (1) perceptions of parental interactions among principals, teachers, and students and (2) students' math achievements.

Regarding the first part of the hypothesis, Table 4 shows that parental involvement in student learning as reported by the students is higher for girls ($\beta = .06$, $p < .01$, SD = 0.03), while a higher parental educational level elicits lower parental involvement in student learning as reported by the students ($\beta = -0.08$, $p < .05$, SD = 0.04). The higher

Table 4 Model correlations between the study variables in two-level math achievement model

		Unstandardized	Standardized
Level 1			
FW11 × sex	Parental involvement in student learning (students' reports) × gender	0.03* (0.01)	0.06** (0.02)
FSESB × sex	Parents' educational level × gender	− 0.03 (0.02)	− 0.05 (0.03)
FW11 × FSESB	Parental involvement × parents' educational level	− 0.08* (0.04)	− 0.08* (0.04)
Origin × FSESB	Origin × parents' educational level	0.01 (0.01)	0.03 (0.03)
Origin × FW11	Origin × parental involvement	0.003 (0.01)	0.01 (0.02)
	Origin × gender	0.01* (0.002)	0.04* (0.02)
Level 2			
FB11 × FBT06	Students' perceptions of parental involvement × teachers' perceptions of parental involvement	− 0.46*** (0.11)	− 0.46*** (0.11)
FB11 × PFB10C	Students' perceptions of parental involvement × principals' perceptions of parental involvement	− 0.19 (0.12)	− 0.19 (0.12)
FB11 × LSES	Students' perceptions of parental involvement × percentage of low socio-economic students in school	− 0.53*** (0.10)	− 0.51*** (0.09)
PFB10C × FBT06	Principals' perceptions of parental involvement × teachers' perceptions of parental involvement	− 0.25* (0.11)	− 0.25* (0.11)
FBT06 × LSES	Teachers' perceptions of parental involvement × percentage of low socio-economic students in school	0.54*** (0.08)	0.52*** (0.07)
PFB10C × LSES	Principals' perceptions of parental involvement × percentage of low socio-economic students in school	− 0.12 (0.09)	− 0.12 (0.09)

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

the percentage of students from lower socio-economic status backgrounds, the lower the level of parental involvement in student learning as reported by the students at the school level ($\beta = -0.51$, $p < .001$, SD = 0.09). We also found that the higher the percentage of students from lower socio-economic backgrounds, the higher the level of direct communication on student progress as reported by the teachers at the school level ($\beta = 0.52$, $p < .001$, SD = 0.07).

Regarding the second part of the hypothesis, no gender differences were revealed in predicting students' achievements (Table 3). However, we found that native-born students attained higher achievements than new immigrants ($\beta = 0.16$, $p < .001$, SD = 0.02). Parental educational level was positively related to student math achievements ($\beta = 0.34$, $p < .001$); thus, students with more educated parents were more likely to attain higher math achievements.

Discussion

This study used a unique integrative approach, based on student, teacher, and principal reports to examine different appearances of parental interactions and the relationships between these appearances and math achievements found in the TIMSS 2011 data. Different appearances of parental interaction emerged, such as "parental involvement in their child's learning," "direct communication on student progress," and "providing general information of school principles and activities," based on student, teacher, and principal perceptions correspondently.

Regarding the first hypothesis, we found a negative relationship between teachers' reports of communicating student progress to the parents (e.g. parent-teacher meetings or sending reports to parents) and students' reports of their parental involvement in their schooling (e.g. parents checking that their children dedicate time for their homework). In addition, we found negative relationships between principal reports to the parents of their general school principles and activities (e.g. informing parents about educational goals, pedagogic principles of the school, workshops for parents on learning or pedagogical issues) and student reports of their parental involvement in their schooling.

These findings may broaden the understanding of parental interactions. While previous studies mainly focused on positive relationships between principal and teacher reports of parental interactions and involvement of parents in their children's learning (Barnyak & McNelly, 2009; Becker & Epstein, 1982; Hughes, Gleason & Zhang, 2005), this study found that in certain cases, higher interactions of teachers and principals toward parents associate with lower scholastic involvement of parents based on student reports. We also found a negative relationship between teacher reports of parental interaction appearances and principal reports regarding school goals, principles, and activities to parents.

These negative relationships can be explained by compensation effects. The findings illustrate a balance in parental interactions among internal stakeholders (teachers, students, and school principals) when the level of parental interaction is low among one of the stakeholders. For instance, high-level appearances of parental interaction among teachers and principals exist when the students perceive low-level appearances of parental interaction. Similarly for principal and teacher reports, low-level

appearances of parental interactions among teachers exist when there is a high level appearance of parental interaction among principals.

The second hypothesis, which states that relationships in different directions would be found between a variety of parental interaction appearances and academic achievements among student, teacher, and principal reports, was confirmed. Results show a positive relationship between student reports of parental involvement in their learning and math achievements and a negative relationship between teacher reports of their communications to parents on student progress and math achievements. No significant relationship was found between principal reports informing parents about school activities and math achievements.

The positive relationship between student reports of parental involvement in their schooling and their math achievements is supported by previous research (Rogers, Theule, Ryan, Adams & Keating, 2009; Sui-Chu & Willms, 1996) and seems logical, considering the study context. For example, higher levels of parental attentions regarding their children's homework associates with higher student math achievements. The literature is less uniform regarding the relationship between parental interactions as reported by teachers and math achievements. While some studies found a positive relationship between teacher reports of parental interactions and student achievements (Hoover-Dempsey et al., 2002), other studies have pointed to weak relationships between teacher reports of parental interactions and math achievements (Hill & Taylor, 2004). The negative relationships we found between teacher reports of their communication with parents and math achievements may describe situations of high levels of communication with parents mostly in cases where the students have learning difficulties expressed by their low achievements.

Our third hypothesis argued that significant relationships would be found between background factors and (a) student, teacher, and principal reports of appearances of parental interactions and (b) students' achievements. Initially, our findings showed that gender affiliation positively related to parental involvement in their child's schooling among students reports with girls perceiving their parents' involvement in their schooling as higher than boys. Previous studies (e.g. Hong et al., 2010) suggested that gender differences in parental involvement reports stem from the differences in actual parental involvement for girls and boys, as parental involvement styles vary according to the child's gender. It is also possible that gender relates the students' subjective sense of their parents' involvement, even when parental involvement is the same.

In addition, based on principal reports, high percentages of students from lower socio-economic backgrounds relate negatively to student reports of parental involvement. This finding may support previous studies indicating that parents from low socio-economic status lack the time to be involved in their children's learning because of intensive work demands to meet their family needs. The positive relationship between teacher reports of their communications with parents regarding student progress and low socio-economic backgrounds may describe a situation where higher levels of meetings, discussions and sending reports appear among low socio-economic families. This relationship may describe a situation in which students from lower socio-economic backgrounds are the focus of the teacher's concern.

Regarding the relationship between background variables and student math achievements, we found that parental educational levels and countries of origin significantly relate to math achievements. Thus, immigrant students had lower achievements than

native-born students, and children whose parents have higher educational levels had higher achievements. The finding that immigrant students attain lower achievements is supported by several studies explaining that academic achievements of immigrants are lower than those of native-born students based on language difficulties in the new countries (Levels, Dronkers & Kraaykamp, 2008; Zussman & Frish, 2009). The positive relationship between parental educational levels and academic achievements confirms the findings of most studies in the field explaining that parents with higher education know where to act and what to demand so their children will succeed in their studies (Davis-Kean, 2005; Englund, Luckner, Whaley & Egeland, 2004; Green, Walker, Hoover-Dempsey & Sandler, 2007; Hill & Taylor, 2004).

We also found that schools with higher percentages of students from lower socio-economic backgrounds had lower student achievements. This finding confirms the positive relationship between high socio-economic status and math achievements reported in previous studies, explaining by resources dedicated by parents of higher socio-economic status to promote their children's achievements (Sirin, 2005).

Conclusions, Study Limitations, and Recommendations for Future Research

Our integrative approach to study parental interactions based on student, teacher, and principal reports found a compensational model, where an appearance of high levels of one parental interaction (e.g. students reports) relates to low levels of other appearances of parental interactions (e.g. teacher and principal reports). Thus, educational systems seem to balance themselves. It seems that in practice, teachers and principals use parental interaction mostly in problematic cases and not in regular student performance. Follow-up research might examine the nature of the parental interactions and consider the students' academic situation, using qualitative methodology.

Both the 2011 and 2015 TIMSS datasets have similar items. We therefore encourage future studies to analyze TIMSS 2015. Examining the relationship between parental interactions and student achievements using a comparative approach (2011 vs. 2015 data) may allow the development of a longitudinal study and a broad perspective. Moreover, although we used parental interactions indexes that varied from one questionnaire to the other (principals, teachers, students), such an approach can be supported by the many aspects of parental interactions described in the literature. Follow-up research should be done to compare perception differences among school staff, students, and parents, as well as the source and influence of these differences based on the context, culture, and policy in different countries.

Our study has two main limitations. First, it focused on the relationships between reports of parental interactions and student achievements. Future studies should focus on causal relationships, based on an intervention study, for example, whether high levels of parental interaction appearances will lead to higher levels of student achievements. Second, parental interactions can be defined in many different ways and measured differently. To minimize bias, this study used an integrative approach to simultaneously examine the reports of teachers, principals, and students. Follow-up research should examine further definitions of parental interactions, compare these

definitions with the present study's definitions, and show how these new definitions relate to academic achievements.

Contribution

This study employed multiple perspectives and an integrative approach to examine parental interaction and the contributions of factors, such as country of origin, socio-economic status to students' achievements. The findings highlight the importance of parental interactions and the urgency of implementing efficacious plans for encouraging parental interactions. Policy-makers should develop teacher and principal training programs that emphasize parental interaction to improve student academic achievements not only in problematic academic situations but also in school routine.

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[1]Inter-rater reliability, one aspect of the test validity, is the degree of agreement among raters and the degree of consensus that ratings are given by various judges.