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Abstract

In this quantitative study we investigated the primary school students' perceived parental involvement in mathematics with respect to different school socio-cultural identity as identified by the students' ethnicity. 493 students attending the two last grades of three primary schools participated in the study. The role of the students' grade and gender, as well as the mother/father contrast were also considered in the analyses. The findings of the study revealed both inter-school and intra-school divergences and convergences, thus suggesting the complex links between school identity and perceived parental involvement. More specifically, according to our results, the 'multi-cultural' seems to be linked with a more stable perceived parental involvement across different year groups and calendar years. The pedagogical implication of the findings are discussed.

Keywords: Parental involvement, mathematics, primary schools, school identity

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Identidad Socio-cultural de la Escuela y la Percepción de la Participación de los Padres en Matemáticas en Grecia

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Resumen

En este estudio cuantitativo investigamos la percepción que tienen estudiantes de primaria de la participación de las familias en matemáticas respecto a diferentes identidades socio-culturales escolares, de acuerdo a la etnicidad. Un total de 493 estudiantes asistieron a los dos últimos años en tres escuelas de primaria que participaron en el estudio. El papel del curso de los estudiantes, así como de su género, y el contraste madre/padre se consideraron en el análisis. Las contribuciones del estudio revelan divergencias tanto inter-escuelas, como intra-escuelas, de manera que se sugiere que existe una relación compleja entre la identidad de la escuela y la participación de las familias percibida. Más concretamente, de acuerdo a nuestros resultados, el "ser multi-cultural" parece que se asocia a una participación de las familias percibida más estable a lo largo de los cursos y de los años. Se discuten las implicaciones pedagógicas de este hecho.

Palabras clave: Participación familiar, matemáticas, escuelas e identidad escolar

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The last decades, the interest of mathematics education researchers has been concentrated in the investigation of the relationships between in-school mathematics learning and the school broader social environment. This interest is related to the contemporary socio-cultural approaches to mathematics education and is in line with the attempt to explain the identified variation in the students' learning mathematics with respect to their socio-cultural background.

The children participate in discourse practices linked with mathematics learning in the family, in the school unit and in the broader social context of their community. The in-school mathematics practices are often in contrast with the out-of-school practices, thus causing diverging mathematics learning conditions and environments as experienced by the student's community or by each student.

The students' family crucially affects their interaction with school mathematics, through the students' everyday homework and through the family's broader views, attitudes, beliefs, emotions and practices about mathematics as experienced in everyday mathematically related (implicitly or explicitly) activities. In specific, we posit that the study of the parents-children interactions in mathematics, as well as the teachers-students-parents interactions, is crucial in the identification of difficulties or obstacles linked with mathematics learning. For example, studies have revealed the relationships between the parents' attitudes and practices about mathematics and their children attitudes and achievement in mathematics (for example, Cao, Bishop & Forgasz, 2006; Crafter, 2012; De Abreu, Cline & Shamsi, 2002; Galindo & Sheldon, 2012; Wang, 2004).

The defining role of the parents in their children's cognitive and affective development about mathematics renders important the investigation of the issue with the purpose to propose appropriate actions in order to improve mathematics education in Greece. In the present study, we concentrate in the perceived by primary school students in Greece parental involvement about mathematics, considering the socio-cultural identity of the school they attend as identified by the ethnicity of the enrolled students.
In this study, we focus on the relationship between the students' perceived parental influence and the cultural identity of the school they attend, as identified by the ethnic origin of the students attending the school. Central to our perspective is the assumption that different cultural school identities, crucially identifying different communities with qualitatively different

goals and protagonists, including the teachers, the students and the family (Moutsios-Rentzos, Kalavasis & Sofos, 2013). Thus, different socio-cultural identities essentially determine different realities within which the students experience mathematics and, therefore, it is reasonable to assume that the perceived parental involvement would be related with the sociocultural identity of the school unit.

Theoretical Framework

Indirect and Direct Parental Involvement

The last two decades, mathematics education researchers have investigated the role of the students' family in the students' developing positive attitudes and better achievement in mathematics (for example, Cao, Bishop & Forgasz, 2006; Cobb & Yang, 1995; Galindo & Sheldon, 2012; Jacobs & Bleeker, 2004; Wang, 2004). The posed research questions mainly concern the ways that parental involvement affects the students' mathematics learning, including the identification of the role of different ways of parental involvement in the students' mathematics learning.

Parental involvement has been differentiated between indirect parental involvement and direct parental involvement (Cai, Moyer & Wang, 1997). Indirect parental involvement includes the family expectations with respect to the student's mathematical attainment, the parental attitudes towards mathematics, the broader family encouragement and support of the students through a variety of material (for example, books or educational software) or immaterial means (for example, guidance about mathematical related or affected professional prospects). Direct parental involvement refers to the immediate parents-children interactions that include their interaction in mathematics homework, as well as a variety of mathematically related activities (formal or informal).

Regarding indirect parental involvement, studies suggest that the parents' views about the value of mathematics affect their children's attitude towards mathematics (Yee, 1986), whilst the parents' attitudes towards mathematics have been found to be linked with the breadth of the constructed corpus of knowledge in ways that transcend the socio-economic family status (Young-Loveridge, 1989). Furthermore, the parents' high expectations about their children mathematical attainment appears to

positively affect both their attainment and their self-estimation or self-confidence (Jacobs & Bleeker, 2004; Wang, 2004) and even more from their early years of schooling (Galindo & Sheldon, 2012). Moreover, considering the broader family support (such as number of books at home), it appears that it is positively linked with the students' attainment (Hyde, Else-Quest, Alibali, Knuth & Romberg, 2006; Wang, 2004).

Focusing on direct parental involvement, research findings suggest that it is the quality of the collaboration between parents and students –rather than the mere amount of the time spent– which crucially determines the effectiveness of parental involvement on the students' preparing their homework (Hyde et al, 2006; Pezdek, Berry & Renno, 2002).

Furthermore, studies in Greece appear to support the fact that mathematics are at the crux of the parental involvement about their children's learning, since the Greek parents appear to spend more time with their children for mathematics, when compared with the time spent about other courses (Kafoussi, 2009).

Socio-Cultural Aspects of Parental Involvement about Mathematics

Cao, Bishop and Forgasz (2006) in a large study conducted in China and Australia with students aged 11, 13 and 15 years old identified variations in the students' perceived parental involvement about mathematics linked with the students' age, country of residence and language. They identified four components in the students' perceived parental involvement: a) "perceived mother's and father's encouragement about mathematics learning" (*Parent Encouragement*), b) "perceived father's attitudes to mathematics and help given for mathematics learning" (*Father's Attitude and Help*), c) "perceived mother's attitudes to mathematics and help given for mathematics learning" (*Mother's Attitude and Help*), and d) "perceived mother's and father's expectations of their child's school achievement" (*Parent Achievement Expectation*). In specific, they found that the perceived parental involvement decreases as the students' age increases. Moreover, the country of residence appeared to affect perceived parental involvement with the China-living students reporting higher perceived parental expectations for doing better in mathematics than the Australia-living students. Furthermore, the students living in China, unlike the Chinese-speaking students living in Australia, expressed substantial perceived parental

expectations for doing better in mathematics. Concentrating within each country of residence, the sociocultural identity of the students appeared to be linked with the perceived parental involvement, since in Australia perceived parental encouragement by the English speaking students (the dominant language in Australia) was less evident than the one reported by the non-English speaking Australian students.

Moreover, mathematics education research projects suggest that when considering students who are not in the dominant sociocultural community of a country the parental involvement is a crucial factor for their appropriate social integration (Crafter, 2012). Crafter employed the term parental cultural models in order to interpret the diverse ways in which the parents are involved with their children's mathematics education. According to her, "when parents try to make sense of their child's mathematical achievement, they utilize and incorporate a variety of resources within the boundaries of particular cultural models" (p. 33). Cultural models, as a form of patterning, facilitate the classification of experience, they are situated, they don't have general or specific character, but they are related to the experiences and the cultural context lived by a person (Pérez Campos, 2004). These models affect the ways that the parents construe and interpret their children behaviour in mathematics and in the school class. Investigating the resources that parents from different cultural backgrounds (parents from ethnic minority backgrounds or white and British born) used in order to understand the mathematical achievement of their children, she found three dominant resources, the teacher, exam test results and constructions of child development. However, all these resources were interpreted by the parents in different ways according to their own cultural models and this issue could cause misunderstandings between home and school.

De Abreu et al (2002) studied the parental support to their children' transitions between school mathematics and mathematics at home. The study was conducted with the students, the parents and the teachers of four schools in a multicultural district of South England. Ethnic origin (white British, Pakistani British), age and mathematical attainment were considered in the study. The researchers found that the parents' views about their own involvement or not in their children's learning varied depending on the ethnic origin. The identified variation concerned both the corpus of the mathematical knowledge that is within the responsibilities of the family and the family members that are actually involved in the students'

mathematics learning at home. For example, white British parents appeared to concentrate in helping their children in simple addition and subtraction computations, whilst the Pakistani British parents emphasised algorithms and multiplication tables, rarely mentioning computations. In addition, the Pakistani British parents appeared to trust the older children to help the younger in their studying mathematics at home (mainly because of language barriers), whilst in the white British families the mathematics help at home appeared to be 'assigned' to mothers.

Consequently, the broader sociocultural environment of a country and importantly the socio-cultural diversity within a country appear to affect parental involvement about the students' learning mathematics.

The Purpose of This Study

In Greece, there appears to be lack of research projects addressing research questions regarding the links between parental involvement about mathematics and the socio-cultural background, including investigations across school units or within a school unit. The literature suggests differentiation in the perceived parental involvement within the same country depending on the ethnic origin of the students. We assume that the school unit community constitutes a socio-cultural environment and as such the socio-cultural identity of the school crucially determines the broader framework within which the students' perceived parental involvement is experienced.

In this study, we draw upon the study conducted by Cao, Bishop and Forgasz (2006) to explore the links between the primary school students' perceived parental influence and the cultural identity of the school they attend. We employed a translated to Greek version of the questionnaire they utilised in their study (see Methods and procedures) to investigate the ways that specific aspects of the perceived parental involvement are affected by socio-cultural factors.

Overall, in this study, we address the following questions:

a) What aspects (if any) of the perceived parental involvement are linked with the sociocultural identity of the school unit as identified by the ethnic origin of the enrolled students?
b) What aspects (if any) of the perceived parental involvement as the students progress through primary school are linked with the

sociocultural identity of the school unit as identified by the ethnic origin of the enrolled students?

Methods and Procedures

Participants

The study was conducted in two phases May 2013 and May 2014 with students attending the 5th and 6th grade of three primary schools (11 and 12 years old) in Athens, Greece (N=492; see Table 1). The schools were chosen according to their socio-cultural identity as identified by the ethnic origin of the enrolled students. More specifically, we formed three categories of schools: School A 'expected' (the ratio of the students of Greek and non-Greek ethnic origin is close to the expected for Athens ratio; around 25%), School B 'multicultural' (various ethnicities are identified, with no ethnic origin exceeding 50% of the population), School C 'mainly of dominant ethnicity' (around 85% of the students are of Greek origin, the dominant ethnicity for Greece).

In this way, data allowing multiple analyses were obtained: both cross-sectional and longitudinal comparative analyses within each school (5th grade vs 6th grade) and amongst the different school sociocultural identities.

The school and sample characteristics are summarised in Table 1.

Instrument: The Translated to Greek Version of the Perceived Parental Influence Scale

To identify the students' perceived parental influence, each student completed a translated to Greek version of the Perceived Parental Influence scale (PPI scale; Cao, Bishop & Forgasz, 2006). PPI was first independently translated and back translated from English to Greek and subsequently it was piloted to refine the language of the items. PPI consists of sixteen 4-point Likert type items ('Strongly Agree', 'Agree', 'Disagree', 'Strongly Disagree'): eight measuring the students' perceptions regarding the mother's influence and eight measuring perceptions of the father's influence. In Table 2, the PPI is presented, along with the components found in the original PPI and in the translated to Greek PPI (*Gr-PPI*). Note

Table 1
The participants of this study (n=493)

		School A (N_A =196) 'expected' (26% non-dominant)		School B (N_B =134) 'multicultural' (76% non-dominant)		School C (N_C =159) 'mainly of dominant ethnicity' (16% non-dominant)	
Phase	Gender	Grade 5 (N_{A5} =98)	Grade 6 (N_{A6}=98)	Grade 5 (N_{B5} =68)	Grade 6 (N_{B6} =66)	Grade 5 (N_{C5} =83)	Grade 6 (N_{C6} =76)
2013	Boys	29 (58%)[a]	27 (50%)	21 (58%)	21 (64%)	25 (52%)	10 (36%)
2014	Girls	21 (42%)	27 (50%)	15 (42%)	12 (36%)	23 (48%)	18 (64%)
	Boys	28 (58%)	26 (59%)	18 (56%)	16 (48%)	17 (49%)	25 (52%)
	Girls	20 (42%)	18 (41%)	14 (44%)	17 (52%)	18 (51%)	23 (48%)

[a] Frequency (valid percent)

also that the Gr-PPI was complemented with questions investigating the students' gender and mathematics grade, as well as with a question investigating the amount of mathematics books the students have at home and a question about the amount of time they spend each day studying mathematics at home. These questions were considered as indicators of the students' mathematical involvement at home.

In order to determine the psychometrics of the Gr-PPI we followed the same analyses that were reported Cao, Bishop and Forgasz (2006) investigating the internal consistency of Gr-PPI and its component structure. Considering internal consistency Cronbach's alpha was found to be 0.798, which is satisfactory (Kline, 1999). Subsequently, the component structure of Gr-PPI was explored through Principal Component Analysis (PCA). The sample adequacy is supported by the ratio of participants to items (more than 30 participants per item) and by the Kaiser-Meyer-Olkin measure (0.76; 'good'-'great' according to Hutcheson & Sofroniou, 1999). Moreover, the statistically significant Bartlett's test of sphericity (P<0.001), as well as the inspection of anti-image matrix (diagonal values greater than 0.5) further support the decision to conduct PCA. The visual inspection of the Scree plot and the Kaiser's criterion suggested retaining the four factors. Thus, PCA with varimax rotation led to a 4-component solution (accounting for the 56.7% of variance). Furthermore, based on Stevens (2002), for the sample size of this study, loadings greater than around 0.3 should be considered significant. The solution is outlined in Table 2.

The extracted solution is in line with solution of the original PPI, thus supporting the cross-cultural validity of the instrument. The main difference is that both items that investigate whether or not the parents make the student to feel that (s)he can do well in maths loaded on the respective (mother or father) attitude and help component. In the original PPI, similar cross-loadings of these two items in the respective components were also reported (see Table 2), but the researchers chose to assign the items in a different component. We posit that in this study, the first component is stronger on the general (not only maths) aspect of the encouragement, thus resulting on the two items describing maths specific encouragement to load on the respective maths focused mother or father components. Hence, we decided to add a characterisation to each component in order to identify this difference in the level of specificity (mathematics or more general) of parental involvement in each component: *m*(athematics) or g(eneral).

Consequently, in the subsequent discussion we considered the four components of PPI-ext as identified in Table 2: a) PECg (Parent EnCouragement; general), FAHm (Father's Attitude and Help; maths), MAHm (Mother's Attitude and Help; maths), and PAEg (Parent Achievement Expectation; general).

Overall, we argue that the conducted analyses support the cross-cultural validity and reliability of the Gr-PPI and, thus, its suitability to be utilised for the purposes of this study.

Table 2
The components of the original PPI and the translated to Greek PPI (Gr-PPI)

	Component[a]			
	PECg	FAHm	MAHm	PAEg
1 My mother is good at maths			0.76 [b]	
			0.66 [c]	
2 My mother checks my maths homework frequently			0.76	
			0.74	
3 My mother asks me about my assessment results in maths	(0.33) [d]		0.55	
			0.41	
4 My mother helps me with some difficult maths problems			0.81	
			0.79	
5 My mother makes me feel that I can do well in maths	0.61		(0.39)	
	(0.31)		*0.36*	
6 My mother tells me that a person must do something carefully in order to do it well	0.76			
	0.69			
7 My mother tells me a person must work hard in order to do something well	0.78			
	0.75			
8 My mother expects me to be the best student in maths and other subjects in my class				0.86
				0.88

Table 2 (…/…)

The components of the original PPI and the translated to Greek PPI (Gr-PPI)

	Component[a]			
	PECg	FAHm	MAHm	PAEg
9 My father is good at maths		0.70		
		0.70		
10 My father checks my maths		0.74		
homework frequently		*0.79*		
11 My father asks me about my		0.66		
assessment results in maths		*0.67*		
12 My father helps me with some		0.81		
difficult maths problems		*0.80*		
13 My father makes me feel that I	0.59	(0.54)		
can do well in maths	(*0.41*)	*0.58*		
14 My father tells me that a person	0.70	(0.39)		
must work hard in order to do	*0.72*			
something well				
15 My father tells me that a person	0.67	(0.38)		
must do something carefully in	*0.73*	(0.33)		
order to do it well				
16 My father expects me to be the				0.88
best student in maths and other				*0.85*
subjects in my class				

Notes: The names of the components are based on the ones proposed in Cao, Bishop and Forgasz (2006), with the addition of the level of specificity (maths or general) for each component as identified by the Principal Components Analysis of this study: PECg (Parent EnCouragement; general), FAHm (Father's Attitude and Help; maths), MAHm (Mother's Attitude and Help; maths), PAEg (Parent Achievement Expectation; general).

[a]. Principal Component Analysis (Varimax rotation applied with Kaiser normalisation; 56,67% of the variance explained). Loadings less than 0.30 are omitted.

[b] '0.xx' indicates the loading of an item of the original PPI to the component to which it is assigned component (loadings less than 0.30 are omitted) as reported in Cao, Bishop and Forgasz (2006).

[c] '*0.xx*' indicates the loading of an item of Gr-PPI to the component to which it is assigned (loadings).

[d] '(0.xx)' and '(*0.xx*)' indicate cross-loadings of an item of respectively the original PPI and the Gr-PPI.

Results

Mathematics Attainment and Mathematics Involvement at Home

Before commencing our investigations it is important to provide a broader account about the students' mathematical attainment (as identified by their mathematics grade) and their mathematical involvement at home (as measured by the time they spend on studying mathematics and the number of mathematics books they have). Such an account (outlined in Table 3) may help in gaining deeper understanding about the subsequent findings with respect to perceived parental involvement. Note that in these analyses we considered only the first time that the students completed the questionnaire (and not for both years of the data collection), in order to ensure all the participant contribute only once to the computed central tendency measures.

It appears that in the 'mainly of dominant ethnicity school', the students get comparatively lower grades (statistically significant lower than the 'expected' school), whilst at the same time the students spent the most time at home studying mathematics and have statistically significant more books at home. Furthermore, the students of the 'expected' school appear to spend statistically significantly less time studying mathematics at home.

The identified differentiations may be linked with the teachers' expectations for their students' attainment and/or with the teachers' views that with respect to the ways that the distribution of the responsibility about the students' mathematics education is affected by the socio-cultural identity of the student. It may be the case that the teachers stereotypically expect the students not of Greek (the dominant) ethnic origin do not enjoy the same amount of parental support (due to diverse factors including language and socio-economic factors) as those of the dominant ethnic origin, thus adopting more 'flexible' assessment criteria for these students (for example, adding an implicit 'effort' grade bonus).

Considering gender differences, no statistically significant gender differences were found with respect to the students' grades ($t(360)=-0.722$, $P=0.471$) and their involvement (books $t(357)=-1.688$, $P=0.092$) or study time, $t(355.9)=0.067$, $P=0.946$).

Table 3
Mathematical attainment and mathematical involvement at home (inter-school comparisons)

				One-way ANOVA			Post-hoc comparisons		
	School A (n=152)	School B (n=102)	School C (n=111)	*F*	*df*	*P*	A vs. B	A vs. C	B vs. C
Attainment	9.2±0.9	9.1±0.9	8.8±1.0	5.644	(2,359)	**0.004**	0.393	**0.003**	0.182
Involvement									
Book	2.0±2.6	1.4±1.7	3.2±4.3	8.978	(2,356)	**<0.001**	0.090	**0.034**	**<0.001**
Time	30.5±21.7	46.0±31.1	55.6±35.3	24.764	(2,355)	**<0.001**	**<0.001**	**<0.001**	0.094

Notes. School A 'expected', School B 'multicultural', School C 'mainly of dominant ethnicity'. Values indicated with '*M*±*SD* [min-max]'. 'Books' number of books. 'Time' in minutes. Post-hoc comparisons based on Games-Howel. Statistically significant comparisons in bold. Only the first time completed the questionnaire considered.

Perceived Parental Influence and School Socio-Cultural Identity

Inter-school-comparisons

For the school level analyses, it should be stressed that we considered only the first time that the students completed the questionnaire (and not for both years of the data collection), in order to ensure all the participant contribute only once to the computed central tendency measures.

Considering the individual scale and subscale scores, in line with Cao, Bishop and Forgasz (2006), the students of the 'multicultural' school appeared to have *higher* perceived parental involvement than the students of the two other schools, which is statistically significant in the overall perceived influence (Gr-PPI), in the Parent EnCouragement (PECg) and in the Parent Achievement Expectation (PAEg). In specific, these differences are predominantly situated in the contrast between the perceived parental influence of the students of the 'multicultural' school and of the students of the 'mainly of dominant ethnicity' school (see also Table 4).

The stronger perceived by the students' parental involvement may be linked with the constant effort of the families of not of dominant ethnicity students to belong to, be 'incorporated' within the dominant culture in the school unit.

Moreover, we followed these results with cross-sectional comparisons within each year (2013 and 2014) between the 5th grade and the 6th grade of each school to determine the level of stability of the identified differences. The analysis revealed that mixed results about the identified patterns of cross-sectional change between 2013 and 2014. The 'expected' school appeared to be the most amenable to change, since in 2013 all differences between the two grades were statistically significant, whilst in 2014 none was statistically significant. In the 'mainly of dominant ethnicity' the pattern of changes slightly changed across the two years with the PPI-ext and MAHm for the two grades statistically significantly differing in the same direction for both years, whilst FAHm was found to be statistically different between the two grades in 2013, but not in 2014 (though in the same direction, decrease, for both years). Finally, the 'multi-cultural' appeared to be more stable in the identified differences, with only PAEg statistically significantly increasing when moving from Grade 5 to Grade 6

Table 4
Perceived parental influence (inter-school comparisons)

				One-way ANOVA			Post-hoc comparisons		
	School A (n=152)	School B (n=102)	School C (n=111)	*F*	*df*	*P*	A vs. B	A vs. C	B vs. C
Gr-PPI	3.1±0.5	3.2±0.4	3.1±0.4	3.291	(2,362)	**0.038**	0.073	0.934	**0.036**
PECg	3.3±0.7	3.6±0.5	3.4±0.6	8.895	(2,362)	**<0.001**	**<0.001**	0.408	**0.007**
MAHm	3.1±0.6	3.1±0.5	3.1±0.6	0.322	(2,362)	0.725	-	-	-
FAHm	3.0±0.8	3.0±0.8	3.0±0.7	0.199	(2,362)	0.820	-	-	-
PAEg	3.3±0.9	3.3±0.8	2.9±0.9	10.378	(2,362)	**<0.001**	0.757	**0.001**	**<0.001**

Notes. School A 'expected', School B 'multicultural', School C 'mainly of dominant ethnicity'. PECg (Parent EnCouragement; general), FAHm (Father's Attitude and Help; maths), MAHm (Mother's Attitude and Help; maths), PAEg (Parent Achievement Expectation; general). Values indicated with '*M*±*SD* [min-max]': '1' (strong disagreement) to '4' (strong agreement). Post-hoc comparisons based on Games-Howel. Statistically significant comparisons in bold.

Table 5
Longitudinal intra-school comparisons

	School A (n=152)					School B (n=102)					School C (n=111)				
	Gr.5	Gr.6	*t*	*df*	*P*	Gr.5	Gr.6	*t*	*df*	*P*	Gr.5	Gr.6	*t*	*df*	*P*
Gr-PPI	3.32	2.86	2.57	43	**0.014**	3.30	3.05	2.43	35	**0.020**	3.19	3.05	1.70	47	0.095
PECg	3.45	3.10	0.85	43	0.400	3.67	3.49	1.32	35	0.197	3.43	3.39	0.35	47	0.729
MAHm	3.32	2.76	3.93	43	**<0.001**	3.14	2.96	1.50	35	0.143	3.16	2.97	1.72	47	0.093
FAHm	3.15	2.77	0.64	43	0.540	3.26	2.92	1.98	35	0.056	3.14	2.98	1.16	47	0.253
PAEg	3.52	2.86	2.10	43	**0.042**	3.08	2.71	2.33	35	**0.026**	2.93	2.79	0.78	47	0.437

Notes. School A ‘expected’, School B ‘multicultural’, School C ‘mainly of dominant ethnicity’. ‘Gr.5’ Grade 5. ‘Gr.6’ Grade 6. PECg (Parent EnCouragement; general), FAHm (Father’s Attitude and Help; maths), MAHm (Mother’s Attitude and Help; maths), PAEg (Parent Achievement Expectation; general). Values indicated with ‘*M’*: ‘1’ (strong disagreement) to ‘4’ (strong agreement). Dependent Student’s t-test. Statistically significant comparisons in bold.

for both, 2013 and 2014. The results of these analyses further support the qualitative and temporal stability of the perceived parental involvement in the 'multicultural' school.

The identified differences may be linked with the parents of different ethnic origin construing different conceptions with respect to their children mathematics education autonomy. In other words, in the course of the students' mathematical development and considering that Grade 6 is the final grade of the primary school (in our country, followed by three-year Gymnasio, 13-15 years old, and three-year Lykeio 16-18 years old), the parents of the students in the 'expected' school may think that their involvement should decrease since the child is 'old enough' to cope with the primary school. On the other hand, in both the 'mainly of dominant ethnicity' school and the 'multicultural' school the decrease in the perceived parental involvement in Grade 6 is not as steep, with the 'mainly of dominant ethnicity' identified difference not being statistically significant. It appears that the school identities that deviate from the 'expected' are less affected from the school unit structure maintaining their own specific characteristics. For example, the stability of the identified differences across the years and not statistically significant longitudinal differences may be linked with the traditional family-centred Greek social structure. On the other hand, a mixture of attempting to maintain the special sociocultural characteristics and of attempting to enter the dominant structures may account for the multicultural stability of the identified patterns of perceived parental involvement changes across the grades in the 'multicultural' school.

Gender, mathematics attainment, mathematics involvement at home

Further analyses were conducted in order to investigate the links between the PPI scales and the students' gender, their mathematical attainment (as identified by their mathematics grade) and their mathematical involvement at home (as measured by the time they spend on studying mathematics and the number of mathematics books they have).

With respect to the students' gender and the PPI scales, the independent samples t-test did not reveal any statistically significant differences (PPI, $t(362)=-0.207$, $P=0.836$); PECg, $t(362)=0.404$, $P=0.686$; MAHm, $t(362)=-1.645$, $P=0.101$; FAHm, $t(362)=0.789$, $P=0.431$; PAEg, $t(362)=1.234$,

P=0.218). Similar statistically non-significant results were found when the analyses concentrated in each school.

Focussing on mathematical attainment for all three schools, the initial investigations did not reveal any statistically significant differences. Focussing on each school separately, in the 'expected' school mathematical attainment was found to be negatively correlated with MAHm (*r*=-0.169, *P*=0.037). We hypothesise that the higher attaining students may seem to experience less maternal encouragement, which might be a result of their mother's considering their children's higher grades as indicators of their achieving a satisfactory level of hard and careful work in school. Nevertheless, such an effect was *not* identified in either of the two other schools. Further investigation revealed that the aforementioned MAHm correlation in the 'expected' School A is situated *only* in the boys (*r*=-0.221, *P*=0.044) and not in the girls (*r*=-0.108, *P*=0.379).

Considering mathematical involvement, two dimensions were investigated: 'number of books' and 'study time'. It should be noted that though they were not statistically significantly correlated (*r*=0.075, *P*=0.161), in the 'multi-cultural' school only they were found to be statistically significantly positively related.

Focussing on the 'number of books', positive statistically significantly correlation were found between 'number of books' and MAHm (*r*=0.106, *P*=0.044). Nevertheless, when focussing on each school separately, 'number of books' and MAHm positive correlation was statistically significant only for the 'expected' school (*r*=0.201, *P*=0.013), whilst in the 'multi-cultural' school 'number of books' was significantly positively correlated with PPI (*r*=0.260, *P*=0.010) and FAHm (*r*=0.202, *P*=0.046).

Focussing on 'study time', statistically significant correlations were found with PECg (*r*=0.123, *P*=0.020) and MAHm (*r*=0.107, *P*=0.044). In the 'expected' school 'study time' was significantly positively correlated only with PPI (*r*=0.178, *P*=0.029), whilst in the 'multi-cultural' school 'study time' was found to be significant positively correlated with PPI (*r*=0.219, *P*=0.031), MAHm (*r*=0.207, *P*=0.041), and PAEg (*r*=0.269, *P*=0.007). Note that no statistically significant correlation with respect to mathematical involvement were found in the 'mainly of dominant ethnicity' school.

Following the above, it appears that mathematical involvement (as realised in the 'number of books' and 'study time') is mainly linked with

the overall perceived parental influence (PPI) and specifically with the maternal involvement (perceptions and help). Nevertheless, focussing on each school separately, the effect of the school identity is noted as in the 'mainly of dominant ethnicity' school no statistically significant parental involvement links were found. This may be linked with the cohesion of the perceptions and the teaching and parental practices about mathematics homework. In contrast, in the 'multi-cultural' school the students' mathematics home activity is linked with the overall perceived parental influence (PPI), as well as with the students' perceived parental involvement subscales: Father's Attitude and Help, Mother's Attitude and Help, Parent Achievement Expectation. These links are further amplified by the fact that only in this school the two measured dimensions of mathematical involvement at home are statistically significantly correlated suggesting broader links between parental involvement and mathematical involvement.

Towards More Detailed Investigations: Some Results from Item Level Analysis

In this section, we present micro-level analyses concentrating in the specific items of the questionnaire. The purpose of these analyses is to gain deeper insight in the complex phenomena by revealing significant aspects of each PPI component linked with the mother or the father in specific.

In order to identify patterns of perceived parental involvement evident in both mother and father influence, we investigated the links between MAHm and FAHm within each School. Though in all schools MAHm scores were slightly higher than the FAHm scores, the dependent Student's t-test revealed that these differences were not statistically significant.

Nevertheless, we followed these results with an item-focussed analysis to investigate specific aspects of parental involvement in the three schools that may have been conflated by the aggregation involved in the computation of a subscale (considered in the aforementioned dependent t-tests), by correlating the perceived father and mother involvement (Kendall's tau was employed). Statistically significant relationships were evident in all three schools, notably:

- The children's perception of their mother as being good at maths was usually positively linked with her helping with difficult mathematics problems at home ('expected': τ=0.337, P<0.001; 'multi-cultural': τ=0.330, P<0.001; 'mainly of dominant ethnicity': τ=0.380, P<0.001). Nevertheless, their perception of the *father* being good at maths had broader positive links, which included at least a *core of four items* common to all schools ('My father checks my maths homework frequently', 'My father asks me about my assessment results in maths', 'My father helps me with some difficult maths problems', 'My father makes me feel that I can do well in maths').
- The mother's perceived interest in the children' mathematical attainment and her encouragement were positively correlated with the fathers' respective interest ('expected': τ=0.230, P=0.001; 'multi-cultural': τ=0.199, P= 0.028; 'mainly of dominant ethnicity': τ=0.346 P<0.001) and encouragement ('expected': τ=0.394, P<0.001; 'multi-cultural': τ=0.375, P<0.001; 'mainly of dominant ethnicity': τ=0.374, P<0.001).
- The mother's expectations for higher grades in mathematics with the fathers' respective expectations ('expected': τ=0.523, P<0.001; 'multi-cultural': τ=0.428, P<0.001; 'mainly of dominant ethnicity': τ=0.544, P<0.001) and values ('expected': τ=0.501, P<0.001; 'multi-cultural': τ=0.405, P<0.001; 'mainly of dominant ethnicity': τ=0.546, P<0.001).

The above results reveal, on the one hand, the specific roles assumed by the mothers and fathers when they are involved with their children's mathematics education as perceived by their children and, on the other hand the cohesion of the family perceptions and expectations. Importantly, the identified findings appear to transcend all three schools.

Subsequently, drawing upon research (de Abreu et al, 2002) suggesting gender differences in the parental involvement with respect to their ethnic origin, we focused on the participants' responses for each item separately within each school. The Mann-Whitney U test revealed no statistical differences in the 'expected' School A. Nevertheless, in the remaining schools two gender-related differences were found in two items concerning the perceived mother's influence. Specifically, in the 'multi-cultural' School B, the girls reported a statistically significant *more positive*

perceived influence by their mothers with respect the MAHm item 'My mother makes me feel that I can do well in maths' when compared to the boys (U=959.5, P=0.032, r=-0.21). Furthermore, in the 'mainly of dominant ethnicity' School C the girls reported a statistically significant *more positive* perceived influence by their mothers concerning the MAHm item "My mother is good at maths" (U=1123.0, P=0.007, r=-0.26).

It appears that identified differentiations in the girls' perceived maternal involvement has multi-cultural characteristics, since the girls of the 'multi-cultural' school perceive their mother's involvement as encouragement to their efforts, whilst the girls of the 'mainly of dominant ethnicity' school seem to perceive their mother's involvement as a 'role model', since they concentrate in their mother being good at maths.

Discussion

In this study, drawing upon the study of Cao et al (2006), we investigated the parental involvement about mathematics, as perceived by primary school children. In particular, we investigated the role of the school socio-cultural identity in the perceived parental involvement, since the aforementioned study conducted in Australia and China revealed complex relationships between parental involvement and the students' ethnicity.

Thus we investigated which aspects of the perceived parental involvement were linked with the sociocultural identity of the school unit as identified by the ethnic origin of the enrolled students. For the purposes of the present study, we utilised a translated to Greek version of the original questionnaire, the good psychometrics of which supported its cross-cultural validity thus supporting our conducting further analyses based on this instrument.

The results of the conducted analyses revealed diverse statistically significantly differences in the perceived parental involvement across the three schools, with different socio-cultural identities: 'expected', 'multi-cultural', 'mainly of dominant ethnicity'.

The first conclusion is that the students of the 'multi-cultural' school appear to have a statistically significant higher overall Perceived Parental Influence which was situated in the statistically significantly higher perceived Parent Achievement Expectation. In line with Cao et al (2006), perceived parental involvement was found to be stronger in the 'multi-

cultural' school. It is posited that the multi-cultural context weakens the effect of the broader socio-cultural context within which the school unit functions. Hence, the multi-cultural school seems to be in a stable equilibrium that is mainly affected by the family itself, which implies and explains the greater identified stability in the perceived parental involvement reported in this school with respect to various factors (including school grade and year of measurement).

The second conclusion, evident in all three schools, is that concerning the similarities between mother and father's involvement we found that the mother's perceived interest in the children's mathematical attainment and her encouragement were positively correlated with the fathers' respective interest and encouragement. Moreover, the mother's expectations for higher grades in mathematics and the value that she attributes to mathematical knowledge were positively correlated with the fathers' respective expectations and values. We posit that these findings support the hypothesis that within the family unit exists an internally consistent value system about mathematics.

However, we found also differences between fathers' and mothers' involvement, evident in all three schools, with respect to the ways that the students perceive the parental role of their mother and father about mathematics. The children's perception of their mother *as being good at maths* was usually positively linked with her helping with difficult mathematics problems at home, while their perception of the father *as being good at maths* had broader positive links, which included *at least a core* of four items common to all schools. This implies qualitatively different role that each parent plays in his/her child about mathematics, which renders the need for conducting further multi-focussed, qualitative and quantitative research to allow for in-depth investigations of the father-mother relationships with their children's mathematics education.

Finally, according to our results about the perceived parental involvement, we can assume that the three school-units had a different sociocultural identity as identified by the ethnic origin of the enrolled students. More specifically:

- In the *expected school*, the assessment of the students' mathematics attainment by the teachers appears to be less strict and the students of the 'expected' school appear to spend less time studying mathematics at home. The students appear to experience relatively

strong parental involvement only in Grade 5, whilst their mathematical involvement at home is mainly linked with the overall perceived parental influence (PPI) and the Mother's Attitude and Help. However, the boys' mathematical attainment was found to be negatively correlated with Mother's Attitude and Help.

- In the *multi-cultural school*, the assessment of the students' mathematics attainment by the teachers is also less strict with the students experiencing a qualitatively and temporarily stable pattern of parental involvement about mathematics across the grades and the years. The students' mathematical involvement at home is affected by the overall perceived parental influence (PPI), situated in its sub-components concerning the family expectations and the mother's and father's help. This is in accordance with the aforementioned first main conclusion emphasising finding of stronger perceived parental involvement in the 'multi-cultural' school. Moreover, in the 'multi-cultural' school, the girls report the positive effect of their mother's encouragement.
- In the *mainly of dominant ethnicity school* the assessment of the students' mathematics attainment by the teachers seems to be stricter, whilst the students spent the most time at home studying mathematics and have statistically significant more books at home. The students experience a relative stable parental involvement about mathematics across both grades, whilst the girls report the positive effect of their mother's involvement when they consider their mother to be good at maths; that is, when they consider their mother to satisfy the attainment requirements of a role model for mathematics.

Consequently, it appears that the findings of this study support the hypothesis that the socio-cultural identity of the school is related with the children's perceived parental influence. This hypothesis could be linked with Crafter's use of the term "parental cultural models" in order to interpret the diverse ways in which the parents are involved with their children's mathematics education. That is, in analogy with parental cultural models, this study reveals the emergent "students' cultural models" about their parents' involvement in their school mathematics. According to our

results the "students' models" about the perceived parental involvement seem to be affected by their socio-cultural background.

Furthermore, the above results support the need for designing and conducting broader research projects in order to investigate the complexity of the phenomena. Such a project should utilise both qualitative and quantitative methods with a larger qualitatively sample, addressing the multiple levels and interactions within and across the school unit, the school grade, the school class, as well as family unit. The findings of such a systemic-like (cf Moutsios-Rentzos, Kalavasis & Sofos, 2013) design may help in a more pragmatic and effective educational design of mathematics education, suitable and relevant with the expanded multi-cultural society.

The methodology for the present study about the perceived parental involvement was based in the comparative investigations amongst schools with socio-culturally different identities, revealing factors and relationships of factors that affect and constitute the perceived parental involvement, emphasising the importance of the school identity. It is posited that the utilisation of these findings in research projects bearing the aforementioned characteristics will allow the pedagogical implementations within the micro-society of the school class not 'in vacuum', but within the experienced multi-layered reality, thus adding to a mathematics education more relevant to more students, parents and teachers.

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