Perceptions of parental involvement in schooling, student milieu and student achievement in mathematics

Nicole Wernert, Australian Council for Educational Research, wernert@acer.edu.au

Abstract

This study builds on recent research that has found that teacher perceptions of parental involvement in schooling are an important influence on student outcomes, in addition to the effects of parent reports of their involvement. Using data from TIMSS 2003, this study explores the relationship between principal perceptions of parental involvement and student milieu and the impact of both on student achievement in mathematics. Moderated multiple regression analyses were used to explore these relationships. A significant relationship was found for mean school mathematics achievement regressed on principals' perceptions of parental support and involvement at both Grades 4 and 8. However, statistically significant evidence of milieu moderating those relationships was not found. This may be because low statistical power is often associated with moderated hierarchical regression analyses. Significant interaction terms suggested that moderation may be found with more power. Further investigation into these relationships is suggested.

Keywords: *parental involvement, principal perceptions, socioeconomic background, student achievement, structural equation modeling*

Introduction

Parents are one of many influences on student outcomes. Since Coleman et al. (1966), the relationship of family background with achievement has been well known. It is the belief of many involved in education that active involvement in schooling by parents can also be an important influence. However, unlike the influence of teachers and schools, the effect of parental involvement in schooling is not as well established empirically. Early studies of parental involvement provided conflicting results, including positive, negative and no relationship with outcomes.

Recent reviews of the literature and meta-analyses (Desforges & Abouchaar, 2003; Fan & Chen, 2001; Harris & Goodall, 2007; Jeynes, 2007) conclude that parental involvement does have an impact on student outcomes but that there is variation depending on the form of involvement and on context. In particular, parental behavior and activities that demonstrate educational values and aspirations were found to have a strong impact on student outcomes.

However, parental involvement in school activities (such as volunteering at the school) appears to have little direct impact on student achievement (Desforges & Abouchaar, 2003; Harris & Goodall, 2007).

Of great interest, however, are the contextual factors that influence the relationship between parental involvement and student outcomes. Understanding these will enable targeted intervention and policy where it can make a difference. Parental socioeconomic status is a major factor, as is ethnicity (Lee & Bowen, 2006). That is, level of parental involvement tends to vary according to socioeconomic status and ethnicity (Desforges & Abouchaar, 2003; Harris & Goodall, 2007; Lee & Bowen, 2006). Differences in level of involvement and impact of involvement appear to reflect differences in human, social and cultural capital (Lee & Bowen, 2006).

Additionally, it appears that the relationship between parental involvement and student achievement can moderated by variables such as socioeconomic status and ethnicity (Lee & Bowen, 2006). For example, Lee and Bowen (2006) found that, while parent-child discussions tend to have a positive relationship with achievement among European Americans, parent-child discussions had a negative relationship with achievement amongst Hispanic/Latino Americans. According to Lee and Bowen (2006) this is likely to be due to a view that parent-child discussions about school are only necessary when the child is not doing well at school. Therefore, it appears that the relationship between parental involvement and student achievement is complicated and depends on the type of involvement and a range of cultural and social factors.

Teacher perceptions of parental involvement have also been found to be an important influence on student outcomes in addition to the effect of parent reports of their actual level of involvement (Bakker, Denessen, & Brus-Laeven, 2007). These perceptions appear to be based on stereotypes based on the socioeconomic status of parents (Bakker et al., 2007). However, the mechanisms that enable this relationship are still unknown. Bakker, Denessen and Brus-Laeven (2007) suggest that it may be that teachers expectations for students may be influenced by their perception of the parental expectations, changing the nature of their interactions with those students.

In TIMSS 2003, the school questionnaires included questions about the perceptions the principals had of the level of parental support for student achievement and the level of parental involvement in school activities. Together with information about the level of disadvantage and advantage in the school, these questions enable an exploration of the relationship of the principal's perceptions of the level of parental involvement across the school with mathematics achievement and possible moderation of that relationship by the student milieu.

Methodology

Sample

The data used in this study are the Australian data from TIMSS 2003. As required for TIMSS, a two-stage stratified cluster sampling design was used, with schools selected in the first stage and classrooms selected in the second. In Australia, the school sample was explicitly stratified by state (Australia has 8 states and territories), with implicit stratification by school type (Government, Catholic or Independent). As the study focuses on principals and their perceptions of parental involvement, the analyses are based at the school level. Thus, the sample contains 204 schools for Population 1 (Grade 4) and 207 schools for Population 2 (Grade 8), representing a participation rate of 90% for both samples. Non-response to the School Questionnaire further reduces the sample to 201 for Population 1 and 189 for Population 2. No demographic data was collected about the principals.

Variables

The variables of interest are the principal's perceptions of *Parental Involvement in School Activities* (Involvement) and *Parental Support for Student Achievement* (Support). These are questions in the School Questionnaire that form part of the Principals' Perceptions of School Climate scale. The response set for these items is a 5-point Likert scale – Very High, High, Medium, Low and Very Low. For ease of interpretation, these items were reverse scored, so that Very Low = 1 and Very High = 5.

The variables that were used to measure milieu were *Percentage of Disadvantaged Students in the School* and *Percentage of Advantaged Students in the School*. These required the principal to indicate if the percentage of disadvantaged (or advantaged) students was 0-10%, 11-25%, 26-50% or greater than 50%. In order to describe the milieu, these two variables were combined into a 3-category variable: 1 = Majority disadvantaged students; 2 = Neither majority disadvantaged nor majority advantaged; and 3 = Majority advantaged students.

As all of the variables being used are measured at the school level, it was considered most appropriate to use the mean mathematics achievement for the school. TIMSS achievement data uses plausible values to provide unbiased estimates for population statistics (for more information about plausible values see Martin, 2005; Martin, Mullis, & Chrostowski, 2004). Therefore, the mean of each of the five plausible values for mathematics achievement was calculated for each school, such that each school had five estimates of the mean achievement.

Analysis

As the relationship between perceived parental support and involvement and student achievement is hypothesized to differ depending on the milieu within the school, this can be considered to be a moderated relationship. Therefore, the analysis used was Moderated Multiple Regression, based on the model:

$$\hat{Y} = a + b_1 X + b_2 Z + b_3 X \bullet Z, \quad (1)$$

where $\hat{Y}$ is the predicted value of criterion variable, a is the least squares intercept, b_1 is the least squares estimate of the population regression coefficient for the predictor X, b_2 is the least squares estimate of the population regression coefficient for the moderator Z, and b_3 is the least squares estimate of the population regression coefficient for the interaction between X and Z (Cohen & Cohen, 1975).

Moderated Multiple Regression involves hierarchical regression, with the first step regressing the criterion (in this case, mean school mathematics achievement) on the predictor (parental involvement or support). In the second step, the moderator variable (milieu) is entered; and in the third step the interaction term (simply the predictor multiplied by the moderator) is entered. If the interaction term is significant, then it can be said that a moderated relationship has been found (Cohen & Cohen, 1975).

For ease of interpretation, and to minimize problems with multicollinearity (Aiken & West, 1991), the parental involvement and support variables were standardized to have a mean of 0 and a standard deviation of 1.

The milieu variable, being a 3-category nominal variable, was dummy-coded so that dummy variable 1 (Disadvantage) indicated those schools with a majority of disadvantaged students and dummy variable 2 (Advantage) indicated those schools with a majority of advantaged students. Code 0 on both dummy variables, therefore, indicates those schools with neither a majority of disadvantaged nor a majority of advantaged students.

Given that milieu is now encoded by two dummy variables, the regression model also now includes two interaction terms (Cohen & Cohen, 1975):

$$\hat{Y} = a + b_1 X + b_2 Z_1 + b_3 Z_2 + b_4 X \bullet Z_1 + b_5 X \bullet Z_2, \quad (2)$$

where $\hat{Y}$ is the predicted value of the criterion variable (achievement), a is the least squares intercept, b_1 is the least squares estimate of the population regression coefficient for the predictor X (Support or Involvement), b_2 is the least squares estimate of the population regression coefficient for the moderator Z_1 (Disadvantage), b_3 is the least squares estimate of

the population regression coefficient for the moderator Z_2 (Advantage), b_4 is the least squares estimate of the population regression coefficient for the interaction between X and Z_1, and b_5 is the least squares estimate of the population regression coefficient for the interaction between X and Z_2.

AM Version 0.06.03 was used for all analyses in order to make use of the facility to use the jackknifing procedure with replicate weights. This is necessary to calculate unbiased standard errors given the complex sampling design of TIMSS (for more information, see Martin, 2005; Martin et al., 2004). All analyses were also weighted with sampling weights.

Results

Perceptions of parental support

Pearson product moment correlations were carried out between the three variables – principals' perceptions of parental support, milieu and student achievement. Table 1 presents these correlations. From Table 1 it can be seen that all of the variables are related (as expected) and that the relationships are stronger at Grade 4.

[Take in Table 1 about here]

A moderated hierarchical regression analysis was conducted as discussed above (under Methodology). Stage 1 used *principals' perceptions of parental support* to predict average mathematics achievement at Grades 4 and 8. At Grade 4, the variance accounted for by this initial model was modest ($R^2 = 0.18$). Stage 2 involved using both the hypothesized main predictor (Support) and a moderator (Milieu). The incremental increase in R-square for this model ($R^2 = 0.11$) was significant, $F(2, 73) = 5.390$, $p < .01$, revealing that the addition of milieu increases the predictive power of the model. The final stage of the regression involved adding the interaction term to the model. The incremental increase in R-square for this ($R^2 = 0.03$) was not significant, $F(1,71) = 1.401$, $p > .05$, indicating that there is not milieu does not moderate the relationship between *Perceptions of parental support* and mean mathematics achievement at Grade 4.

Table 2 shows the regression coefficients and their standard errors for the moderated hierarchical regression of achievement on perceptions of parental support, with milieu as the moderator, for Grade 4 students in Australia.

[Take in Table 2 about here]

Table 2 shows that once milieu is added into the regression, the coefficient for perceptions of parental support decreases and loses significance, suggesting that some of the predictive

power of parental support may be explained by milieu (but is not moderated by milieu). That is, principal's perceptions of parental support are likely to be higher when there is a majority of advantaged students compared to when there is a majority of disadvantaged students and, in turn, the achievement is higher when there is a majority of advantaged students compared to when there is a majority of disadvantaged students.

At Grade 8, the variance accounted for by the initial model (Mathematics Achievement regressed on Support) was small ($R^2 = 0.07$). Stage 2 involved adding the moderator (Milieu). The incremental increase in R-square for this model ($\Delta R^2 = 0.04$) was not significant, $F(2, 71) = 0.159$, $p > .05$**,** revealing that the addition of milieu did not increase the predictive power of the model. The final stage of the regression, adding the interaction term, also resulted in a non-significant incremental increase in R-square for this ($\Delta R^2 = 0.02$; $F(2,69) = 0.793$, $p > .05$)**.**

Table 3 shows the regression coefficients and their standard errors for the moderated hierarchical regression of achievement on perceptions of parental support, with milieu as the moderator, for Grade 8 students in Australia.

[Take in Table 3 about here]

Despite the fact that the increase in R-square with the addition of the interaction terms was not significant, Table 3 shows that one of the interaction terms was significant. Moderated rultiple regression analyses often have low statistical power, for a number of reasons (see Aguinis & Pierce, 1999). Therefore, given that one of the interaction terms was significant, it was decided to explore that relationship. To do so, the regression coefficients from Step 3 were inserted into Equation 2 and values of $\hat{Y}$ were calculated for each combination of X (Support), Z_1 (Disadvantaged) and Z_2 (Advantaged). As X was standardized, one standard deviation from the mean for X results in 2 values of X: -1 and 1. As Z_1 and Z_2 are dummy variables, they were each coded 0 and 1. Therefore, there were 6 predicted values of $\hat{Y}$ calculated. Figure 1 shows the conditional regression lines based on the predicted values of $\hat{Y}$.

[Take in Figure 1 about here]

Figure 1 shows that most of the interaction occurs because there is little difference in mean school mathematics achievement according to level of Principals' Perceptions of Parental Support for schools that are neither majority disadvantaged nor majority advantaged. However, for schools that are either majority disadvantaged or majority advantaged, there is a clear parallel drop in achievement for schools whose principals perceive parental support to be low compared to those that perceive it to be high.

Perceptions of parental involvement

Pearson product moment correlations were carried out between the three variables – principals' perceptions of parental support, milieu and student achievement. Table 1 presents these correlations. From Table 1 it can be seen that all of the variables are related (as expected) and that the relationships are stronger at Grade 4.

[Take in Table 4 about here]

A moderated hierarchical regression analysis was conducted as discussed above (under Methodology). Stage 1 used *principals' perceptions of parental involvement* to predict average mathematics achievement at Grades 4 and 8. At Grade 4, the variance accounted for by this initial model was modest ($R^2 = 0.10$). Stage 2 involved using both the hypothesized main predictor (Involvement) and the moderator (Milieu). The incremental increase in R-square for this model ($R^2 = 0.14$) was significant, $F(2, 73) = 6.886$, $p < .01$**,** revealing that the addition of milieu increases the predictive power of the model. The final stage of the regression involved adding the interaction term to the model. The incremental increase in R-square for this ($R^2 = 0.05$) was not significant, $F(1,71) = 2.091$, $p > .05$.

Table 5 shows the regression coefficients and their standard errors for the moderated hierarchical regression of achievement on perceptions of parental involvement, with milieu as the moderator, for Grade 4 students in Australia.

[Take in Table 5 about here]

Table 5 shows that milieu is a significant influence on achievement in both steps 2 and 3 and, despite the lack of significant improvement in R-square at Step 3, one of the interaction terms also has a significant influence. Given the known lack of power for moderated regression analyses, it was decided to also explore this as a potential source of moderation. As above, predicted values of $\widehat{Y}$ were calculated and conditional regression lines plotted, as shown in Figure 2.

[Take in Figure 2 about here]

Figure 2 shows that the interaction appears to be due to an increase in mean school mathematics achievement for students in schools with a majority of advantaged students whose principals perceived parental involvement to be low as compared to schools where the principal perceived parental involvement to be high. This is somewhat counter-intuitive. However, a possible explanation might be that in majority advantaged schools there may be more parental involvement when students are not achieving well than when they are: that is, a lower level of achievement leads to higher parental involvement. This explanation is more

likely than higher parental involvement leading to a lower level of achievement within schools where the majority of students are advantaged.

At Grade 8, the variance accounted for by the initial model (Mathematics Achievement regressed on Involvement) was small ($R^2 = 0.05$). Stage 2 involved adding the moderator (Milieu). The incremental increase in R-square for this model ($\Delta R^2 = 0.05$) was not significant, $F(2, 71) = 2.172$, $p > .05$, revealing that the addition of milieu did not increase the predictive power of the model. The final stage of the regression, adding the interaction term, resulted in an incremental increase in R-square of zero.

Table 6 shows the regression coefficients and their standard errors for the moderated hierarchical regression of achievement on perceptions of parental involvement, with milieu as the moderator, for Grade 8 students in Australia.

[Take in Table 6 about here]

Table 6 shows that only the influence of Involvement in Step 1 was significant. However, in Step 2 the term for Advantage was almost significant. A t-test comparing the coefficients for Disadvantage and Advantage found that the difference between the two coefficients was significant, $t(73) = -2.734$, $p<.01$. Therefore it is likely, if there were more statistical power, that the coefficient for Advantage would also be significant.

Discussion and Conclusions

Unfortunately, although probably due to the low statistical power often associated with moderated regression analyses, the current analyses did not find statistically significant evidence of milieu moderating the relationship between principals' perceptions of parental support or involvement and mean school mathematics achievement at Grades 4 and 8. There was, however, some evidence of complexity in the relationships between these variables. That is, in some cases there was some suggestion that more statistical power may have revealed a moderated relationship (for Support at Grade 8 and for Involvement at Grade 4). As well, it is clear that the relationship of Support to milieu and achievement is not the same as that for Involvement. Nor can it be said that the relationships found at one grade level were the same at the other grade level. Therefore, there are definite avenues for further research.

It was found, nevertheless, that both principals' perceptions of parental support and principals' perceptions of parental involvement had a statistically significant relationship with mean school mathematics achievement at Grades 4 and 8. Some caveats have to be made here, however. Firstly, actual parental support and involvement were not measured.

Rather the variables used were the principal's perceptions of the level of parental support and involvement, which could be heavily influenced by difference in the yardstick used by each principal. That is, depending on what previous experience each principal has had with parental support and involvement, one principal may perceive a school to have high involvement and support and another principal may perceive this school to have only medium support and involvement. Thus, these variables are rather imperfect proxies for actual levels of involvement.

The same thing can actually be said about the Milieu variable. That is, this variable is based on the principal's assessment of the percentage of disadvantaged and advantaged students in the school. As the questions did not determine upon which criteria the judgment of disadvantage and advantage was to be based, it is highly likely that the criteria used did vary across respondents. Therefore it is likely that there is considerable measurement error associated with this variable as well, contributing to the lack of statistical power associated with moderated regression analyses.

Another caveat associated with the results is that nothing found in the present results can be considered to apply to the individual student. That is, while it appears that there may be some relationship between the level of parental support and involvement within a school and the mean mathematics achievement at the school, it may be a completely different story in terms of the relationship of the actions of an individual parent on the achievement of that parent's child. Indeed, research into parental involvement in schooling seems to suggest that it is parental support for achievement that has the greatest influence on the achievement of individual students; parental involvement in school activities, however, appears to have little impact on student achievement (Harris & Goodall, 2007).

In summary, a significant relationship was found for mean school mathematics achievement regressed on principals' perceptions of parental support and involvement at both Grades 4 and 8. However, statistically significant evidence of milieu moderating those relationships was not found. This may be because low statistical power is often associated with moderated hierarchical regression analyses. Significant interaction terms suggested that moderation may be found with more power. Further investigation into these relationships is suggested.

References

Aguinis, H., & Pierce, C. A. (1999). Improving the power of Moderated Multiple Regression to estimate interaction effects [Electronic Version]. *Research Methods Forum, 4.* Retrieved 23 July 2008 from http://division.aomonline.org/rm/1999_RMD_forum_moderated_multiple_regression.htm#TOP.

Aiken, L. S., & West, S. G. (1991). *Multiple Regression: Testing and interpreting interactions.* Newbury Park, CA: Sage Publications.

Bakker, J., Denessen, E., & Brus-Laeven, M. l. (2007). Socio-economic background, parental involvement and teacher perceptions of these in relation to pupil achievement. *Educational Studies (03055698), 33*(2), 177-192.

Cohen, J., & Cohen, P. (1975). *Applied multiple regression/correlational Analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Coleman, J. S., Hobson, E. J., McPartland, J., Mood, A. M., Weinfeld, F. D., & York, R. L. (1966). *Equality of Educational Opportunity*. Washington, D.C.: U.S. Government Printing Office.

Desforges, C., & Abouchaar, A. (2003). *The impact of parental involvement, parental support and family education on pupil achievements and adjustment: A literature review* (No. Research Report RR433). Research Report RR433: Department for Education and Skills.

Fan, X., & Chen, M. (2001). Parental Involvement and Students' Academic Achievement: A Meta-Analysis. *Educational Psychology Review, 13*(1), 1-22.

Harris, A., & Goodall, J. (2007). *Engaging parents in raising achievement: Do parents know they matter?* Research Report DCSF-RW004: Department for Children, Schools and Families.

Jeynes, W. H. (2007). The Relationship Between Parental Involvement and Urban Secondary School Student Academic Achievement. *Urban Education, 42*(1), 82-110.

Lee, J.-S., & Bowen, N. K. (2006). Parent Involvement, Cultural Capital, and the Achievement Gap Among Elementary School Children. *American Educational Research Journal, 43*(2), 193-218.

Martin, M. O. (Ed.). (2005). *TIMSS 2003 User Guide for the International Database.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Martin, M. O., Mullis, I. V. S., & Chrostowski, S. J. (Eds.). (2004). *TIMSS 2003 Technical Report*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Table 1: Intercorrelations between Principals' Perceptions of Parental Support, Milieu and Mean School Mathematics Achievement for Grades 4 and 8

	Grade 4		Grade 8	
	Milieu	Achievement	Milieu	Achievement
Support	0.43	0.43	0.35	0.32
Milieu	-	0.47	-	0.28
Achievement		-		-

Table 2: Summary of results from the hierarchical regression analysis of Principal's Perceptions of Parental Support on Mathematics Achievement, with Milieu as moderator, for Grade 4 students in Australia

Variable	*B*	*SE B*
Step 1		
Support	20.90**	7.09
Step 2		
Support	13.32	7.21
Disadvantage	-27.24*	11.77
Advantage	14.12	11.55
Step 3		
Support	11.89	7.78
Disadvantage	-23.09*	10.69
Advantage	19.28	12.11
Support x Disadvantage	9.65	12.70
Support x Advantage	-9.39	11.48

[a]R^2=0.18, F(1, 75) = 8.704, p< .01; [b]R^2=0.29, F(3, 73) = 7.635, p< .01; [c]R^2=0.32, F(5, 71) = 5.692, p< .01

*p< .05; **P< .01

Table 3: Summary of results from the hierarchical regression analysis of Principal's Perceptions of Parental Support on Mathematics Achievement, with Milieu as moderator, for Grade 8 students in Australia

Variable	*B*	*SE B*
Step 1[a]		
Support	14.15*	5.99
Step 2[b]		
Support	10.17	5.79
Disadvantage	-9.36	12.18
Advantage	25.76	16.98
Step 3[c]		
Support	1.74	6.21
Disadvantage	-6.20	11.85
Advantage	19.68	16.23
Support x Disadvantage	16.08*	6.66
Support x Advantage	17.68	12.39

[a]R^2=0.07, F(1, 73) = 5.587, p< .05; [b]R^2=0.11, F(3, 71) = 4.146, p< .01; [c]R^2=0.13, F(5, 69) = 4.349, p< .01

*p< .05; **P< .01

Table 4: Intercorrelations between Principals' Perceptions of Parental Involvement, Milieu and Mean School Mathematics Achievement for Grades 4 and 8

	Grade 4		Grade 8	
	Milieu	Achievement	Milieu	Achievement
Involvement	0.43	0.31	0.30	0.22
Milieu	-	0.47	-	0.28
Achievement		-		-

Table 5: Summary of results from the hierarchical regression analysis of Principal's Perceptions of Parental Involvement on Mathematics Achievement, with Milieu as moderator, for Grade 4 students in Australia

Variable	*B*	*SE B*
Step 1		
Involvement	15.33**	5.70
Step 2		
Involvement	6.42	6.43
Disadvantage	-31.56*	13.60
Advantage	16.95	10.63
Step 3		
Involvement	10.27	8.62
Disadvantage	-27.31*	13.10
Advantage	28.00**	10.80
Involvement x Disadvantage	2.63	10.87
Involvement x Advantage	-25.78*	12.87

[a]R^2=0.10, F(1, 75) = 7.235, p< .01; [b]R^2=0.24, F(3, 73) = 6.696, p< .01; [c]R^2=0.29, F(5, 71) = 5.501, p< .01

*p< .05; **P< .01

Table 6: Summary of results from the hierarchical regression analysis of Principal's Perceptions of Parental Involvement on Mathematics Achievement, with Milieu as moderator, for Grade 8 students in Australia

Variable	*B*	*SE B*
Step 1		
Involvement	11.63*	4.75
Step 2		
Involvement	8.50	4.60
Disadvantage	-8.92	12.31
Advantage	30.26	15.78
Step 3		
Involvement	7.96	7.81
Disadvantage	-8.58	12.14
Advantage	30.33	16.68
Involvement x Disadvantage	1.39	10.98
Involvement x Advantage	0.21	10.40

[a]R^2=0.05, F(1, 73) = 5.995, p< .05; [b]R^2=0.10, F(3, 71) = 4.118, p< .01; [c]R^2=0.10, F(5, 69) = 2.867, p< .05

*p< .05; **P< .01

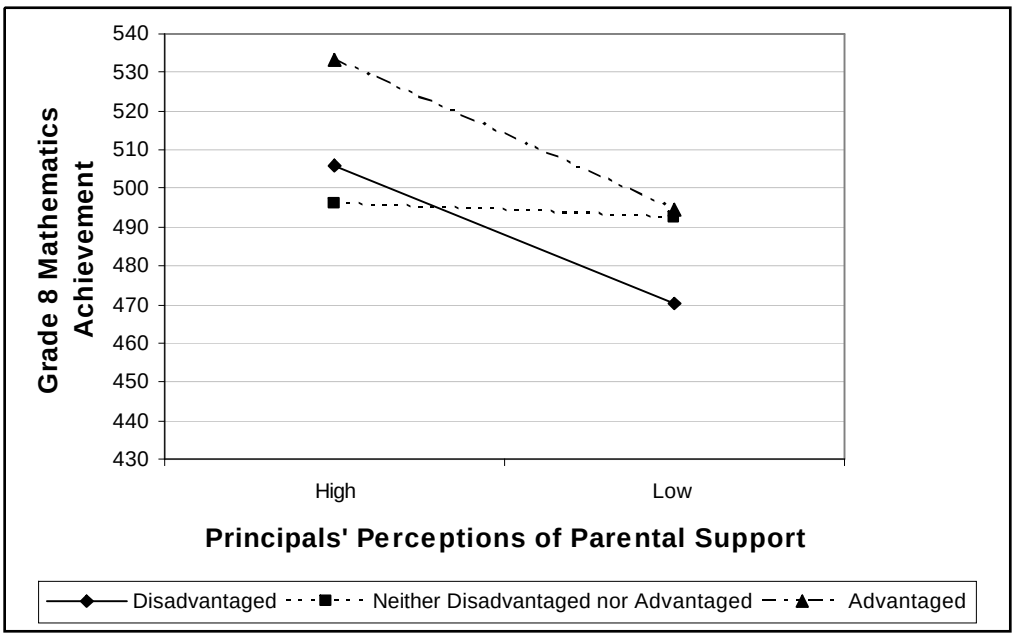

Figure 1: Conditional regression lines for differences in Grade 8 Mathematics Achievement according to Milieu and level of Principals' Perceptions of Parental Support

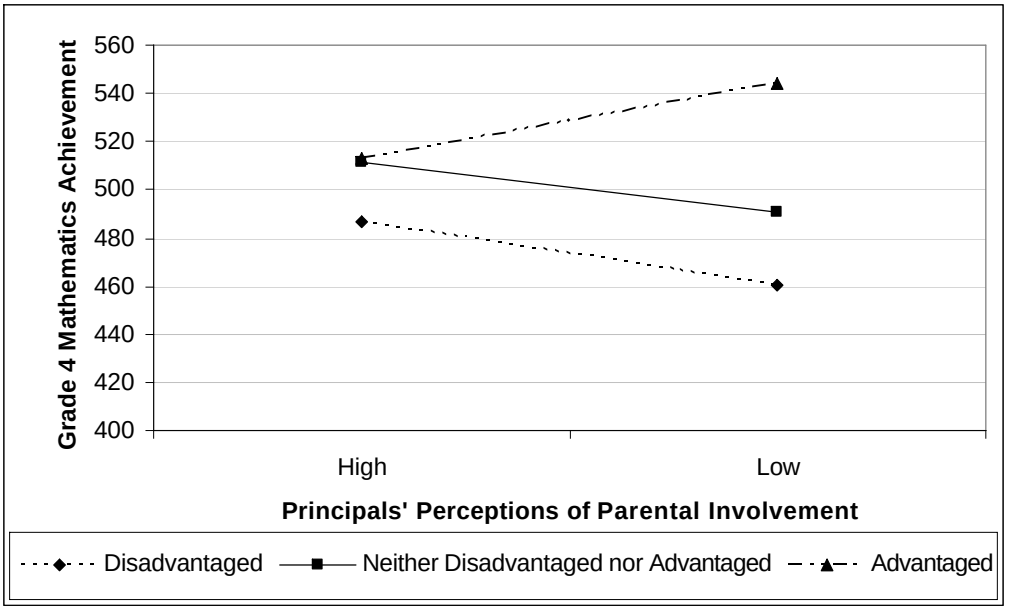

Figure 1: Conditional regression lines for differences in Grade 4 Mathematics Achievement according to Milieu and level of Principals' Perceptions of Parental Involvement