Students’ Big Three Personality Traits, Perceptions of Teacher Interpersonal Behavior, and Mathematics Achievement: An Application of the Model of Reciprocal Causation

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The purpose of the present study was to investigate the application of the Model of Reciprocal Causation (MRC) in examining the relationship between student personality (personal factors), student-perceived teacher interpersonal behavior (environment), and Mathematics achievement (behavior), with the simultaneous investigation of mediating effects and bidirectional relationships. The sample consisted of 317 Cypriot students and their 19 teachers. The relationship among the three constructs was examined using structural equation modeling. Results supported the mediating role of student perceptions of teacher interpersonal behavior in the personality-achievement relationship, and the unidirectional effect between student perceptions and achievement, with perceptions affecting achievement. Overall, the study demonstrated that the MRC provides a comprehensive and dynamic framework for examining the role of classroom interactions, student personal characteristics, and achievement. Implications for research and educational practice are discussed.

Keywords: Reciprocal Causation; Big Three Personality; Classroom Interactions; Teacher Interpersonal Behavior; Achievement.
A number of theories have tried to explain the person–environment interaction within learning environments (e.g., Chavez, 1984; Dorman, 2002; Fraser, 1989). One of the most significant theoretical frameworks is the Model of Reciprocal Causation (MRC), a model that serves as the basis of the social cognitive theory (Bandura, 1989). In simple words, the MRC states that “behavior, cognition and other personal factors, and environmental influences, all operate as interacting determinants that influence each other bidirectionally” (Bandura, 1989, p. 2). Within this framework, it is posited that the influences of the different sources are not of equal strength and do not occur at the same time or time breadth. While the MRC is generally endorsed by the literature, empirical support is limited (Williams & Williams, 2010), especially with regard to student personality traits and perceptions of their learning environment, for which the MRC would be a potentially fruitful framework of conceptualization as presented in the subsequent literature review.

The purpose of the present study was to investigate the application of the MRC using a set of variables not previously examined under the MRC scope. Specifically, the type (bidirectional or unidirectional) and the strength (weak or strong) of the relationships among students’ Mathematics achievement (behavior), their personality characteristics (personal factors), and their perceptions of teacher interpersonal behavior (environment) were examined.

**Student Perceptions of Teacher Interpersonal Behavior**

The contribution of student perceptions of their teacher’s interpersonal behavior to the improvement of their academic and affective outcomes has been documented in many research studies in the past (e.g., Fraser, 1998, 2007; Roach, Richmond, & Mottet, 2006). In the Netherlands, Wubbels, Créton, and Hooymayers (1985) developed a model to map student perceptions of teacher interpersonal behavior, derived from Leary’s general model for interpersonal relationships (Leary, 1957), named the Model of Interpersonal Teacher Behavior (MITB). The MITB (Figure 1) is represented as a circle with two independent, intersecting dimensions, namely *Influence* (Dominance vs. Submission, which refers to the control over the communication process) and *Proximity* (Opposition vs. Cooperation, which measures the degree of affinity and cooperation felt by the communicators). The model has been predominantly assessed by the Questionnaire on Teacher Interaction (QTI), an eight-subscale instrument, named after the sectors of the model depicting teacher interpersonal behavior (Wubbels et al., 1985).

While QTI-based research supports the model of interpersonal teacher behavior for students in secondary schools (Fraser & Walberg, 2005; Wubbels & Brekelmans, 2005), findings regarding elementary school students indicate slight changes in the model. In recent studies (Charalampous & Kokkinos, 2011, 2013), where both qualitative and quantitative methodologies were applied, students in Greek elementary schools were found to have difficulty perceiving their teacher Influence behaviors and seemed to place more emphasis on the Proximity ones. The findings suggested a rather elliptical positioning of teacher interpersonal behaviors, based on student
perceptions, at this developmental level, contrary to the circumplex model originally proposed. In light of these findings, a re-examination of earlier studies with elementary students from other cultures (Goh & Fraser, 1996; Kokkinos, Charalambous, & Davazoglou, 2009; Kyriakides, 2005; Scott & Fischer, 2004) revealed that the same held true for the samples in these studies, denoting this effect as developmental rather than cultural in nature.

Effects of Perceived Teacher Interpersonal Behavior on Academic Performance

Studies using the QTI indicated that, in general, higher academic performance was found in classes where students recognized more positive interpersonal behaviors in their teachers (Koul & Fisher, 2004; Mottet, Frymier, & Beebe, 2006; Wubbels, Breckelmanns, & Hooymayers, 1991). In terms of the Proximity axis, the findings from studies with secondary school students are somewhat ambiguous. Whereas in some studies, perceived cooperative teacher behaviors were found to be related to higher achievement, and perceived oppositional teacher behaviors to lower grades (Evans, 1998; Henderson, 1995), other studies found no relation between teacher Proximity and student academic performance (den Brok, Breckelmanns, & Wubbels, 2004). Moreover, some studies indicated a negative relationship between academic performance and oppositional behaviors but no relation between cooperative behaviors and academic performance (Rawnsley, 1997). For primary school students, Goh and Fraser (2000) found that the impact of oppositional teacher behaviors on performance was negligible, whereas mixed results were found for cooperative behaviors. In a study with primary school students (Kyriakides, 2005), where the
analyses were based on the dimensions of Proximity and Influence, results indicated that Proximity was related to student language but not to Mathematics achievement.

Effects of Academic Performance on Teacher Interpersonal Behavior

The relationship between teacher interpersonal behavior and student academic achievement is often examined as being unidirectional with perceived teacher behavior affecting achievement. However, the opposite has also been confirmed. That is, students with higher academic performance tend to receive more favorable feedback by teachers at the interpersonal level (Jussim, Eccles, & Madon, 1996). Teacher expectations regarding student current and future performance affect their interpersonal behavior, which in turn affects student performance, making the relationship between the two a reciprocal one. While the claims of the original Pygmalion effect study by Rosenthal and Jacobson (1968), which posited that teachers’ expectations affect students’ intelligence, have subsided, subsequent studies have confirmed the regulation of teacher interpersonal behavior towards their students based on their expectations (Brophy, 1985; Mottet, Beebe, Raffeld, & Paulsel, 2005; Rosenthal & Rubin, 1978; Trouilloud, Sarrazin, Martinek, & Guillet, 2002). On the other hand, these studies also supported the accuracy of those expectations.

While theoretically plausible, the reciprocal relation between student perceptions of their interaction with teachers and academic achievement has not been investigated in previous research, as the majority of scholars approached this relationship as de facto unidirectional.

As opposed to the perceptions of teacher interpersonal behavior, student self-perceptions have been examined in the past regarding their relation with academic achievement (see Marsh & Craven, 2006 for a review) indicating, in fact, the presence of a reciprocal effect. This examination was carried out using cross-lagged panel data from a variety of sources used to estimate models that allowed for the reciprocal effects of self-concept and performance across time. Recently, Williams and Williams (2010) based an investigation on Bandura’s (1989) MRC and used data from 33 nations from the PISA 2003 study, in order to examine the reciprocal effect between efficacy and achievement in Mathematics. The authors employed structural equation modeling with a feedback loop representing the reciprocal relationship. Findings supported the reciprocal effect for 24 of the 32 nations, including Greece, while structural equation modeling with cross-panel data was deemed as a plausible way of examining reciprocal relationships.

Student Personality Traits

Personality refers to “those characteristics of the person that account for consistent patterns of feelings, thinking, and behaving” (Pervin, Cervone, & John, 2005, p. 6). Among the most recognized personality trait theories is the three-factor model of personality known as the Big Three: Extraversion, Neuroticism, and Psychoticism (Barrett, Petrides, Eysenck, & Eysenck, 1998; Romney, 1992).1 The Extraversion dimension relates to attributes such as sociability, longing for thrill, energy, activity,
and control. The Neuroticism dimension has to do with the ease and frequency with which an individual becomes upset and distressed, with greater moodiness, anxiety, and depression reflecting higher levels of Neuroticism. The Psychoticism dimension refers to a tendency to display psychopathic behavior, hostility, manipulativeness, and impulsivity.

Personality traits are formed early on and are relatively stable over time (Caspi et al., 2003). Although trait consistency in childhood is lower than in adulthood, bearing a test–retest correlation coefficient of approximately .31 (Roberts & DelVecchio, 2000), in the present study we assumed trait stability given the cross-sectional character of the data used. Thus, in this investigation, personality traits are considered as potential determinants of students’ cognitive, behavioral, and environmental variables, such as academic achievement and their teacher interpersonal behavior. The opposite is not expected, i.e., student cognitive, behavioral, and environmental variables are not considered as potential determinants of student personality.

**Student Personality and Perceived Teacher Interpersonal Behavior**

A way of conceptualizing student perceptions of teacher interpersonal behavior is through their stable predispositions of viewing and understanding the world. Towards this direction, psychologists have argued that perceptions are a result of attribution processes, which are based on relatively stable traits or dispositions (Cantor, 1990; Watson, 1982). Students perceive their teachers by selecting and interpreting their interpersonal behavior using existing schemata and scripts of classroom behavior. While research findings associating student personality with perceptions of teacher interpersonal behavior are scarce, there is ample evidence regarding the association between personality traits and interpersonal interaction (Caralis & Haslam, 2004; Fransson, Granqvist, Bohlin & Hagekull, 2013; Heisel, LaFrance & Beatty, 2003; McCroskey, Heisel & Richmond, 2001; Petrides et al., 2005). In a study investigating dyadic interactions using the Big Five personality traits (Cuperman & Ickes, 2009), it was found that personality traits, such as Extraversion and Agreeableness, were predictive of social behavior and perceptions in initial dyadic interactions. Additionally, Casciaro (1998) indicated that personality traits had a significant contribution on the perceptions of informal patterns of interpersonal relationships for people in the same social group.

**Student Personality and Academic Performance**

Personality traits have been among the most often examined noncognitive determinants of academic performance (Petrides et al., 2005). Research has delineated a small but steady relationship between personality traits and academic performance (Bratko, Chamorro-Premuzic, & Saks, 2006; Poropat, 2011). In terms of Extraversion, student age is considered a salient moderator of its relationship with academic performance. In elementary school, Extraversion is positively related to academic performance, while in higher grades, this relation is negative (Eysenck & Eysenck,
probably because introverts are more likely to be more focused and more systematic in their studying and learning goals (Entwistle & Entwistle, 1970). Neuroticism, on the other hand, is found to be negatively associated with academic performance (Chamorro-Premuzic & Furnham, 2003; Rindermann & Neubauer, 2001). This has been mostly attributed to high anxiety levels that characterize Neurotic individuals, which lead to test anxiety and fear of failure. Psychoticism is also a negative predictor of academic performance (Aluja-Fabregat & Torrubia-Beltrí, 1998; Chamorro-Premuzic & Furnham, 2003). Researchers suggest that Psychoticism might have a detrimental effect on responsibility, as nonconformity (associated with high Psychoticism) is not conducive to school success.

Environment as a Mediator of the Effect of Personality on Academic Achievement

Given that the effect of personality on academic achievement is generally confirmed, researchers have further investigated the “pathways” through which this effect takes place (Conard, 2006; Tabak, Nguyen, Basuray, & Darrow, 2009). In this line of research, certain theorists posit that personality might affect academic achievement not directly but through its association with achievement-related variables. Indeed, a number of variables have been found to mediate the personality–achievement relationship, such as student self-efficacy, motivation, goal orientations, learning strategies, and class absences (Conard, 2006; De Feyter, Caers, Vigna, & Berings, 2012; Levpušček, Zupančič, & Sočan, 2013; Steinmayr, Bipp, & Spinath, 2011; Swanberg & Martinsen, 2010; Tabak et al., 2009).

Student perceptions of classroom environment are also considered as a potential mediator of the personality–achievement relationship, even though relative research is scarce. For example Nijhuis, Segers, and Gijselaers (2007) examined the effect of personality traits, elements of the learning environment, and learning strategies with a sample of 522 college students. Their findings suggested that three personality traits, namely Extraversion, Agreeableness, and Emotional Stability,² had no direct effects on learning strategies but were found to influence learning strategies through their perceptions of the learning environment. Similar findings have also been reported for work settings. Westerman and Simmons (2007), for example, showed that environmental preferences fully mediated the effect of certain personality traits such as Extraversion on employee performance and commitment.

While students’ environmental and self-perceptions have been indicated as mediators in the personality–achievement relationship, scholars have not yet examined the potentially mediating role of student perceptions of teacher interpersonal behavior. Given the ample empirical support of the effect of these perceptions on academic achievement (Wubbels & Brekelmans, 2005) and the association of personality with interpersonal interactions (Casciaro, 1998; Cuperman & Ickes, 2009), the mediation of the personality–achievement relation by these perceptions seems likely.
Gender, Socioeconomic Status, and the Variables under Study

Regarding students’ gender and socioeconomic status (SES), previous studies have indicated a close relationship between these variables and the classroom environment, including students’ perceptions of their teacher’s interpersonal behavior (Dorman, 2009; Fisher, den Brok, & Rickards, 2006; Waldrip & Fisher, 1999). At the same time, studies have also supported the effect of gender and SES on academic achievement (Caro, McDonald, & Willms, 2009; Linver, Davis-Kean, & Eccles, 2002), whereas gender has been associated with differences in personality traits (Lynn & Martin, 1997; Schmitt, Realo, Voracek, & Allik, 2008). In order to control for the effect of students’ gender and SES, these variables served as covariates in the hypothesized model of the present study.

Hypothesized Model of Reciprocal Causation

The hypothesized MRC encompassing the three variables considered in the present study contains a reciprocal relation between perceived teacher interpersonal behavior and achievement, two unidirectional relations between personality and teacher interpersonal behavior, and between personality and achievement, with personality being the predictor/exogenous variable.

In order to examine the hypothesized model, the interrelationships between the variables were examined in a progressive fashion. The effect of student personality traits on academic performance was examined in the first step, while the second step examined the mediating role of perceived teacher interpersonal behavior on this effect. Finally, the third step examined the status of the relationship, bidirectional or unidirectional, between perceived teacher interpersonal behavior and academic achievement. The hypothesized model along with the effects examined in each step is presented in Figure 2.

Thus, the purpose of the present study was to investigate an application of the MRC (Bandura, 1989) by examining the relationship among perceived teacher interpersonal behavior, student personality traits, and academic achievement. Two issues in the tested model were more explicitly addressed: (a) the mediating role of

![Figure 2](image-link)  
**Figure 2**  Hypothesized Model. a = Effect Examined in Step 1; b = Effects Examined in Step 2; c = Effects Examined in Step 3.
perceived teacher interpersonal behavior in the association between personality traits and performance, and (b) the nature of the effect (unidirectional or bidirectional) between perceptions of teacher interpersonal behavior and academic achievement.

Method

Data

A significant part of the present data was also used in two previous studies (Kokkinos et al., 2009; Kokkinos, Charalambous, & Davazoglou, 2010). In the present study, however, we utilized the data in a totally different manner. First, we explored different research questions and set different research goals. While in previous instances the data were used to psychometrically test the Greek translation of the QTI (Kokkinos et al., 2009) or to examine the development of student perceptions regarding the interaction with their teacher (Kokkinos et al., 2010), here we investigated mediating and reciprocal effects. Second, we introduced a more comprehensive theoretical framework, namely the MRC (Bandura, 1989). Third, the variables used in the present study differed, since new construct validation analyses (e.g., Exploratory and Confirmatory factor analyses) resulted in new composite variables. Finally, different statistical analyses were employed to answer the study’s research questions (Structural Equation Modeling). The information disclosed comply with the American Psychological Association (2010, pp. 14–15) guidelines for reanalysis of published data.

Sample

A convenience sample of 317 elementary school students from eight public elementary schools from three educational districts of Cyprus and their 19 teachers (9 males and 10 females) participated in the study. The distribution of the student sample according to gender was 138 (43.5%) boys and 168 (53.0%) girls, whereas 11 (3.5%) did not answer; in terms of grade level, 140 (44.2%) were fifth graders, and 177 (55.8%) were sixth graders.

Measures

Teacher Interpersonal Behavior. We used the Greek translation of the 48-item Australian version of the Questionnaire on Teacher Interaction as it was adapted to elementary students by Goh and Fraser (1996) (G-QTI; Fisher, Henderson, & Fraser, 1995; Kokkinos et al., 2009). For the present study, four of the instrument’s eight subscales were used. These were the Helping/Friendly and Understanding subscales (comprising the Cooperation behaviors), and the Dissatisfied and Admonishing subscales (comprising the Opposition behaviors), all of which represent the Proximity axis in the Leary model (1957). According to earlier studies, students at elementary schools place more emphasis on their teacher Proximity than Influence behaviors
Big Three, Teacher Behavior, and Achievement

(Charalampous & Kokkinos 2011, 2013; Goh & Fraser, 1996; Kokkinos et al., 2009; Kyriakides, 2005; Scott & Fischer, 2004).

**Personality.** Students’ Big Three personality traits were measured with the Greek version of the Junior Eysenck Personality Questionnaire (G—JEPQ; Demetriou, 1989; Eysenck & Eysenck, 1975; Kokkinos, Panayiotou, Charalambous, Antoniadou, & Davazoglou, 2009), which assesses Extraversion, Psychoticism, and Neuroticism. The Greek version maintains the same number of items and the same scoring procedures as the original.

**Academic Achievement.** Teachers were asked to rate their students’ academic performance in Mathematics on a scale from 1 (poor) to 10 (excellent), based on their professional judgments. Consistent with previous MRC-related literature (Williams & Williams, 2010), Mathematics achievement was preferred over achievement in other courses. The ratings were collected during the second semester of the school year. Teachers who taught Mathematics were also teaching most of the other courses to students in the sample. Earlier findings support the validity of teacher ratings as valid indicators of students’ academic performance (Jussim, 1989; Jussim & Eccles, 1992; Jussim et al., 1996; Trouilloud et al., 2002), as well as the congruence of these ratings with students’ scores in standardized tests (Leondari, 1992).

**Demographics.** Students also provided information regarding their gender and their parents’ education (rated on a 6-point scale). The latter served as an indicator of students’ socioeconomic status (SES; Kokkinos et al., 2010; McDermott, 1995).

**Procedure**

After permission was granted from the Cyprus Ministry of Education and Culture, schools were contacted, and the head teachers were informed about the purpose of the study. Students were provided with parental consent forms and were asked to return them only if their parents did not wish them to participate in the project. The voluntary basis of participation was also stressed to the students. Only 10 students denied participation. Student surveys were group-administered during a classroom session by the first author with the collaboration of teachers. Students were provided with verbal instructions on how to complete the survey, and they were also assured about the anonymity and confidentiality of their responses. Questionnaire completion time took approximately 30–35 min.

In the mean time, teachers were asked to provide their ratings of student achievement. Data were collected within a period of 2 days. Student and teacher questionnaires were anonymous, and the two datasets were matched with the use of a numerical code that was provided to the students, based on the classroom lists, which was not disclosed to the researchers.
Structural Equation Modeling (SEM) using maximum likelihood estimation was the main analysis technique for the present study. SEM is considered optimal for assessing (a) the factor structure of measurement instruments, (b) structural relations, especially when mediation is present, and (c) bidirectional relationships for cross-sectional data (Byrne, 2009; Martens & Haase, 2006; Patrick, Ryan, & Kaplan, 2007; Wong & Law, 1999). In evaluating model fit, we report the chi-square test of significance, the chi-square to degrees of freedom ($\chi^2/df$) index, the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) (Browne & Cudeck, 1989; Byrne, 2001; Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004; Smith & McMillan, 2001). Adequate fit is indicated by nonsignificance for the chi-square statistic and by values lower than 2.00 for the chi-square to degrees of freedom ratio. For the CFI, values above .95 indicate excellent fit, and values above .90 indicate adequate fit. As for the RMSEA, values lower than .05 indicate excellent fit, and values less than .08 indicate adequate fit. A note should be made regarding widely known limitations of the chi-square (see, for example, Byrne, 2001), especially for complex models that include many parameters such as those examined here. Thus, more attention should be paid to the $\chi^2/df$, the CFI, and the RMSEA indices.

We first examined the psychometric properties of G-QTIP and G-JEPQ. We employed exploratory and confirmatory factor analyses (EFA and CFA) along with the estimation of the internal consistency for each factor. The EFA helped in delineating the factorial structure of the instruments without taking for granted previous findings (Russell, 2002), while the CFA assisted in constructing the measurement model for subsequent SEM analyses. Next, we considered several models that examined the relations among the variables of the study. The first model considered the effect of personality traits on Mathematics achievement, and the second examined the mediation of the relationship depicted in the first model through student perceptions of teacher Proximity. Support for the mediation role of the classroom environment variables would be indicated by a significant drop in the direct relations between personality traits and academic achievement in comparison with the first model (Baron & Kenny, 1986).

Finally, the third model constituted an extension to the second one by additionally examining the bidirectional nature of the association between student academic achievement and perceptions of teacher Proximity. While attempts to model reciprocal effects with cross-sectional data are relatively rare, researchers have highlighted potential benefits of using cross-sectional rather than time-lagged data (Finkel, 1995; Kessler & Greenberg, 1981). Specifically, unlike time-lagged data, cross-sectional data do not require the estimation of the exact time lag, thus avoiding the detrimental effects that a false estimation might have on the results. Second, cross-sectional data bear other practical advantages in cases where assumptions for examining nonrecursive models are met (e.g., the equilibrium assumption; Kaplan, Harik, & Hotchkiss, 2001), and the analysis seems feasible. In the present study, the equilibrium assumption for cross-sectional data is supported in that teacher
interpersonal behavior under the MITB is considered to take the form of steady interaction patterns after only a few classes (Brekelsmans, den Brok, Tartwijk, & Wubbels, 2005), with the teacher acknowledging the academic achievement of each student early on.

Results

Psychometric Analyses

The four subscales of the G-QTIP were factor analyzed using Principal Axis Factoring (see Mor et al., 2008). Inspection of the scree plot explicitly indicated the presence of one factor explaining 41.4% of the variance. In accordance with the MITB Helping/Friendly and Understanding behaviors, loadings bore a different sign compared with those of Dissatisfied and Admonishing behaviors. Next, the one-factor structure was tested using CFA. The results were consistent in their depiction of a poorly fitting model $\chi^2 (2, N = 317) = 28.66, p < .001; \chi^2/df = 14.33; CFI = .91; RMSEA = .21$. Subsequent inspection of the Modification Indices indicated that the insertion of a correlation between the error variances of the Admonishing and the Dissatisfied behaviors would significantly improve model fit. Because this correlation was supported in the literature, as the two subscales are part of the hostility pole of the MITB, the correlation was added. Indeed, model fit was greatly improved and was deemed a good fit to the data $\chi^2 (1, N = 317) = .29, p = .59; \chi^2/df = .29; CFI = .100; RMSEA = .000$. The Cronbach’s alpha coefficient based on the four subscales was estimated at .73.

Regarding the G-JEPQ’s factor structure, an exploratory factor analysis (EFA) was performed based on the 84 items, using Principal Axis Factoring (see Mor et al., 2008). The inspection of the scree plot explicitly indicated the presence of three factors explaining 29.64% of the variance. An EFA was performed next with the request of three factors implementing Promax rotation (see, for example, Fabrigar, Wegener, MacCallum, & Strahan, 1999). The rotated factor matrix revealed that while many of the items loaded highly (> .4) on their respective factors, many had either low loadings (< .4) or loaded on factors other their respective ones. By retaining only those items that loaded highly on their respective factors, nine items were retained for Extraversion, 14 for Neuroticism, and five for Psychoticism. The decision to retain such a low number of items was supported by the low percentage of explained variance (which indicated item redundancy) and by the internal consistency of the resulting subscales: Cronbach’s alpha coefficient was estimated at .89 for Extraversion, .78 for Neuroticism, and .82 for Psychoticism. The resulting factor structure was additionally examined through CFA. For the CFA and further SEM analyses, scale items were merged into groups of 4, 3 and 2 items creating a smaller group of composite items (i.e., parcels) (West, Finch, & Curran, 1995), in order to meet the data-adequacy assumptions. All subscales were allowed to correlate with each other. Results indicated an adequate fit. While the chi-square was statistically significant
\[ \chi^2 (24, N = 317) = 40.04, p < .05 \], the rest of the fit indices were consistent in their depiction of a well-fitting model \( \chi^2/df = 1.67; CFI = .98; RMSEA = .046 \).

**Zero-Order Correlations**

Having established the factor structure of teacher-perceived Proximity and students’ personality traits, the measurement model was tested next with the inclusion of these two factor structures along with Mathematics achievement, student gender, and SES. All variables were allowed to correlate. Generally, the fit indices suggested that the fit was adequate \( \chi^2 (85, 317) = 125.91, p < .01; \chi^2/df = 1.48; CFI = .97; RMSEA = .039 \). Correlations are shown in Table 1. As can be seen, correlations of varying significance, magnitude, and sign were recorded among the variables of the study.

**Effects of Student Personality on Mathematics Achievement**

The next step in the analysis included the testing of a structural model with direct paths from student personality traits to Mathematics achievement (Model 1). Student gender and SES served as covariates, with direct paths from these variables leading to Mathematics achievement. Results indicated that the model was a good explanation for the data \( \chi^2 (48, 317) = 54.71, p = .05; \chi^2/df = 1.30; CFI = .99; RMSEA = .031 \), and model parameters were in the expected direction associated with reasonable standard errors. The structural part of Model 1 along with standardized estimates is presented in Figure 3. As can be seen, Extraversion was the only variable significantly associated with Mathematics achievement, with the model accounting for a total of 15% of the variance of Mathematics achievement, which is attributed almost equally to Extraversion and SES.

**Mediating Role of Student Perceptions of Teacher Interpersonal Behavior**

In the next step, perceptions of teacher Proximity were entered into the model, mediating the effect between personality and Mathematics achievement. Structural paths were added from personality traits, gender, and SES towards teacher Proximity, and from teacher Proximity towards Mathematics achievement. The fit of this model was adequate \( \chi^2 (85, 317) = 122.77, p < .01; \chi^2/df = 1.44; CFI = .97; RMSEA = .037 \).

**Table 1 Zero-Order Correlations Among Perceived Teacher Proximity, Big Three Personality Traits, Mathematics Academic Achievement, Gender, and Socioeconomic Status.**

<table>
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<th>Variables</th>
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<td>(1) Teacher Proximity</td>
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<td>(2) Extraversion</td>
<td>.39*</td>
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<td>(3) Neuroticism</td>
<td>−.14</td>
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<tr>
<td>(4) Psychoticism</td>
<td>−.30*</td>
<td>−.48*</td>
<td>−.23*</td>
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<td></td>
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<tr>
<td>(5) Mathematics Achievement</td>
<td>.33*</td>
<td>.25*</td>
<td>−.08</td>
<td>−.06</td>
<td></td>
<td></td>
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<tr>
<td>(6) Gender</td>
<td>.26*</td>
<td>.11</td>
<td>.05</td>
<td>−.28*</td>
<td>−.02</td>
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<tr>
<td>(7) Socioeconomic Status</td>
<td>.03</td>
<td>.01</td>
<td>−.17*</td>
<td>.07</td>
<td>.29*</td>
<td>−.10</td>
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*p < .05.
Model parameters were in the expected direction and were associated with reasonable standard errors. The structural part of Model 2 along with standardized estimates is presented in Figure 4. As can be seen, perceived teacher Proximity seems to fully mediate the effect of Extraversion on Mathematics achievement. In addition, Psychoticism seems to be affecting Mathematics achievement indirectly through teacher Proximity, even though no association was detected between the two variables in the zero-order correlations. In addition, gender had an effect on student perceptions of teacher Proximity and thus indirectly affected Mathematics achievement. As for Psychoticism, the nonsignificant effect towards teacher Proximity, as opposed to what was found with the zero-order correlations, is attributed to the high correlation between Psychoticism and Extraversion.

Figure 3  Associations Between Student Personality Traits and Mathematics Achievement. All Coefficients Shown Are Standardized and Significant at $p < .05$.

Figure 4  Perceived Teacher Proximity Mediating the Relationship Between Student Personality Traits and Mathematics Achievement. All Coefficients Shown Are Standardized and Significant at $p < .05$.
Bidirectionality of the Relationship between Student Perceptions of Teacher Interpersonal Behavior and Mathematics Achievement

The final model (Model 3) tested the bi-directionality of the relationship between perceived teacher Proximity and student Mathematics achievement; i.e., it tested whether there was a reciprocal effect between these variables. Model 3 was an extension of Model 2 with the insertion of a structural path from Mathematics achievement on teacher Proximity. In addition, the error terms associated with these variables were set to correlate (Kaplan, 2000; Wong & Law, 1999). Extraversion, Neuroticism, and gender served as instrumental variables for teacher Proximity, whereas SES served as instrumental variable for Mathematics achievement. The stability of the system of linear dependencies was examined using the stability index (Fox, 1980). The stability index was found to be within the acceptable range, i.e., between -1 and +1. Furthermore, results indicated that the fit for this model was acceptable \( \chi^2 (89, 317) = 131.00, p < .01; \chi^2/df = 1.47; CFI = .97; RMSEA = .039 \]. Model parameters were in the expected direction associated with reasonable standard errors. Model 3 along with standardized estimates is presented in Figure 5. As can be seen, the effect of Mathematics achievement on teacher Proximity was not statistically significant (CR = .64). The rest of the parameters were identical to Model 2. This indicates that for the present data, the relationship between student perceptions of teacher interpersonal behavior and Mathematics achievement was unidirectional with the first as the exogenous and the latter as the endogenous variables.

**Discussion**

The purpose of the present study was to apply Bandura’s (1989) model of reciprocal causation within the classroom context by investigating the relationships among

![Figure 5](https://example.com/figure5.png) **Figure 5** Reciprocal Relation Between Perceived Teacher and Mathematics Achievement. All Coefficients Shown Are Standardized and Significant at \( p < .05 \). Dashed Lines Represent Non-Significant Relationships.
student perceptions of teacher interpersonal behavior, student Big Three personality traits, and Mathematics achievement. Special emphasis was given to the mediating role of perceived teacher interpersonal behavior in the association of personality traits on performance, and to the nature of the relationship (unidirectional or bidirectional) between perceptions of teacher interpersonal behavior and Mathematics achievement. In general, the results indicated a complex relationship among student personality traits, perceptions of teacher interpersonal behavior, and Mathematics achievement, and showed that the MRC (Bandura, 1989) provides a comprehensive framework for studying classroom phenomena.

Concerning the effect of personality traits on Mathematics achievement (Model 1), zero-order correlations indicated a significant relation for two of the three traits, but SEM analyses examined the effects of all three traits simultaneously, controlling for gender and SES. Results of SEM indicated that only Extraversion had a significant effect on Mathematics achievement: when Extraversion scores increased one standard deviation, Mathematics achievement increased by .27 standard deviations.

In a similar study with adolescents (Smrtnik-Vitulić & Zupančič, 2011), where the Big Five personality traits were regressed simultaneously along with gender and maternal education on achievement, results indicated that only two of the Five traits, one of which was Extraversion, had a significant effect on achievement. This indicates that potentially much of the effect on achievement attributed to personality traits might be different when personality traits and gender effects are estimated simultaneously.

In terms of the role of student perceptions of teacher interpersonal behavior on the personality–achievement relationship (Model 2), these seem to fully mediate the effect of Extraversion on Mathematics achievement, whereas, through these perceptions, Neuroticism seems to affect Mathematics achievement indirectly. Thus, student perceptions of their teacher interpersonal behavior offer a new perspective on the pathways through which personality affects Mathematics achievement. Compared with other variables such as approaches to learning, efficacy, and achievement goals, which partially mediated the personality–achievement relationship (Levpuşćek et al., 2013; Steinmayr et al., 2011; Swanberg & Martinsen, 2010; Tabak et al., 2009), perceptions of teacher interpersonal behavior also proved to be a significant mediator.

Extraversion, Neuroticism, and gender explained 26% of the variance of student perceptions of teacher interpersonal behavior. In another study where teacher Proximity was used as the dependent variable (Fisher et al., 2006), the findings indicated a larger percentage of explained variance (52.7%) by student variables such as attitude towards the course taught, gender, language spoken at home, mother’s place of birth, and gender percentage in class. However, the use of some of these variables as predictors of student perceptions in that study raises certain questions, mainly because attitudes towards the course taught—which was the strongest predictor of student perceptions—are considered in the literature as outcomes of student perceptions of their teacher interpersonal behavior and not as predictors (Fraser, 1998, 2007). Overall, the explained variance of student perceptions of their teacher’s interpersonal behavior by student disposition in the present study signifies
the role of personality in interpreting social interactions as found in other studies (Casciaro, 1998; Cuperman & Ickes, 2009).

In addition, perceived teacher Proximity behavior seems to account for 19% of the variance of Mathematics achievement (along with SES). Similar findings are reported in other studies with elementary school students (Goh & Fraser, 2000; Kyriakides, 2005), suggesting that teacher Proximity is a significant determinant of students’ Mathematics achievement at this age level.

With respect to the nature of the relationship between perceived teacher Proximity and Mathematics achievement (whether uni- or bi-directional), we examined a nonrecursive model where both variables were exerting an effect on each other (Fox, 1980; Kaplan, 2000; Wong & Law, 1999). Results support that the relationship between the two is a uni-directional one: whereas perceived teacher’s Proximity was found to influence Mathematics achievement, the opposite effect was not supported. Earlier studies provided support that students’ achievement might influence actual and perceived teacher behavior (Brophy, 1985; Mottet et al., 2005; Rosenthal & Rubin, 1978; Trouilloud et al., 2002). However, for the present sample, teachers do not seem to be regulating their interpersonal behavior based on their expectations of their students’ achievement. While the majority of earlier studies approached this relationship as de facto uni-directional (see, for example, Fraser & Walberg, 2005; Wubbels & Brekelmans, 2005), the present is one of the first studies to provide empirical indications of this uni-directionality.

In terms of students’ gender and SES, results were in accordance with those of earlier studies. For gender, female students reported more Proximity in the interaction with their teacher, while males reported higher levels of Psychoticism as in earlier studies (Escoirial & Navas, 2007; Goh & Fraser, 2000; Lynn & Martin, 1997; Schmitt et al., 2008). In terms of SES, a higher SES was associated with higher Mathematics grades, whereas a lower SES was associated with higher scores in Neuroticism, similar to earlier findings (Caro et al., 2009; Jonassaint, Siegler, Barefoot, Edwards, & Williams, 2011).

A significant innovation of the present study was the use of personality traits as part of the MRC model (Bandura, 1989). In the MRC personal characteristics are considered as flexible and intentionally regulated attributes, such as self-beliefs of efficacy, cognized goals, quality of analytic thinking, and affective self-reactions (Bandura, 2001). By contrast, the findings of the present study suggest that the use of personality traits in the MRC framework provides a fruitful conceptualization for examining the interplay among students’ personality traits with environmental and behavioral variables and appears to be in accordance with earlier findings regarding the relationships among these variables. Drawing from the findings of the present study, given that personality traits in childhood are not as stable as in adulthood (Roberts & DelVecchio, 2000), full triadic reciprocity models with the inclusion of personality traits investigated through longitudinal study designs are needed to clarify the role of perceived classroom environment and behavioral variables in the formation of personality traits. Recent research has underlined the role of environmental influences on personality traits (Hopwood et al., 2011), as well as
the importance of personality traits on important life outcomes (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

When considering the present findings, certain limitations should be kept in mind. First of all, the sample of the study was not randomly selected. Though every effort was made for the characteristics of the sample to resemble those of the general population, generalizability of the results should be made with caution in the given context. Second, we examined cause-and-effect relations using cross-sectional data. Despite strong theoretical and previous empirical support of the findings, we acknowledge the limitations of cross-sectional data. Longitudinal data would provide additional support to the present findings; however, the limitations of longitudinal data in terms of estimating the exact time lag in which the anticipated effects take place, make the successful application of the statistical analyses in the present study a reasonable alternative (for a discussion, see Finkel, 1995; Kessler & Greenberg, 1981). Nonetheless, because the analyses of the present study offer mere inferences of causality, and despite theoretical and earlier empirical support for the relationships under study, statements of causality used throughout the paper should be interpreted with caution. Another limitation is that the factor structure of the G-JEQP (Kokkinos et al., 2009) was not fully supported, in that certain items were excluded based on the EFA findings. However, given that reliability and validity are not qualities of the instrument but qualities of a measurement procedure (e.g., Thorndike, 2005) the CFA and reliability analyses made it clear that, even with fewer items, the Big Three personality traits were reliably and validly measured in the present study.

The present study has both research and educational implications. At a research standpoint, findings suggest that the MRC (Bandura, 1989) offers a comprehensive framework to approach the study of the interplay between personal, environmental, and behavior-related factors. Second, findings indicate that examining these sets of factors in relation to each other in comprehensive theoretical models helps in unmasking intricate effects and in delineating complex interactions. Finally, the findings suggest that modeling reciprocal effects with cross-sectional data when relative requirements are met (e.g., Finkel, 1995; Kaplan et al., 2001; Kessler & Greenberg, 1981) provides a useful alternative that might supplement or coexist with cross-lagged effect data in investigating such effects.

At an educational standpoint, the study sheds light on the significance of personality traits that affect student perceptions of teacher behavior, the daedal paths through which different traits seem to affect student academic performance, and finally the mediating role of student perceptions of teacher interpersonal behavior. These results indicate that sociable, empathetic, and gregarious students tend to perceive higher levels of helpful and understanding behaviors from their teachers, and this leads to a higher achievement in Mathematics. This suggests that teachers working with preadolescents should strive to stimulate cooperation, both among students (increasing sociability) and between students and themselves (increasing perceived teacher Proximity).

To this end, teachers should improve their relational communication behavior by improving their immediacy, i.e., their physical and psychological closeness to students
(see, for example, Richmond, Lane, & McCroskey, 2006; Witt, Wheeless, & Allen, 2004) and by employing more affinity-seeking strategies with their students. Such behaviors will create positive emotional reaction from students towards their teachers, purposefully working to increase students’ enjoyment by expressing optimism, being helpful, and listening without interrupting (Beebe & Mottet, 2009; Frymier & Wanzer, 2006). Thus, by fostering simple verbal and nonverbal communication behavior such as smiling, keeping eye contact, forward body leans (Mehrabian, 1969), showing interest and interacting with students before, during, and after lessons, teachers are expected to achieve higher academic and affective outcomes (see also Richmond et al., 2006; Witt et al., 2004).

In all, the present study makes significant contributions to the relevant literature. However, further research is needed to further validate, clarify, and elaborate on the present findings, in order to offer a more comprehensive picture of how students perceive and process their teacher interpersonal behavior, and how student individual characteristics relate to their classroom perceptions and academic performance.

Notes
[1] Eysenck’s three-trait theory was preferred over the Big Five theory to measure personality in the present study despite their similarities (Costa & McCrae, 1992a, 1992b; Eysenck, 1992a, 1992b) based mostly on the parsimony of the measured constructs. Its parsimony means that it is relatively easy to incorporate in complex modeling analyses, and renders it an ideal starting point for studies seeking to evaluate the role and impact of personality in different contexts. The broader five-factor model may be subsequently employed in order to determine the predictive value of its incremental variance. Bearing certain exceptions (e.g., hypothesis testing), it is only after the role of the basic personality dimensions has been clarified that it makes sense to examine the potential relevance of narrower (lower-order) personality constructs. (Petrides, Chamorro-Premuzic, Frederickson & Furnham, 2005, p. 241)

References


