

**The importance of teacher interpersonal behaviour for secondary science
students' attitudes in Kashmir.**

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Re-submitted to: Journal of Classroom Interaction

January 2006

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Abstract

This study focuses on the relationship between teacher-student interpersonal behaviour and students' attitudes toward science. To investigate this relationship, student perception data have been gathered with 1021 secondary science students, located in 31 classes in Kashmir, India. Teacher interpersonal behaviour was conceptualised in terms of two behavioural dimensions, Influence (the degree of teacher control in communication with students) and Proximity (the degree of cooperativeness between teacher and students), and measured with the Questionnaire on Teacher Interaction (QTI). Multilevel analyses of variance were conducted on students' attitude scores and the effect of the interpersonal variables was corrected for the effects of student, class and teacher background variables, as well as other elements in the learning environment. Results indicated that both teacher Influence and Proximity were positively associated with students' attitudes and that their effect remained statistically significant after correction for other covariates and learning environment variables.

The importance of teacher interpersonal behaviour for secondary science students' attitudes in Kashmir.

1. Rationale

The question on how to motivate students for (specific) school subjects has occupied teachers, trainers and researchers for several decades. Interest in the effect that teachers may have on students' affective outcomes can be found in multiple research domains, such as research on teaching of specific subjects, school and teacher effectiveness research and learning environments research. In this study, we will investigate how teacher behaviour affects students' enjoyment of Science with a sample of Indian students.

In the domain of *learning environments research*, there is a growing body of research that links teacher-student interpersonal behaviour – one of the many aspects of teaching – to students' attitudes towards the subject taught (Brekelmans, Wubbels, & den Brok, 2002; Brekelmans, den Brok, van Tartwijk, & Wubbels, 2005; den Brok, Brekelmans, & Wubbels, 2004). This research has shown that both teacher dominance and cooperativeness are positively linked to students' affective outcomes and has included countries such as the Netherlands (Brekelmans, Wubbels, & Créton, 1990; den Brok, 2001; den Brok, et al., 2004), Australia (Evans, 1998; Henderson, 1995; Rawnsley, 1997), Singapore (Goh, & Fraser, 1998), Korea (Kim, Fisher, & Fraser, 2000) and Brunei (den Brok, Fisher, & Scott, 2005; Riah, & Fraser, 1998).

Despite this consistent and growing body of knowledge, there were several reasons to conduct this particular study. First and most importantly, although many studies have been carried out on examining learning environments in different parts of the world, none or few have been reported from India. As such, the present study provides a basis upon which future Indian efforts can draw in the future. Second, Kashmir is a particularly interesting area for such research, because it finds itself in the midst of changing social and political climates. India's partition in August 1947 on the basis of religion, and Kashmir's accession with India, has led to a number of disturbances in Kashmir and two international wars with Pakistan. In recent times, there has been an exodus of people from the valley for Jammu – the city in which our research was carried out – which had major consequences on the

populations of schools and classes and the school careers of students. The present generation of high school students have all been through an educational journey while living in politically uncertain conditions. Third, the state of Jammu and Kashmir has the distinction of having a multifaceted, variegated and unique cultural blend that distinguishes it from the rest of the country. The state is comprised of three different cultural forms of heritage in three regions namely Jammu, Kashmir and Ladakh. These social entities form a distinct spectrum of diversity of religion, language and culture. Kashmir's different cultural forms like art and architecture, fairs and festivals, rites and rituals, seers and sagas, languages and mountains are embedded in an ageless period of history. Fourth, investigation of the link between teaching and student outcomes has an important value for the government of Kashmir, because for Kashmiri parents education of Kashmiri children is a top priority in their culture, and despite living in tough conditions parents continued sending their children to (mainly private) schools.

The present study is also interesting from a methodological point of view. It investigates the link between teacher interpersonal behaviour and student outcomes by means of multilevel analysis and determines its strength after having corrected for student, class and teacher background characteristics as well as other teaching elements.

In this article, we will first briefly discuss the theoretical framework that is being used to study teacher interpersonal behaviour. After a review of prior research investigating the effect of interpersonal behaviour on student motivation in various countries, we will present our research question, sample, instruments and analysis method. We will present how teacher interpersonal behaviour links to students' attitudes towards science in Jammu, India, and link our findings to the existing body of research. The article ends with some implications, both for research and practice.

2. Teacher interpersonal behaviour

Our conceptualisation of teacher-student interpersonal behaviour partially evolved from a *systems approach to communication* (Watzlawick, Beavin, & Jackson, 1967), in which classroom groups are conceived as ongoing systems. Systems require a certain stability in order to exist. When students meet a teacher in a new class, they will be open to any impressions, though they may be influenced by

their (stereotypical) expectations about the teacher. As the class progresses, students will begin to develop ideas about their emerging relationship with this particular teacher. Finally, after a number of lessons (which may take weeks or months), the students' tentative ideas will have stabilised and they can tell what "kind" of teacher they have. This gradual stabilisation of perceptions applies equally to the teachers as well as to the students. Once the tone is set, it is difficult to modify, and both students and teachers resist changes (see also Blumenfeld, & Meece, 1985; Doyle, 1986). To describe these various processes, the systems approach to communication distinguishes between different levels of communication. The lowest consists of single messages, questions, assignments, responses, gestures, etc. The intermediate level describes interactions, or chains of several messages. The pattern level is reached when the interactions regularly follow identifiable patterns. It is at the pattern level that the stable interpersonal relationships that determine the working atmosphere of classrooms are understood.

In the systems approach to communication, the focus is on the effect of communication on the persons involved (pragmatic aspect). In our conceptualisation of the interpersonal perspective, we focus on the *perceptions* of students toward the behaviour of their teachers. To describe these perceptions, Wubbels, Créton, and Hooymayers (1985, cited in Wubbels, & Levy, 1993) applied Leary's general model for interpersonal relationships (Leary, 1957) to the context of education. The Leary model has been extensively investigated in clinical psychology and psychotherapeutic settings (Strack, 1996). It has proven to be adept at describing interpersonal relationships (e.g. Foa, 1961; Lonner, 1980). According to Leary, two dimensions are important - Dominance-Submission and Hostility-Affection. While the two dimensions have occasionally been given other names, - Brown (1965) used Status and Solidarity, Dunkin and Biddle (1974) Warmth and Directivity - they have generally been accepted as universal descriptors of human interaction. The two dimensions have also been easily transferred to education. Slater (1962) used them to describe pedagogical relationships, and Dunkin and Biddle (1974) demonstrated their importance in teachers' efforts to influence classroom events.

Adapting the Leary Model to the context of education, Wubbels et al. (1985) labelled the two dimensions *Influence* (Dominance-Submission) and *Proximity* (Opposition-Cooperation). They structured interpersonal teacher behaviour into eight segments: leadership, helpful/friendly

understanding, giving students freedom and responsibility, uncertain, dissatisfied, admonishing and strict. Figure 1 is a graphic representation of the adapted model for education, the *Model for Interpersonal Teacher Behaviour* (Wubbels, et al, 1985).

Figure 1 about here

The Wubbels, et al (1985), and Leary (1957) models are linked theoretically to the family of *circumplex* models (e.g. Blackburn, & Renwick, 1996; Fabrigar, Visser, & Browne, 1997; Gaines, Panter, Lyde, Steers, Rusbult, Cox, & Wexler, 1997; Gurtman, & Pincus, 2000). Circumplex models assume that the eight interpersonal sectors can be represented by two independent dimensions (Influence and Proximity), are ordered with equal distances to each other on a circular structure and maintain equal distances to the middle of the circle.

The sections are labelled DC, CD, etc. according to their position in the coordinate system (much like the directions in a compass). For example, the two sectors “leadership” and “helpful/friendly” are both characterised by Dominance and Cooperation. In the DC sector, the Dominance aspect prevails over Cooperation. A teacher displaying DC behaviour might be seen by students as enthusiastic, motivating, and the like. The adjacent CD sector includes behaviours of a more cooperative and less dominant type; the CD teacher might be seen as helpful, friendly and considerate.

The *Questionnaire on Teacher Interaction* (QTI) (Wubbels et al., 1985) was developed based on this model and can be used to map students’ (and teachers’) perceptions of teacher interpersonal behaviour according to the MITB. The QTI originally consisted of 77 items, answered on a Likert-type 5-point scale. The items of the QTI refer to the eight sectors of behaviour – leadership, helpful/friendly, understanding, giving responsibility/freedom, uncertain, dissatisfied, admonishing and strict – that jointly make up the MITB. Since its development, the QTI has been the focus of well over 120 (learning environment) studies in many countries (den Brok, Brekelmans, Levy, & Wubbels, 2002) and has been translated into more than 15 languages (Wubbels, Brekelmans, van Tartwijk, & Admiraal, 1997). The original QTI, designed for secondary education, also formed the basis for a number of other versions for primary education, higher education, principals and supervisors (den

Brok, 2001). The QTI was first constructed in the Netherlands between 1978 and 1984 (Wubbels, et al., 1985) and its development involved four rounds of testing using different sets of items, interviews with teachers, students and teacher educators; and researchers judging the face validity of items. In this manner, out of a pool of over 200 items, 77 items were selected for the final version. The American version was created between 1985 and 1987 by translating the set of 77 items from the Dutch version, adding several items (since several items could be translated in more than one way), and adjusting this set of items based on three rounds of testing (Wubbels, & Levy, 1991). The American 64 item-version of the QTI was initially used in Australia (Wubbels, & Levy, 1993), but ultimately a more economical 48-item version was developed in Australia (Wubbels, 1993; Fisher, Henderson, & Fraser, 1995). In Appendix A the 48-items Australian version used in this study can be found.

3. Teacher interpersonal behaviour and student subject-related attitudes in various countries.

As was described in the Rationale section, within the domain of learning environments research, several studies have investigated relationships between teacher-student interpersonal behaviour and students' attitudes towards the subject. The vast majority of these studies mapped teacher interpersonal behaviour with the QTI (e.g. Wubbels, et al., 1985) and reported on this behaviour in terms of two, independent relationship *dimensions*, called teacher Influence and Proximity, or in terms of the eight interpersonal behaviour *sectors* displayed in Figure 1. Furthermore, in most of these studies students' attitudes towards the subject were studied in terms of the *pleasure* or *enjoyment* experienced during a subject lesson and measured by means of short questionnaires (scales), such as the Enjoyment (ENJ) scale of the Test of Science Related Attitudes (TOSRA, e.g. Fraser, & Fisher, 1982; Fisher, Rickards, Goh, & Wong, 1997) or the Attitude Scale (AS, e.g. Kuhlemeier, Van den Bergh, & Teunisse, 1990). The present study also used these instruments (both QTI and ENJ).

From the existing data base of studies a consistent pattern of associations emerges. Studies using interpersonal *dimension scores* all found a positive effect for both Influence and Proximity on subject-related attitudes. Generally, effects of Proximity are stronger than those of Influence. For example, in a study of English as a Foreign Language (EFL) teachers in the Netherlands (den Brok, et al., 2004) it was found that the effect of Proximity on students' pleasure in the subject was three to four times

stronger than the effect of Influence, even though both had a positive effect. In a study of Physics teachers and their students in the Netherlands, Brekelmans, Wubbels and Créton (1990) also found a stronger relationship between Proximity and students' attitudes than between Influence and student attitudes: the stronger the perception of Proximity the more positive the attitude of the students towards the subject. In both these studies the effects of Influence and Proximity were corrected for the effect of student, class and teacher characteristics, such as gender, SES, class size, teacher gender, school type and report card grade. Moreover, these studies employed multilevel analysis techniques, thereby taking into account the effects of non-random sampling. A study in Brunei (den Brok, et al., 2005) - also employing multilevel analyses and correcting the effect of interpersonal behaviour for various student, class and teacher characteristics - indicated equally strong effects of Influence and Proximity. However, their study was conducted with primary education science teachers and their students.

Positive, strong associations have also been demonstrated between several *interpersonal behaviour sectors*, such as Leadership and Helpful/Friendly, and subject-related attitudes, while negative relationships were found with Admonishing, Dissatisfied, and, in most cases, Strictness (e.g. Evans, 1998; Goh, & Fraser, 1998; Fisher, et al., 1997; Henderson, 1995; Rawnsley, 1997; van Amelsvoort, 1999). In most of these studies, all scales related statistically significant to student attitudes in terms of *correlation coefficients* – with Leadership, Helpful/Friendly, Understanding and Student Responsibility relating positively; Uncertain, Dissatisfied, Admonishing and Strict relating negatively – but only a small number of scales (e.g. Helpful/Friendly and Understanding) remained statistically significant if the more conservative *regression weights* were used (e.g. Scott, 2003). A number of these studies was conducted in Australia. Henderson (1995), for example, studied Biology classes and reported correlation coefficients between $-.36$ (Uncertain) and $+.49$ (Leadership; Helpful/Friendly). In his study, he found that the interpersonal sectors explained 33 percent of the variance in enjoyment, either uniquely or in combination with other learning environment variables. Evans (1998) studied Australian science classes and reported similar coefficients and percentages of variance explained in enjoyment. Rawnsley (1997) studied mathematics teachers and reported similar findings as in the other two mentioned Australian studies. Characteristic of the Australian studies is that they

investigated the effects of interpersonal behaviour taking into account other learning environment elements, but that respondent characteristics were not included. The studies indicated large amounts of variance explained jointly by interpersonal and other teacher behaviours (Henderson, 1995; Rawnsley, 1997), while also a large amount of variance appeared to be explained by interpersonal behaviour uniquely.

Two studies investigating associations between QTI scales and Enjoyment have been conducted in Singapore, one with primary education mathematics classes (Goh & Fraser, 1998) and one with secondary education science classes (Fisher, et al., 1997). Interestingly, the authors of both these studies report higher amounts of variance explained in student enjoyment than was the case in the Australian studies. Fisher and colleagues (1997), for example, report a percentage of explained variance by interpersonal variables of 49 percent. This is also reflected in correlation coefficients, ranging between $-.56$ (Dissatisfied) and $+.66$ (Helpful/Friendly). These patterns are similar in both studies. One other study was conducted in Korean science classes (Kim, et al., 2000) and reported correlation coefficients ranging between $-.36$ (Dissatisfied) and $+.49$ (Helpful/Friendly).

None of the above mentioned studies using the interpersonal sectors (rather than dimensions) employed multilevel analysis techniques. Instead, in most cases one-way analyses of variance (ANOVA), multivariate analyses of variance or correlations were used to investigate associations. While these analytic techniques can provide useful information, they usually overestimate effects because they assume random sampling. In most studies, classes were sampled as a whole, meaning that data were hierarchical in nature. The effects of ignoring the hierarchical structure are considerable: effect sizes and correlations may appear two times larger than they are 'in reality'. Moreover, in these studies results were not corrected for covariates, such as student, teacher or class characteristics. This may have led to overestimation of the influence of interpersonal teacher behaviour on student attitudes. Research has shown that teacher behaviours – and students' perceptions of them – are partially dependent on and may interact with characteristics of respondents and the context in which they occur (Levy, den Brok, Wubbels, & Brekelmans, 2003). Finally, many of the reported studies included teaching in terms of the eight sectors of the Model for Interpersonal Teacher Behaviour, while only a few used the two underlying dimensions of Influence and Proximity.

The interpersonal dimensions are preferable from a research point of view, because they are independent and can be used as such (whereas the eight sectors are interrelated) and because they are less subject to reliability and validity problems (e.g. den Brok, Fisher, Brekelmans, Rickards, Wubbels, Levy, & Waldrip, 2003). The present study hopes to overcome some of these limitations by using dimension scores, by employing multilevel analyses and by including both background characteristics and other learning environment variables in estimating the effect of interpersonal behaviour on student attitudes.

4. Research Questions

This study investigated the relationship between teacher-student interpersonal behaviour and students' enjoyment of secondary science classes in Kashmir (Jammu), India. The following research questions were investigated:

1. *To what degree is secondary students' enjoyment of science determined by their teachers and classes?*
2. *What relationship exists between secondary students' enjoyment of science and their teachers' interpersonal behaviour?*
3. *What relationship exists between secondary students' enjoyment of science and their teachers' interpersonal behaviour, after correction for teacher and student background characteristics?*
4. *What relationship exists between secondary students' enjoyment of science and their teachers' interpersonal behaviour, after correction for both background characteristics as well as other learning environment variables?*

5. Method

5.1 Instrumentation

Data about the perceptions of students on their teachers' interpersonal behaviour were gathered by means of the *Questionnaire on Teacher Interaction (QTI)*. The Australian version of the QTI was distributed among the Indian students and teachers. This version consists of 48 items which are

answered on a five-point Likert scale. These items are divided into eight scales each of six items which conform to the eight sectors of the model. Table 1 presents a typical item for each scale.

Several studies have been conducted on the reliability and validity of the QTI. They have included Dutch (e.g. Brekelmans, et al., 1990; den Brok, 2001; Wubbels, et al., 1985), American (Wubbels, & Levy, 1991) and Australian (Fisher, Fraser, & Wubbels, 1992) samples. Both reliability and validity were acceptable¹.

Each completed questionnaire yields a set of eight scale scores. Scale scores equal the sum of all item scores and are reported in a range between zero and one. Scale scores of students from the same class are combined into a class mean. In the present study, the teacher-student relationship is analysed on the basis of dimension scores. To arrive at dimension scores, we use linear combinations of the scale scores². We designate the two linear combinations of the eight scores as an Influence (DS)-score and a Proximity (CO)-score. The higher these scores are, the more dominance (DS) or cooperation (CO) is perceived in the behaviour of a teacher.

Table 1 about here

To determine the quality of the QTI for this sample we first performed reliability analyses: Cronbach's alpha was determined at the class level. Moreover, for each scale we determined the percentage of variance at the class level. Reliability analyses indicated that two items needed to be deleted, one from the Helpful/Friendly scale ('This teacher has a sense of humour') and one from the Student Responsibility scale ('We can decide some things in this teacher's class'). In Table 2 the results of these analyses are presented. As can be seen in Table 2, the alpha coefficients of all scales are above .70, while the percentage of variance at the class level lies between 12 (Leadership) and 26 (Uncertain) percent.

Although the QTI seems to be a valid and reliable instrument for use in Kashmir, still its reliability coefficients and percentages of variance are consistently lower than those in Western countries (e.g. den Brok, et al., 2003). These lower scores may be attributed to the culture where students are reluctant to provide a free view. Also, these students were exposed to this type of study for the first

time in their lives and some may not have been sure about the way to respond. Despite the fact that the alpha reliability scores are lower than in other countries, we still can say with confidence that the QTI is a reliable instrument for use in India.

Table 2 about here

To check whether two dimensions were present in the scale scores, an *exploratory* factor analysis was performed. It appeared that two factors could be extracted with an eigenvalue larger than one, explaining a total of 68.4 percent of the variance. Moreover, these two factors were uncorrelated. It thus seems that two, independent dimensions underlie the scales of the QTI, which is in line with the Model for Interpersonal Teacher Behaviour (Figure 1). Furthermore, a (multilevel) confirmatory factor analysis testing a perfect circumplex model (as in Figure 1) indicated minor distance between model and data (Chi-squared=74.78, with df=26 (p=.00); CFI=.97; TLI=.92; RMSEA=.04; and SRMR=.06), and even better fit was displayed by a slightly less restrictive model allowing for unequal distances between the eight sectors on the interpersonal circle (Chi-squared=38.16, with df=39 (p=.12); CFI=.99; TLI=.96; RMSEA=.03; and SRMR=.04). A last validity check was made by computing dimension scores (Influence and Proximity). A correlation of .07 (non-significant) was found between the dimension scores. Again, these findings corresponded to the theoretical framework behind the QTI.

To measure other aspects of the learning environment, the *What is Happening in this Classroom* (WIHIC) questionnaire was used. Developed by Fraser, Fisher and McRobbie (1996), the WIHIC measures high school students' perceptions of their classroom environment. The WIHIC includes relevant dimensions from past questionnaires and combines these with dimensions that measure particular aspects of constructivism and other relevant factors operating in contemporary classrooms. A description of each scale in the WIHIC is presented in Table 3. To date, the original questionnaire in English has been translated into Chinese for use in Taiwan (Aldridge, & Fraser, 1997) and Singapore (Chionh, & Fraser, 1998) and Korean for use in Korea (Kim, et al., 2000).

Table 3 about here

The WIHIC contains 56 items that are answered on a five-point Likert-type Scale. The items refer to seven scales. Firstly, an examination of whether scales had been measured reliably was conducted by computing a Cronbach's Alpha reliability coefficient at the class (aggregated) level. It appeared that two items needed to be deleted from the analyses in order to obtain sufficient reliability, one from the Student Cohesiveness scale ('Students in this class like me') and one from the Investigation scale ('I draw conclusions from investigations'). Secondly, we computed the percentage of variance of each of the scales at the class level, in order to determine whether the questionnaire was able to discriminate between classes. The outcomes of these analyses are presented in Table 4.

As can be seen, all reliability coefficients were above .70 and percentages of variance ranged between 8 (Cooperation) and 14 (Support) percent. These values are similar to those found in previous studies done with the WIHIC. Additionally, we computed mean scale correlations between one scale and the other scales of the instrument, in order to see whether they measured distinctive elements of the learning environment. These analyses showed that correlations were between .27 (Student Cohesiveness) and .51 (Involvement), suggesting only minor overlap between variables.

Table 4 about here

Attitude was measured with the ENJ (*Enjoyment in Science*) scale from the TOSRA questionnaire. The ENJ scale is an eight-item Likert type scale. Reliability (alpha) of this scale in the present sample was .82, indicating sufficient reliability.

Table 5 about here

Table 5 presents descriptive information for each of the teaching and learning environment variables, as well as the attitude scale. Teachers in Kashmir are perceived as both dominant and cooperative. However, the amount of Influence is higher than generally found in Dutch, Australian or other

samples, while the amount of Proximity is lower than generally found in these countries (e.g. den Brok, et al., 2003). For example, den Brok and colleagues (in press) report Influence scores of .56 in Singapore, .73 in Brunei and .55 in Australia, while they report Proximity scores for these countries of 1.28 (Singapore), .85 (Brunei) and .55 (Australia). Den Brok et al. (2004) report Influence scores of .29 for Physics teachers and .19 for English (as a foreign language) teachers in the Netherlands. They report Proximity scores of .36 (Physics) and .53 (English) respectively. Furthermore, on average teachers are able to create learning environments that provide a lot of Student Cohesiveness, Task Orientation, Cooperation and Equity and moderate amounts of Teacher Support, Involvement and Investigation. On average, students have very positive attitudes towards Science.

5.2 Sample

A total of 1021 students participated in the study, located in 31 classes in 18 schools in the city of Jammu. From the students, 33 percent (337 students) were grade 10 students, the remainder were grade 9 students. Furthermore, a little over half of the students (581 or 56.9 percent) was male. To determine cultural background of the student, they were asked to write down the language they spoke at home most of the time. More than half of the students (522 or 51.1 percent) spoke Hindi. This was the largest group, followed by Kashmiri speaking students (221 students or 21.6 percent), Dogri speaking students (175 students, or 17.1), the remaining students speaking other languages. Last, students were asked for their religion. Most of the students indicated Hindu (86.4 percent), the other religions such as Sikh (6.8 percent), Muslim (4.7 percent), Christian (1.4 percent) being much less present in the sample.

5.3 Analyses

To determine the effect of teacher interpersonal behaviour on students' attitudes toward Science, multilevel analyses of variance were performed (with MLN for Windows). Because of the small number of schools compared to the number of classes sampled, two rather than three levels were discerned in the analyses: a student level and a teacher-class level. Analyses were performed in a number of steps. First, an empty model (with no independent variables) was tested in order to obtain

raw percentages of variance in the attitude scores at the student and class level. In the second step, the interpersonal dimension scores (Influence and Proximity) were entered into the model, in order to see their 'uncorrected' effects on attitude scores. In the third step, student covariates were entered into the model as sets of dummy-variables: grade level, gender, report card grade, language spoken at home and religion. Fourth, the other learning environment variables were entered into the model: Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity. The outcomes of this step provide the 'corrected' effects of the interpersonal variables. In the fifth and last step, both interpersonal dimensions were removed from the model, in order to see what amount of variance was uniquely added by the other learning environment variables. By doing so, it becomes possible to see both the joint and overlapping effects of the interpersonal and the other learning environment variables as well as their unique effects.

Regression coefficients were estimated using the RIGLS method³. We also determined effect sizes, in order to compare the relative importance of variables, as well as percentages of variance explained by all the significant variables combined. In the results section, coefficients of the student characteristics variables are not reported.

6. Results

In this section, we present the outcomes of the analyses according to the steps described in the Analyses section, thereby following the research questions presented earlier. Outcomes of the analyses are presented in Tables 6A to 6C.

In Table 6A, the empty model indicates the amount of variance in attitude scores that is present at the class level (research question 1). As can be seen, roughly 15 percent of the variance is between classes, indicating that attitudes not only differ within Kashmiri classes, but that teachers (and schools) can also affect these attitudes for each of their classes. The empty model indicates also that students enjoy science to a high degree, similar to Table 5.

When teacher Influence and Proximity are entered into the model (IPP-only model; research question 2), it appears that most of the variance at the class level (over 80 percent) disappears. This means that the differences found between classes can be explained to a very large degree by teacher interpersonal

behaviour. Interpersonal behaviour explains over 12 percent of the total variance. Both Influence and Proximity are positively related to students' attitudes. The effect sizes indicate that the effect of teacher Proximity is twice as strong as the effect of teacher Influence.

Table 6A about here

The difference in effect between Influence and Proximity diminishes somewhat but remains considerable when student covariates are entered into the analyses (corrected model; research question 3). As can be seen in Table 6B, covariates explain an additional 15.7 percent of the total variance in student attitudes, which corresponds to almost 25 percent of the variance between students⁴.

However, when other learning environment variables are added to the model (Complete model; research question 4), the differences between Influence and Proximity disappear. Nevertheless, Influence has a small and Proximity has a modest positive effect on students' enjoyment. Table 6B shows that most of the WIHIC scales are not strongly associated with students' attitudes. Only Task Orientation and Equity are statistically significant, both having a positive effect. The effect of Task Orientation is almost as large as that of Influence and Proximity, but the effect of Equity is half that of the other variables mentioned. The learning environment variables explain an additional 0.6 percent of the variance to that of the interpersonal variables.

Table 6B about here

From Table 6C (LER-only model) one can conclude that – if Influence and Proximity are not included in the model - the learning environment variables leave 4.1 percent of the variance unexplained at the class level, meaning that the learning environment variables also explain a vast amount of the differences between classes. This, in turn, means that Influence and Proximity uniquely explain only 1.7 percent of the total variance (corresponding to 11.2 percent of the variance at the class level), that the learning environment variables uniquely explain only 0.6 percent of the total variance (which is 3.9 percent of the variance at the class level), but that the overlapping effect of both types of variables

on students' attitudes is 10.5 percent (69 percent of the variance at the class level). It seems that when considered separately, teacher interpersonal behaviour has a strong effect on students' attitudes, but that much of its effect overlaps with the effects of other variables in the learning environment.

Table 6C about here

7. Discussion

This study was among the first to study the effect of teacher-student interpersonal behaviour on students' science-related attitudes in India (Kashmir). It was found that while the majority of the variance in students' attitudes could be found between students within a class, considerable differences in attitudes could still be detected between classes. This finding corresponds with previous research in the Netherlands (den Brok, 2001; den Brok, et al., 2004) and other countries (den Brok, et al., 2005).

It appeared that both Influence and Proximity had a positive effect on students' attitudes, another finding that is in line with previous work (e.g. den Brok, et al., 2004). The interpersonal variables remained strongly associated with attitudes when student covariates and other learning environment variables were taken into account, even though their effect was shared with the latter group of variables to a large degree. These findings show that a positive teacher-student relationship, in which the teacher is perceived as both in control (highly influential) and cooperative (highly proximate) by students, may be an important factor in creating positive attitudes towards a subject.

Of course, the study also made some unique contributions to the existing knowledge base. First of all, results indicated that while effects of Proximity might be stronger than those of Influence – something that was reported by other researchers as well – this only occurs when teacher interpersonal behaviour is studied separately. As soon as other elements of the learning environment are taken into account Influence and Proximity appear to have a similar effect. This may be an indication that Proximity has both a direct and an indirect effect – via other elements in the learning environment - on students' attitudes.

Second, descriptive analyses indicated that the sample of teachers studied was rated lower on Proximity and higher on Influence than teachers in some other (Western) countries. It may be that cultural differences are responsible for these differences. On the other hand, the results may be tied to the sample involved – no information was available whether the current sample was representative for the larger population in Kashmir or India. Also, the effects might be linked with the use of the Australian QTI (and WIHIC), rather than using instrument versions adapted to local languages and the Kashmiri context. Of course, future research could shed light on these issues, as they were not the focus of the present research.

The outcomes of this study provide further support for a cross-cultural link between teacher interpersonal behaviour and students' science-related attitudes. It seems that, whatever the country of interest may be, teacher Influence and Proximity are always beneficial when one is interesting in improving students' subject-related attitudes. Additionally, this study shows that researchers should always be careful to interpret the nature of any relationship studied, if important covariates or confounding factors are not taken into account. Including such factors may result in associations that are different in strength, direction and magnitude, but it may also point towards more subtle processes at work, such as effects established through or via other elements in the learning environment.

A few words of caution are in order. While the study provided support for an effect of teacher interpersonal behaviour on students' attitudes, the study cannot make any claims regarding the causal nature of this relationship. It seems very likely that positive attitudes may have an effect on teachers' interpersonal behaviour as well. Other types of analyses are needed in future research to provide more insight on this issue. Moreover, the sample was relatively small, which made it impossible to distinguish more than two levels in the analyses. Therefore, any school-related effects could not be established. Previous research has shown that schools may have their own interpersonal pedagogy (e.g. Levy, et al., 2003), and this may in turn lead to school-related effects in students' attitudes.

Finally, it is hoped that this study is the first in a line of learning environment studies to be conducted in India. Because of its geopolitical development and huge diversity, it is an excellent context for research as it is likely to contain much variation, both within a point of time as well as over time. For

such research, instruments are needed that are specifically adapted and translated to the Indian (and Kashmiri) context.

The instruments used in this study may have important practical value for teachers and school administrators in this country, as they can be a powerful tool in professional development or school-based evaluations (den Brok, et al., 2002). If such use is considered, it may be wise to collect teacher perception data as well, and/or to collect data on actual and preferred teaching.

Notes

¹ Homogeneity of each of the eight groups of items was considerable. The internal consistencies (Cronbach's α) at class level are generally above .80. The agreement between the scores of students in a single class met the general requirements for agreement between observer scores. The mean of the internal consistencies was .92 (Cronbach's α ; students' scores in one class were considered as repeated measures). From a generalisability study it was concluded (Wubbels, & Levy, 1993) that the QTI should be administered to at least 10 students in a class for the data to be reliable. The QTI does not need to be administered more than once per year, since interpersonal style remains relatively stable. A minimum of 2 classes should complete the questionnaire for each teacher to achieve a reliable measure of overall style. Factor analyses on class means and LISREL analyses (den Brok, 2001) determined that the two-factor structure did indeed support the 8 scales. Brekelmans (Brekelmans, et al., 1990) demonstrated that both factors explain 80 per cent of the variance on all the scales of the Dutch QTI. Similar results were obtained for the American version (Wubbels, & Levy, 1991).

² To this end the eight scores are represented as vectors in a two dimensional space, each dividing a section of the model of interpersonal behaviour in two and with a length corresponding to the height of the scale score. We then compute the two coordinates of the resultant of these eight vectors. Dimension scores are computed as follows: Influence = $(.92*DC) + (.38*CD) - (.38*CS) - (.92*SC) - (.92*SO) - (.38*OS) + (.38*OD) + (.92*DO)$; Proximity = $(.38*DC) + (.92*CD) + (.92*CS) + (.38*SC) - (.38*SO) - (.92*OS) - (.92*OD) - (.38*DO)$.

³ Standard estimation procedures in multilevel analyses programs, such as Iterative Generalized Least Squares (IGLS), often produce biased estimates of coefficients and variance distribution, especially

when small numbers of units are available at the higher levels (Luyten, & De Jong, 1998). Because of the small number of schools and teachers involved in this study, it was decided to use the Restricted Iterative Generalized Least Squares (RIGLS) method, which is suitable for small numbers of units at the highest levels (Goldstein, 1995).

⁴ Variables that significantly related to students' attitudes were being Christian (negative effect), report card grade (positive effect) and speaking Dogri (negative effect). This means that Christian students were less motivated than students from other religions, that students speaking Dorgi were less motivated than students speaking other languages and that higher report card grades correspond with higher attitudes. None of the other covariates displayed a statistically significant effect.

References

- Aldridge, J. M. and Fraser, B. J. (1997, August). *Examining science classroom environments in a cross-national study*. Proceedings Western Australian Institute for Educational Research Forum, Perth.
- Blackburn, R., & Renwick, S. J. (1996). Rating scales for measuring the interpersonal circle in forensic psychiatric patients. *Psychological Assessment*, 8 (1), 76-84.
- Blumenfeld, P. C & Meece, J. L (1985). Life in classrooms revisited. *Theory into Practice*, 24, 50-56
- Brekelmans, M., Brok, P.den, Tartwijk, J. van, & Wubbels, T. (2005). An interpersonal perspective on teacher behaviour in the classroom. In L. V. Barnes (ed.), *Contemporary Teaching and Teacher Issues* (pp.197-226). New York: Nova Science Publishers.
- Brekelmans, M., Wubbels, Th., & den Brok, P. (2002). Teacher experience and the teacher-student relationship in the classroom environment. In S. C. Goh & M. S. Khine (Eds.), *Studies in educational learning environments: an international perspective* (pp.73-100). Singapore: World Scientific.
- Brekelmans, M., Wubbels, Th. and Créton, H. A. (1990). A study of student perceptions of physics teacher behavior, *Journal of Research in Science Teaching*, 27, 335-350.
- Brok, P. den (2001). *Teaching and student outcomes: a study on teachers thoughts and actions from an interpersonal and a learning activities perspective*. Utrecht: W. C. C..

- Brok, P. den, Brekelmans, M., Levy, J., & Wubbels, T. (2002). Diagnosing and improving the quality of teachers' interpersonal behaviour. *The International Journal of Educational Management*, 16 (4), 176-184.
- Brok, P.den, Brekelmans, M., & Wubbels, T. (2004). Interpersonal teacher behaviour and student outcomes. *School Effectiveness and School Improvement*, 15 (3/4), 407-442.
- Brok, P. den, Fisher, D., Brekelmans, M., Rickards, T., Wubbels, Th., Levy, J., & Waldrup, B. (2003, April). *Students' perceptions of secondary teachers' interpersonal style in six countries: a study on the validity of the Questionnaire on Teacher Interaction*. Paper presented at the annual meeting of the American Educational Research Association, Chicago. ERIC document: ED475164.
- Brok, P. den, Fisher, D., & Scott, R. (2005). The importance of teacher interpersonal behaviour for student attitudes in Brunei primary sciences classes. *International Journal of Science Education*, 27 (3), 765-779.
- Brok, P. den, Fisher, D., Wubbels, T., Brekelmans, M., & Rickards, T. (in press). Secondary teachers' interpersonal behaviour in Singapore, Brunei and Australia: a cross-national comparison. Accepted for publication in *Asia-Pacific Journal of Education*.
- Brown, R. (1965). *Social psychology*. London: Collier-McMillan.
- Chionh Y. H & Fraser, B. J. (1998, April). *Validation and use of the "What Is Happening In This Class" Questionnaire in Singapore*. Paper presented at Annual Meeting of the American Educational Research Association, San Diego.
- Doyle, W. (1986). Classroom organization and management. In M. C. Wittrock (Ed.), *Handbook of research on teaching (third edition)* (pp. 392-431). New York: Macmillan.
- Dunkin M. & Biddle, B. (1974). *The study of teaching*. New York: Holt, Rinehart & Winston.
- Evans, H. (1998). *A study on students' cultural background and teacher-student interpersonal behaviour in Secondary Science classrooms in Australia*. Unpublished doctoral dissertation. Perth: Curtin University of Technology.

- Fabrigar, L. R., Visser, P. S., & Browne, M. W. (1997). Conceptual and methodological issues in testing the circumplex structure of data in personality and social psychology. *Personality and Social Psychology Review, 1*, 184-203.
- Fisher, D. L., Fraser, B. J. and Wubbels, Th. (1992, May) *Teacher communication style and school environment*, Paper presented at the European Conference on Educational Research, Enschede.
- Fisher, D. L., Henderson, D., & Fraser, B. J. (1995). Interpersonal behaviour in senior high school biology classes. *Research in Science Education, 25*, 125-133.
- Fisher, D. L., Rickards, T. W., Goh, S. C., & Wong, A. F. L. (1997). Perceptions of interpersonal teacher behaviour in secondary science classrooms in Singapore and Australia. *Journal of Applied Research in Education, 1*, 2-13.
- Foa, U.G. (1961). Convergence in the analysis of the structure of interpersonal behavior. *Psychological Review, 68*, 341-353.
- Fraser, B. J. & Fisher, D. L. (1982). Effects of classroom openness on science students' achievement and attitudes. *Research in Science and Technological Education, 1*, 41-51.
- Fraser, B. J., Fisher, D. L., & McRobbie, C. J. (1996, April). *Development, validation and use of personal and class forms of a new classroom environment instrument*. Paper presented at the annual meeting of the American Educational Research Association, New York.
- Gaines, S. O., Panter, A. T., Lyde, M. D., Steers, W. N., Rusbult, C. E., Cox, C. L., & Wexler, M. O. (1997). Evaluating the circumplexity of interpersonal traits and the manifestation of interpersonal traits in interpersonal trust. *Journal of Personality and Social Psychology, 73*, 610-623.
- Goh, S. C., & Fraser, B. J. (1998). Teacher interpersonal behaviour, classroom environment and student outcomes in primary mathematics classes in Singapore. *Learning Environments Research, 1*, 199-229.
- Goldstein, H. (1995). *Multilevel statistical models*. London: Edward Arnold.
- Gurtman, M. B., & Pincus, A. L. (2000). Interpersonal adjective scales: confirmation of circumplex structure from multiple perspectives. *Personality and Social Psychology Bulletin, 26*, 374-384.

- Henderson, D. G. (1995). *A study of the classroom and laboratory environments and student attitude and achievement in senior Secondary Biology classes*. Unpublished doctoral dissertation. Perth: Curtin University of Technology.
- Kim, H., Fisher, D., & Fraser, B. (2000). Classroom environment and teacher interpersonal behaviour in secondary science classes in Korea. *Evaluation and Research in Education*, 14, 3-22.
- Kuhlemeier, H., Van den Bergh, H., & Teunisse, F. (1990). Internal structure and construct validity of the Attitude Scales towards Mathematics and English [In Dutch]. *Tijdschrift voor Onderwijsresearch*, 15, 110-122.
- Leary, T. (1957). *An interpersonal diagnosis of personality*. New York: Ronald Press Company.
- Levy, J., den Brok, P., Wubbels, T., & Brekelmans, M. (2003). Students' perceptions of the interpersonal aspect of the learning environment. *Learning Environments Research*, 6 (1), 5-36.
- Lonner, W. J. (1980). The search for psychological universals. In H. C. Triandis & W. W. Lambert (Eds.). *Handbook of cross cultural psychology*. (vol.1) pp. 143-204. Boston: Allyn and Bacon.
- Luyten, H., & De Jong, R. (1998). Parallel classes: differences and similarities. Teacher effects and school effects in secondary schools. *School Effectiveness and School Improvement*, 9, (4), 437-473.
- Rawnsley, D.G. (1997). *Associations between classroom learning environments, teacher interpersonal behaviour and student outcomes in secondary Mathematics classrooms*. Unpublished doctoral dissertation. Perth: Curtin University of Technology.
- Riah, H., & Fraser, B. J. (1998, April). *The learning environment of high school chemistry classes*. Paper presented at the annual meeting of the American Educational Research Association, San Diego.
- Scott, R. (2003). *Students' perceptions of science teachers' behaviour in Brunei Darussalam*. Unpublished doctoral dissertation. Perth: Curtin University of Technology.
- Slater, P. E. (1962). Parental behaviour and the personality of the child. *Journal of Genetical Psychology*, 101, 53-68.

- Strack, S. (1996). Special series: Interpersonal theory and the interpersonal circumplex: Timothy Leary's Legacy. *Journal of Personality Assessment*, 66, 211-307.
- Watzlawick, P., Beavin, J. H. and Jackson, D. (1967). *The pragmatics of human communication*. New York, Norton.
- Wubbels, Th. (1993). *Teacher-student relationships in science and mathematics classes* (What research says to the science and mathematics teacher, volume 11). Perth: Science and Mathematics Education Centre, Curtin University of Technology.
- Wubbels, Th., Brekelmans, M., van Tartwijk, J., & Admiraal, W. (1997). Interpersonal relationships between teachers and students in the classroom. In H. C. Waxman, & H. J. Walberg (eds.), *New directions for teaching practice and research* (pp.151-170). Berkely: McCutchan Publishing Company.
- Wubbels, Th., Créton, H. A., & Hooymayers, H. P. (1985). *Discipline problems of beginning teachers, interactional teacher behaviour mapped out*. Abstracted in *Resources in Education*, 20, 12, p. 153, ERIC document: 260040.
- Wubbels, Th., & Levy, J. (1991) A comparison of interpersonal behavior of Dutch and American teachers. *International Journal of Intercultural Relationships*, 15, 1-18.
- Wubbels, Th., & Levy, J. (1993). *Do you know what you look like? Interpersonal relationships in education*. London: The Falmer Press.

Appendix A

Items and scales of the Questionnaire on Teacher Interaction (male version).

Leadership

1. This teacher talks enthusiastically about his subject.
5. This teacher explains things clearly.
9. This teacher holds our attention.
13. This teacher knows everything that goes on in the classroom.
17. This teacher is a good leader.
21. This teacher acts confidently.

Helpful/friendly

25. This teacher helps us with our work.
29. This teacher is friendly.
33. This teacher is someone we can depend on.
37. This teacher has a sense of humour.
41. This teacher can take a joke.
45. This teacher's class is pleasant.

Understanding

2. This teacher trusts us.
6. If we don't agree with this teacher, we can talk about it.
10. This teacher is willing to explain things again.
14. If we have something to say, this teacher will listen.
18. This teacher realizes when we don't understand.
22. This teacher is patient.

Student freedom

26. We can decide some things in this teacher's class.
30. We can influence this teacher.
34. This teacher lets us fool around in class.
38. This teacher lets us get away with a lot in class.
42. This teacher gives us a lot of free time in class.
46. This teacher is lenient.

Uncertain

3. This teacher seems uncertain.
7. This teacher is hesitant.
11. This teacher acts as if he doesn't know what to do.
15. This teacher lets us boss him around.
19. This teacher is not sure what to do when we fool around.
23. It is easy to make a fool out of this teacher.

Dissatisfied

27. This teacher thinks that we cheat.
31. This teacher thinks that we don't know anything.
35. This teacher puts us down.
39. This teacher thinks that we can't do things well.
43. This teacher seems dissatisfied.
47. This teacher is suspicious.

Admonishing

4. This teacher gets angry unexpectedly.
8. This teacher gets angry quickly.

12. This teacher is too quick to correct us when we break a rule.
16. This teacher is impatient.
20. It is easy to pick a fight with this teacher.
24. This teacher is sarcastic.

Strict

28. This teacher is strict.
32. We have to be silent in this teacher's class.
36. This teacher's tests are hard.
40. This teacher's standards are very high.
44. This teacher is severe when marking papers.
48. We are afraid of this teacher.

Table 1

Typical Items for the Questionnaire on Teacher Interaction (QTI).

Scale	Typical item
DC Leadership	This teacher is a good leader
CD Helpful/friendly	This teacher is someone we can depend on
CS Understanding	If we have something to say this teacher will listen
SC Student responsibility/freedom	This teacher gives us a lot of free time in class
SO Uncertain	This teacher seems uncertain
OS Dissatisfied	This teacher is suspicious
OD Admonishing	This teacher gets angry
DO Strict	This teacher is strict

Table 2

Reliability (Alpha at class level) and percentage of variance of the QTI scales.

Scale	N _{items}	Alpha	Percentage of variance (class level)
DC – Leadership	6	.85	12
CD – Helpful/Friendly	5	.75	13
CS – Understanding	6	.84	15
SC – Student Responsibility	5	.70	13
SO – Uncertain	6	.86	26
OS – Dissatisfied	6	.89	19
OD – Admonishing	6	.84	19
DO – Strict	6	.79	16

Table 3

Scale descriptions for each scale in the WIHIC Questionnaire.

WIHIC scale	Description The extent to which...
Student cohesiveness	...students are friendly and supportive of each other.
Teacher support	... the teacher helps, befriends, and is interested in students.
Involvement	... students have attentive interest, participate in class and are involved with other students in assessing the viability of new ideas.
Investigation	..there is emphasis on the skills and of inquiry and their use in problem-solving and investigation.
Task orientation	... it is important to complete planned activities and stay on the subject matter.
Cooperation	... students cooperate with each other during activities.
Equity	... the teacher treats students equally, including distributing praise, question distribution and opportunities to be included in discussions.

Table 4

Reliability (Alpha at class level) and percentage of variance at the class level of WIHIC scales.

WIHIC-Scale	N _{items}	Alpha	Percentage of variance (class level)
Student Cohesiveness	7	.74	10
Teacher Support	8	.84	14
Involvement	8	.87	13
Investigation	7	.84	10
Task Orientation	8	.85	11
Cooperation	8	.80	08
Equity	8	.90	12

Table 5

Descriptive statistics of main variables of the study.

Variable	Min	Max	Mean	St.dev
DS – Influence	.20	.86	.51	.16
CO – Proximity	.07	1.04	.55	.25
Cohesion	.71	.92	.81	.04
Support	.50	.81	.63	.07
Involvement	.45	.76	.61	.07
Investigation	.48	.81	.63	.07
Task Orientation	.72	.92	.81	.05
Cooperation	.65	.83	.74	.05
Equity	.59	.87	.76	.07
Science Attitude	.00	1.00	.79	.17

Note: all variables can be scored between 0 and 1, except DS and CO, which can range between –3 and +3.

Table 6A

Results of multilevel analyses on Science Attitude scores.

	Empty model		IPP-only model	
	Coefficient (st. error)	Effect size	Coefficient (st. error)	Effect size
Constant	.79 (.01)		.69 (.01)	
DS – Influence			.07 (.01)	.07
CO – Proximity			.10 (.01)	.15
Student Cohesiveness				
Teacher Support				
Involvement				
Investigation				
Task Orientation				
Cooperation				
Equity				
Variance				
- explained	0.0 %		12.1 %	
- class	15.2 %		3.0 %	
- student	84.8 %		84.9 %	
-2*Log likelihood	-723.266		-856.629	

Table 6B

Results of multilevel analyses on Science Attitude scores (continued).

	Corrected model		Complete model	
	Coefficient (st. error)	Effect size	Coefficient (st. error)	Effect size
Constant	.65 (.06)		.39 (.07)	
DS – Influence	.08 (.01)	.08	.06 (.01)	.06
CO – Proximity	.09 (.01)	.13	.05 (.01)	.07
Student Cohesiveness			-.00 (.04) *	.00
Teacher Support			.04 (.03) *	.02
Involvement			.05 (.04) *	.02
Investigation			.03 (.03) *	.01
Task Orientation			.21 (.04)	.06
Cooperation			.02 (.03) *	.00
Equity			.07 (.03)	.03
Variance				
- explained	27.3 %		27.9 %	
- class	3.0 %		2.4 %	
- student	69.7 %		69.7 %	
-2*Log likelihood	-908.887		-999.747	

Note: *=non-significant (at .05).

Table 6C

Results of multilevel analyses on Science Attitude scores (continued).

	LER-only model	
	Coefficient (st. error)	Effect size
Constant	.36 (.07)	
DS – Influence		
CO – Proximity		
Student Cohesiveness	-.01 (.05) *	.00
Teacher Support	.06 (.03)	.07
Involvement	.03 (.04) *	.04
Investigation	.04 (.03) *	.05
Task Orientation	.25 (.04)	.12
Cooperation	.03 (.03) *	.03
Equity	.12 (.04)	.08
Variance		
- explained	26.2 %	
- class	4.1 %	
- student	69.7 %	
-2*Log likelihood	-962.197	

Note: *=non-significant (at .05).

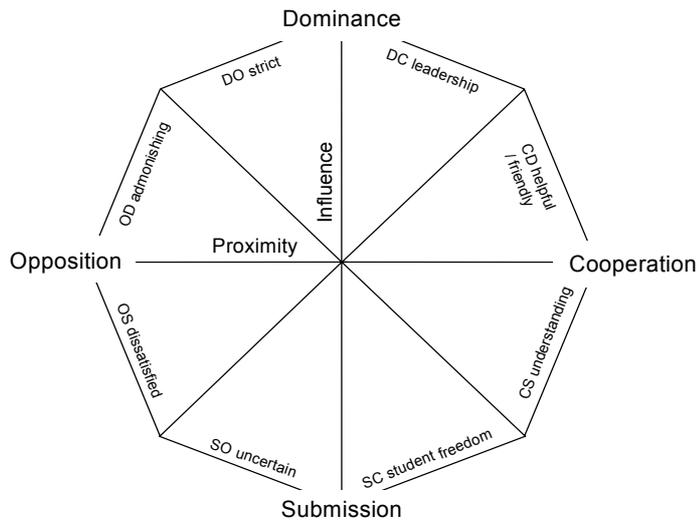


Figure 1. *The Model for Interpersonal Teacher Behaviour (MITB).*