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Sustainability of Teacher Expectation Bias Effects on Long-Term Student Performance

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In this article, we address the relationship between teacher expectation bias and student characteristics, its effect on long-term student performance, and the development of this effect over time. *Expectation bias* was defined as the difference between observed and predicted teacher expectation. These predicted expectations were estimated from a multilevel model in which teacher expectations of students' future performance in secondary education were regressed on students' prior achievement, IQ, and achievement motivation. Multilevel analyses were performed on a data set of about 11,000 students who entered secondary school in 1999 and who were monitored for 5 years. We found relationships between teacher expectation bias and student characteristics as well as a clear effect of expectation bias on long-term student performance. Teacher expectation bias partly mediated the effects of student characteristics on students' performance. Moreover, its effect was moderated by some of these characteristics. Mediation and moderation effects were the strongest for parents' aspirations. The effects of teacher expectation bias dissipated partly during the first 2 years but afterwards remained stable over time.

Keywords: teacher expectation bias, self-fulfilling prophecy, student performance, student characteristics

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The effect of teacher expectations on student achievement was first studied by Rosenthal and Jacobson. In 1968 they published the study *Pygmalion in the Classroom*, in which they concluded that students' performance was affected by false-positive teacher expectations. This effect was called the *self-fulfilling prophecy effect*: Expectations about future performance, although inaccurate, tend to come true. Although the methodology of the study received much criticism (Brophy, 1983; Good, 1987; Jussim & Harber, 2005), the study led to an increase in research on the subject of teacher expectations. This resulted in a vast body of research literature, which mainly examined the extent to which biased teacher expectations function as a self-fulfilling prophecy.

In reviews of studies into the effect of teacher expectations, in which the expectations had a natural underpinning, self-fulfilling prophecy effects for about 5%–10% of the students were reported. On average, self-fulfilling effects of teacher expectations ranged from $r = .1$ to $r = 0.2$ (Brophy, 1983; Jussim & Harber, 2005), which seem to be quite small. Teacher expectations most often predicted achievement because the expectations were accurate, but only inaccurate and thus biased expectations can cause self-fulfilling prophecy effects (Jussim, 1989). Brophy (1983) found that teacher expectations do not always automatically function as self-fulfilling prophecies. He suggested that student characteristics such as socioeconomic status, ethnicity, age, and motivation in-

fluence the susceptibility to biased teacher expectations (Brophy, 1983; Good, 1987; Weinstein, 2002). Therefore, for some groups of students the expectation bias effects might be larger than for others. Research literature about possible factors that moderate the effects of teacher expectation bias on achievement is rare. Jussim, Eccles, and Madon (1996) found that self-fulfilling prophecy effects were stronger for students with a lower socioeconomic status and for African American students than for students with a higher socioeconomic status and for Caucasian students. Madon, Jussim, and Eccles (1997) reported stronger self-fulfilling prophecy effects for low-achieving students than for high-achieving students. Controlling for social class, gender, and ethnicity did not change these moderator effects. They also found that positive expectation bias increased later achievement more than negative bias decreased achievement. However, when the authors took into account the moderation of prior achievement, this difference was no longer significant. McKnown and Weinstein (2002) conducted a study to find out whether gender and ethnicity influence students' responses to teacher expectations. They found that members of stigmatized groups (African American children and girls with regard to math) were more susceptible to underestimates of ability and were less likely to benefit from overestimates than were members of nonstigmatized groups (Caucasian children and boys with regard to math). This effect became stronger as students got older. Unfortunately, the study did not measure the effects of socioeconomic status.

Despite all of these studies, there is still no general consensus about the precise self-fulfilling effect of biased teacher expectations on achievement and long-term student performance. Madon et al. (1997) and Jussim and Harber (2005) stated that a complicating factor for the analysis of teacher expectation effects in naturalistic situations is that one never knows the exact accuracy of

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the measured teacher expectations about future student achievement. Or, in other words, one never knows exactly whether teacher expectations are indeed biased. Even when one takes into account many indicators of prior student achievement and predictors of future achievement to determine the accuracy of the expectation, an important factor that might explain the teacher expectations could still be neglected.

Recently, Jussim and Harber (2005) reviewed the literature on teacher expectations and self-fulfilling prophecies to get a broad and up-to-date overview of this area of research. Based on the conclusions of this review, they identified four topics that need more research. First, they proposed further exploration of the relationship between teacher expectation bias and the characteristics of the students. Second, they concluded that little is known about whether self-fulfilling prophecies have mainly a positive or a negative influence on achievement. They considered more knowledge about the self-fulfilling prophecy effect as an important condition for gaining insight into the role of teacher expectation bias effects in creating social problems. Third, they stated that more research is needed to find out which student characteristics moderate self-fulfilling prophecies, because there is evidence suggesting that teacher expectation bias is more powerful for some students than for others. And finally, they proposed to study the accumulation of biased teacher expectation effects over time. Only a few researchers have examined this issue, all demonstrating that expectation bias effects dissipate rather than accumulate over time. Smith, Jussim, and Eccles (1999), for example, showed that teacher expectation bias effects, occurring in the sixth grade, dissipated partly but endured even up to the 12th grade. Because of this small number of studies, Jussim and Harber argued that more research is needed before it is known for certain that expectation bias effects do not accumulate.

In this study, we have elaborated on Jussim and Harber's (2005) suggestions for further research in the Dutch context. The educational system in the Netherlands provides a perfect natural situation for studying teacher expectations and teacher expectation bias effects.

Teacher Expectation Bias in Dutch Education

The Dutch system of secondary education is highly tracked. There are five main tracks; the lowest three tracks take 4 years, the middle track takes 5 years, and the highest track requires 6 years and gives access to university. In the first years of secondary school, students are often placed in classes consisting of a combination of two or sometimes three tracks. So, definite track placement often does not take place up until the 2nd or 3rd year. After that, upward and downward change of tracks is still possible as well as transfer to a higher track after having completed a lower one. Eventually, all students have the chance to go on to university, but a student who is initially placed in a lower track needs more years of education to reach this point than does a student who is placed in the highest track. In practice, most students who pass for a lower track leave secondary school and continue in a senior vocational course.

At the end of primary school (age 12), students are recommended by their teacher for the secondary school track that would be the most suitable. This recommendation is explicitly communicated to the student and his or her parents. The track recommen-

dation reflects the teacher's opinion of the student's expected future achievement level and thus can be considered as a good indicator of teacher expectations. Students and their families are, however, not obliged to follow the recommended secondary school track.

Only a few Dutch studies pertaining to teachers' recommendations have focused explicitly on teacher expectation bias. In many studies, however, it has been implicitly the subject of analysis. In these studies, it is assumed that a discrepancy between a student's actual achievement level and the teacher's track recommendation implies that the teacher has inaccurate or biased expectations. In most of these studies, multiple regression analysis was applied to estimate to which degree teacher recommendations were predicted by other student (background) characteristics, over and above student achievement (de Boer, van der Werf, Bosker, & Jansen, 2006; Driessen, 1991; Luyten & Bosker, 2004; Mulder, 1993b; van der Hoeven-van Doornum, 1994; Uerz & Mulder, 1999). The outcomes of these analyses resulted in a list of student characteristics that were, on top of achievement, related to the recommendations, implying that recommendations were biased. It was found that recommendations were positively biased by students' socioeconomic status, their achievement motivation, and their parents' educational aspiration level, as well as by gender, ethnic background, and grade repetition in primary school (bias was in favor of girls, ethnic minorities, and students who had not repeated a grade).

Dutch research on the effects of inaccurate recommendations, and thus biased expectations, on future student performance has hardly been conducted. Only two studies on this subject were found, and they showed that positively biased expectations for ethnic minority students had no negative influence on their performance level in the 2nd year of secondary school. The progress of these students was equal to the progress of other students (Koeslag & Dronkers, 1994; Mulder, 1993a). From this, one can conclude that positively biased expectations have a positive effect on future performance level, because positively biased recommended students started in a higher track of secondary education and did not lose this advantage during the 1st years.

The Current Study

In this study, we focused on the four topics that Jussim and Harber (2005) identified as needing more research, and we did so within the Dutch educational context. Teachers' secondary education track recommendations were, just like in the previous Dutch studies, taken as an indicator of teacher expectations. However, unlike these studies, we explicitly established bias in teacher expectation by calculating the difference between observed and predicted teacher expectation. We estimated these predicted expectations from a multilevel model in which teacher expectations were regressed on prior achievement, IQ, and achievement motivation. These three variables were the only relevant and legitimate variables on which the expectations should vary. We assume that this results in a more accurate measurement of the bias in expectations than when using only prior achievement. In contrast to most other (non-Dutch) studies, measurement of teacher expectations took place at the end of the school year, instead of earlier in the year. The advantage of measuring it at the end of the year is that teachers have had at least 1 year to get to know their students.

Raudenbush (1984) has demonstrated that this results in more accurate and probably more sustainable expectations of students' future performance. Addressing the first topic of research mentioned by Jussim and Harber, we examined whether teacher expectation bias relates to student characteristics like achievement level, IQ, socioeconomic status, gender, ethnicity, achievement motivation, parents' aspirations, and grade repetition in primary school.

The main aims of the study, however, pertained to the other three topics outlined by Jussim and Harber (2005). First, we studied the influence of teacher expectation bias on students' performance level in the 5th year of secondary school. We examined whether long-term performance levels depend on the extent to which the expectations were biased. Earlier studies on teacher expectation bias effects often only distinguished between too low or too high expectations, but it seems reasonable that the extent to which the expectations were too low or too high would also matter.

To make sure that the teacher expectation bias effects on student performance were not affected by other factors, we took student characteristics into account. Earlier studies showed that student performance varied according to students' socioeconomic status, gender, ethnicity, achievement motivation, and parents' aspirations (Dekkers, Bosker, & Driessen, 2000; Goldenberg, Gallimore, Reese, & Garnier, 2001; Koeslag & Dronkers, 1994; Kuyper, van der Werf, & Lubbers, 2000; Luyten, 2004; Sammons, 1995; van der Hoeven-van Doornum, 1994; van der Velden, 1994; van der Werf, Kuyper, & Lubbers, 1999; van der Werf, Lubbers, & Kuyper, 2002). These student characteristics are quite similar to the characteristics that also appeared to be related to teacher expectation bias. However, in prior research, hardly the joint effects of teacher expectation bias and student characteristics on student performance were analyzed. Therefore, it is unclear whether teacher expectation bias mediates the effects of student characteristics on student performance, whether both have an independent contribution, or whether they interact with each other. In this study, we analyzed the effects of both teacher expectation bias and student characteristics on student performance together, by which we addressed the mediation as well as the moderation issue.

Finally, the longitudinal design of our study made it possible to address Jussim and Harber's (2005) question about the accumulation of teacher expectation bias effects over time. For each successive year after leaving primary school, we tested the effect of teacher expectation bias on student performance, and we compared the effects over years to show whether they accumulate, dissipate, or remain stable over time.

Hypothesis

The secondary education track recommended was used as an indicator of teacher expectation. Although students were no longer being taught by their primary school teacher (who gave the recommendation), we hypothesized that significant effects of teacher expectation bias on secondary school performance would be expected. This hypothesis was generated by both theory as well as by prior research into recommendation and track placement in secondary school. We reasoned that two mechanisms might explain why teacher expectation bias could function as a self-fulfilling prophecy. The first one is derived from the feedback intervention theory of Kluger and Denisi (1996). Since teachers explicitly

report their expectation to students, this can be considered as feedback on students' performance. Feedback intervention theory suggests that feedback on task performance can affect students' task motivation, task learning, and metatask processes. A discrepancy between the feedback and the achievement standard induces behavior to dissolve the discrepancy. Students can dissolve this discrepancy by changing the standard, by attaining the standard, by abandoning the standard, or by rejecting the feedback. Kluger and Denisi noted that students typically choose for attainment of the standard. Students for whom the feedback exceeds the standard reduce their effort, whereas students for whom the feedback is negative exert more effort. Students for whom the teacher expectation bias is positive probably start secondary school in a higher track than is suitable according to their actual achievement level. As a consequence, it is likely that, in the beginning, feedback (e.g., grades) is negative because of the high standard. As a reaction, students exert more effort to attain the standard. Following the same line of reasoning, we expected that negative teacher expectation bias would induce positive feedback (higher grades because of the lower standard), which would result in less effort and thus lower performance.

The second possible mechanism is that secondary school teachers give students less or more opportunity to learn, depending on whether the teachers have negatively or positively biased expectations of the students, respectively. In the Dutch situation, students are often placed in the track recommended by the primary school teacher. The correlation between recommended track and track placement in the 1st year of secondary school is .90 (Kuyper & van der Werf, 2003). A negatively biased expectation therefore results in placement in a lower and thus slower track. As time passes by, students will encounter difficulties in catching up to the curriculum of the higher track. A positively biased expectation often results in placement in a higher and thus faster track, providing more learning opportunities for students. Thus, we reasoned that even when secondary school teachers do not adopt the biased expectation of the primary school teacher, the expectation of the latter will influence secondary school performance level. This hypothesis is in line with other research (Rubie-Davies, Hattie, & Hamilton, 2006; Smith et al., 1999; Weinstein, 2002). The results of these studies suggest that the detrimental learning opportunities for students for whom teacher expectation is negatively biased are caused by teachers providing a less challenging curriculum to these students. Following the same line of reasoning, we predicted that the favorable learning opportunities of students for whom teacher expectation is positively biased will be caused by a more challenging curriculum. Curriculum differences arise, for example, from ability-based grouping, from asking questions of differential difficulty level, or from differential quality of responses to students' questions. We hypothesized that this differential behavior of the teacher also might influence students' self-image and motivation, which in turn influence student performance.

Method

Data

The subjects were 11,040 students at 112 schools who were monitored for 5 consecutive years after entry into secondary education and for whom we have information both on the criterion and

the predictor variables and the covariates. Data collection started at the moment of secondary school entry in 1999, when the students were about 12 years old. Schools were approached to give background information about the students. Students and parents were both asked to fill in a questionnaire. Students' achievement level at the end of primary school was assessed with a test. Students' IQ was assessed in the 2nd year of secondary school. Every year, information about students' grade and school track was collected. We used this information to define students' educational performance. A demographical sketch of the participants is reported in Table 1, immediately after the description of the variables. The original two-stage sample involved 126 secondary schools and 19,391 students. Further below, we address the issue of potential attrition bias.

Variables

Of focal interest in this study were the criterion variable *student educational performance* and the predictor variable *bias in teacher expectation*. We used teacher expectation, prior achievement, IQ, and achievement motivation to calculate teacher expectation bias. Prior achievement and IQ also functioned as covariates in the analyses of student performance. The other student characteristic variables were socioeconomic status, gender, ethnicity, parents' aspirations, and grade repetition in primary school. These student characteristic variables were used for the prediction of teacher expectation bias and for the analyses of possible mediating and moderating effects of teacher expectation bias on student performance. The variables and their instrumentation are discussed below.

Student performance. The Dutch secondary education system is tracked. There are five tracks, of which the preuniversity track (the highest track) is the only one that directly prepares for university education. The duration of the tracks varies between 4 (the three lowest tracks) and 6 years (the highest track). Intermediate upward or downward mobility between the tracks is possible, as students can change tracks depending of their grades. Grade repetition within tracks is also possible. After completion of a certain track, students can continue at the same level just completed, less one year, in the higher track (e.g., students who completed the higher general secondary education track, which has 5 years, can continue in the 5th year of the preuniversity track,

which has 6 years). This feature of the education system allows for mapping the grade and the track the student is in on a so-called education ladder score (Bosker & van der Velden, 1989). The scores on this ladder range from 1 to 12. Completion of the highest track is valued at 12 points and starting secondary education at the lowest track is valued at 2 points (1 point is for starting special needs education). Thus, a high score reflects a high performance level, and a low score reflects a low performance level. The score on the education ladder increases by 1 point when a student proceeds to the next year or when he or she moves one track higher but stays in the same grade. A student's score on the education ladder is obtained by subtracting the number of years that a student needs to go to get to the top (i.e., direct access to university education) from the maximum score of 12 points. For example, a student's score in the 6th year and thus final grade of the highest track is 11, a student's score in the 5th year is 10, a student's score in the 5th year of one track lower is 9, and so on.

Teacher expectation bias. Strictly speaking, in a meritocratic school system students' prior achievement should be the only factor to influence future achievement. More broadly defined, however, students' talent and effort are also legitimate variables on which future achievement varies (in contrast to other student characteristics such as socioeconomic status, gender, and ethnicity, which might influence future achievement too, but this is in violation with the ideal of equal opportunities). We adopted the broader interpretation to define the degree of accuracy of teacher expectations of students' future achievement in order to reduce the measurement error as much as possible. By doing this, we expected that the chance of overestimation of the bias should be the smallest. Therefore, we used indicators of students' talent, effort, and achievement level (see below for a description of these variables) to calculate the bias in teacher expectations of future achievement. Although measures of students' IQ and achievement motivation are not usually available, primary school teachers use their impression of students' talent and effort to guide them when defining the secondary school recommendations. Teacher expectation bias was defined as the difference between the observed teacher expectation (see below for a description) and the expectation that one would predict on the basis of students' talent, effort, and achievement. These predicted expectations were estimated from a model in which the observed teacher expectations of future performance in secondary

Table 1
Distributional Characteristics

Characteristic	Min.	Max.	<i>M</i>	<i>SD</i>	%	Z score			
						Min.	Max.	<i>M</i>	<i>SD</i>
Student performance Year 5	4.00	11.00	8.23	1.16					
Prior achievement	503.00	550.00	536.33	8.50		−3.92	1.52	0.00	1.00
IQ	64.00	145.00	104.35	12.68		−3.18	3.21	0.00	1.00
Teacher expectation bias	−2.32	2.48	0.00	0.58					
Socioeconomic status	2.00	7.00	4.11	1.08		−1.95	2.68	0.00	1.00
Gender (girl)					51.81				
Ethnicity (minority)					14.07				
Achievement motivation	1.22	4.00	2.86	0.45		−3.66	2.55	0.00	1.00
Parents' aspirations	1.00	6.00	4.34	1.07		−3.12	1.55	0.00	1.00
Grade repetition (yes)					16.88				

education were regressed on students' prior achievement, IQ, and achievement motivation. Because of the two-stage sample, we applied multilevel regression modeling (we refer to the Data Analysis section for more details). The operationalization of the variables in the multilevel regression model is specified below.

Teacher expectations. After completing primary education, students are given a recommendation to continue their education in a certain track in the secondary system. This recommendation is what a primary school teacher expects to be a suitable track for the student, one that he or she can complete successfully. This recommendation can also be mapped on the education ladder. Receiving a recommendation to continue secondary education in the lowest track, for instance, is valued at 2 points and a recommendation for the highest track is valued at 6 points. We therefore defined teacher expectations for a student as the education ladder score corresponding to this recommendation.

Prior achievement. We assessed students' prior achievement at the end of primary school by administering the Final School Leaving Test. This test was developed by the Dutch National Institute for Educational Measurement, which is the Dutch equivalent of the Educational Testing Service in the United States. The test has been designed to provide teachers and students an objective measure of students' achievement level, and to support teachers' recommendations and students' choices for secondary school track types. The test consists of 200 multiple-choice items, divided over three subtests: Dutch Language, Arithmetic, and Study Skills. Test scores ranged from 501 to 550. The reliability of the test ($KR20$) was .95.

IQ. We assessed students' IQ with the NIO test (Dutch intelligence test for level of education), consisting of 150 items (van Dijk & Tellegen, 2004). This test was designed to be administered in a group format. The assessment took place in the 2nd year of secondary school. Unfortunately, students' IQ was not measured at the end of primary school, but analyses showed that students' score on this test was quite stable over time (.88 correlation for scores at the end of primary school and the 3rd year of secondary school). The NIO measures three factors of intelligence: a verbal, arithmetic, and spatial component. The test was multiple choice, with a minimum of four and a maximum of six answer alternatives per item. The average IQ score was 100, and the standard deviation was 15. Van Dijk and Tellegen (2004) reported a reliability of the test with a Cronbach's alpha of .95. As an indication of validity, they reported a strong relation between secondary school track and the test score ($\eta = .79$).

Achievement motivation. We assessed students' achievement motivation with nine multiple-choice items, which were included in the student questionnaire taken in the first year of secondary school. Students were, for example, asked if they worked hard for a test, if it was important to them to receive high grades, and if they kept trying to finish difficult tasks or gave up easily. Each item had to be answered on a 4-point scale, ranging from 1 (*does not apply at all*) to 4 (*applies very much*). The nine items together produced a reliable scale, with a Cronbach's alpha of .74. The student's score for achievement motivation was the mean score on the nine items. The scores ranged from 1 (*low*) to 4 (*high*). With regard to predictive validity, prior research showed that the scale was significantly related to future performance (de Boer, Bosker, & van der Werf, 2009). Although the mean level of students' achievement motivation may increase in the beginning of secondary school compared with students' achievement motivation at the end of primary school, we assumed that the indi-

vidual differences in achievement motivation between students would not change much over time.

Other student characteristics. The characteristics were as follows.

Socioeconomic status. In the parent questionnaire, both parents were asked about their educational level. It was an open question, which probably reduced the chance of false answers in comparison with a multiple-choice question. The highest educational level obtained by one of the parents was used as an indicator of the socioeconomic status of the student. The values on the variable ranged from 1 (lowest level, primary school only) to 7 (highest level, master's degree).

Gender. Boys were coded as 0 (reference category) and girls were coded as 1.

Ethnicity. Information about the ethnic origin of students was gathered by asking the parents in which country they were born. Students' ethnicity was operationalized as a dichotomous variable with the categories indigenous (coded as 0) and minority (coded as 1). Only if both parents and the student were born in the Netherlands was the student considered to be indigenous; in all other cases, the student was considered to be a minority student.

Parents' aspirations. In the parent questionnaire, a single item was included that asked parents to rate on a scale from 1 (*lowest secondary school track with extra student support*) to 6 (*highest secondary school track or university*) what minimum level of education they wanted their child to attain. When parents answered *no opinion*, which happened in 5.8% of the cases, the education track, recommended by the primary school teacher, was used as substitute. If this information was missing, the answer was scored as missing. Prior research showed that this variable was significantly related to future student performance (de Boer et al., 2009).

Grade repetition in primary school. This variable had two categories, namely the reference category that consisted of students who never repeated a grade and the category of students who repeated at least one grade in primary school. Information about this variable was gathered in two ways. The first information source was the parent questionnaire. Parents were asked if their child had ever repeated a grade in primary school. The second one was students' age. Students whose age indicated that they had repeated a grade but whose parents did not report this fact were also coded as grade repeaters.

The distributional characteristics of the variables are presented in Table 1. Since we used the standardized scores of the predictor variables in the multilevel analyses, these scores are also presented. For ease of interpretation, we did not standardize the criterion variables, and logically categorical variables were not standardized either. More detailed information about the variable teacher expectation bias is given in the Results section.

Attrition. Students of whom we lost track (e.g., due to changing schools or leaving secondary school without a diploma, together totaling 3,104 students) and the 5,247 students with one or more missing values on the variables mentioned were not included in the analyses. Since many (7,040) of the 19,391 cases had missing values on a dependent variable or had missing test scores for both prior achievement and IQ, imputation of missing values of the other student characteristics would not result in many more cases. Comparing the information of students who were involved in the analysis with that of students who were left out revealed some attrition bias. The average score on the achievement test taken at the end of primary school and

the average score on the IQ test was higher for the students included in the analysis (respectively, 3.16 points, $t = 25.2$, and 4.42 points, $t = 24.4$). Students of whom we lost track had, on average, lower scores on these variables than did students who were left out of the analyses due to missing values on variables, but this last group still scored lower than the students who were included. Since effects of prior achievement and IQ on student performance were taken into account in every analysis, this selectivity will be minimized as much as possible. There was no attrition bias for the variable teacher expectation bias.

Data Analysis

Sampling took place in two stages. We selected the students by taking a sample of secondary schools. Subsequently, all 1st-year students of these schools were included in the sample. As a consequence of the two-stage sampling, students were nested within schools. The hierarchical structure of the data causes variability at both the level of the students and the schools. Multilevel analysis takes account of the variability associated with each level of nesting and is therefore the appropriate method of analysis. With multilevel analysis, regression models can be estimated in which the residual variance is partitioned into components corresponding to each level, and standard errors for regression coefficients are estimated while taking into account the dependency in the observations.

We calculated teacher expectation bias by estimating the residuals of a multilevel regression model, in which teacher expectations were regressed on students' prior achievement, IQ, and achievement motivation. We summed up the unstandardized residuals of both levels of the estimated multilevel regression model, representing the difference between the predicted and the observed teacher expectation, for each student to calculate his or her score on the teacher expectation bias variable. We imputed missing values for prior achievement, IQ, and achievement motivation by using the expectation maximization algorithm in SPSS. Missing values for prior achievement and IQ were only imputed if at least one of both scores was available. For 3,537 cases, the score on prior achievement was imputed; for 2,435 cases, the score on IQ was imputed; and for 205 cases, the score on achievement motivation was imputed. We used an extra test, a shortened version of the Final School Leaving Test, in addition to the already known values to impute the missing value. This extra test was taken at secondary school entry and consisted of 60 items. We imputed missing values for these variables to maximize the number of cases with a valid value on the teacher expectation bias variable.

In the models tested in this study, all predictor variables pertained to the student level and were considered having the same effect at each school (a fixed effect). The intercept, however, was modeled randomly at school level, meaning that schools could differ in their average score on the criterion variable (Rasbash, Steele, Browne, & Prosser, 2000; Snijders & Bosker, 1999).

Results

Teacher Expectation Bias

We calculated students' scores on the teacher expectation bias variable by summing up the residuals of a multilevel regression model in which teacher expectations were regressed on students'

prior achievement, IQ, and achievement motivation. These variables accounted for 66.96% of the variance in teacher expectations (Cohen's $f^2 = 2.03$). A negative score on the teacher expectation bias variable means that the teacher expectation is biased negatively, and a positive score means that the teacher expectation is biased positively. A score of 0 means that there is no bias in the teacher's expectation. Since the criterion variable of the model tested is expressed as a score on the education ladder, the residuals of this model and thus the bias in teacher expectations are too. Therefore, a bias of 1 point means a bias of 1 school year that is needed to reach the top.

To get an impression of the distribution of students on the teacher expectation bias variable, see some basic statistics in Table 2. In order to clearly present the possibly differential effects of differences in the extent of the expectation bias, we categorized the variable into the following categories:

- severe negative expectation bias: scores of -1.00 or lower;
- moderate negative expectation bias: scores between -1.00 and -0.50 ;
- light negative expectation bias: scores between -0.50 and -0.25 ;
- no expectation bias: scores between -0.25 and 0.25 ;
- light positive expectation bias: scores between 0.25 and 0.50 ;
- moderate positive expectation bias: scores between 0.50 and 1.00 ; and
- severe positive expectation bias: scores of 1.00 or higher.

As Table 2 reveals, each category of expectation bias contains a fairly large number of students. The categories *severe negative* and *severe positive expectation bias* were the smallest. For 33.03% of the students, the expectations were accurate, as there was no expectation bias. There were slightly more students for whom there was a positive expectation bias (33.85%) than there were for whom there was a negative expectation bias (32.68%). The column labeled *Mean expectation bias* presents the mean score on the continuous variable teacher expectation bias. The difference between students for whom there was severe negative and severe positive expectation bias was 2.50 points on the education ladder.

Table 2
Teacher Expectation Bias: Distribution of Students and Mean Expectation Bias

Teacher expectation bias	%	<i>N</i>	Mean expectation bias
Severe negative	5.01	553	-1.26
Moderate negative	13.98	1,543	-0.72
Light negative	13.69	1,511	-0.37
None	33.03	3,647	0.01
Light positive	15.16	1,674	0.37
Moderate positive	15.84	1,749	0.69
Severe positive	3.29	363	1.24
Total	100.00	11,040	0.00

Teacher Expectation Bias and Student Characteristics

Before turning to the analysis of the effects of teacher expectation bias on student performance, we note that we tested a multilevel regression model to examine the relationship between teacher expectation bias and student characteristics. For this analysis, the continuous version of the variable teacher expectation bias was used as a criterion. Because teacher expectations were measured in primary school, in this case the second level in the multilevel analysis was the primary school, and the first level was the student. Since most primary schools only have one class for each grade, it was not necessary to distinguish a class level.

The results of the analysis are reported in Table 3. Model 1 is the empty model, excluding effects of predictors. The results of Model 2 provide information about the relationship between teacher expectation bias and student characteristics. All effects were significant, except for ethnicity. The student characteristics accounted for 27.48% (variance Model 1 minus residual variance Model 2, divided by variance Model 1, and then multiplied by 100) of the variance in expectation bias (Cohen's $f^2 = 0.38$). Teacher expectation bias was positively related to socioeconomic status and parents' aspirations, and the bias was more positive for students with lower prior achievement, students with a lower IQ, students who were girls, students with lower achievement motivation, and students who did not repeat a grade in primary school. Parents' aspirations and prior achievement were the most influential variables. However, the relationship between achievement level and teacher expectation bias might at least partly be due to the fact that negative expectation bias is less likely to occur for low achieving students (regression to the mean).

Teacher Expectation Bias and Its Effect on Student Performance After 5 Years

We estimated a multilevel regression model, with secondary school as the second level, in order to examine whether expectation bias influences student outcomes after 5 years. Several mod-

els, with the performance score in Year 5 as the criterion and prior achievement and IQ as covariates, were tested, and the results are presented in Table 4. The model furthest to the left is the empty model. Model 1 is the model with covariates only. The second model contains the estimated effects of student characteristics on performance. In Model 3, the effect of the categorical variable teacher expectation bias was estimated, which was dummy coded, with the category no bias serving as the reference category. The advantage of using the categorical variable was that possible differential effects, consequent on differences in the extent of the teacher expectation bias, could be presented more clearly. In Model 4, the effects of teacher expectation bias and student characteristics on student performance were analyzed simultaneously.

Model 1 shows that taking into account the covariates prior achievement and IQ resulted in a substantive decrease of variance. The covariates accounted for 57.09% of the variance in student performance. The results presented in Model 2 show that student performance was higher as socioeconomic status, achievement motivation, and parents' aspirations increased. Performance was also higher for girls and ethnic minority students. Performance was not significantly related to grade repetition in primary school. Compared with the model with covariates only, student characteristics accounted for 6.92% additional variance in performance (Cohen's $f^2 = 0.19$).

The effects as presented in Model 3 show that there was a clear relationship between the bias in teacher expectations and student performance. The performance level was the lowest for students with a severe negative expectation bias and increased monotonously as the expectation bias became more positive. Compared with the model with covariates only, this model accounted for 6.72% extra variance (Cohen's $f^2 = 0.19$).

In Model 4, the effects of both student characteristics and teacher expectation bias on student performance are reported. In comparison with Model 1, this model accounted for 9.30% additional variance (Cohen's $f^2 = 0.28$). The effects of teacher expectation bias on performance level were somewhat reduced, just as were the effects of some of the student characteristics. Compared with the model with student characteristics only (Model 2), teacher expectation bias added 2.38% to the variance accounted for (Cohen's $f^2 = 0.07$). The results in Model 3 as well as in Model 4 reveal that the difference in performance scores between students with the most negative and the most positive expectation bias was approximately 1 point, a difference that is the equivalent of 1 school year. There is no clear trend that negative expectation bias is more harmful than is positive expectation bias beneficial for students' performance level. In the case of severe expectation bias, a negative bias seems to be more harmful than is a positive bias beneficial for students' performance level. This is in contrast to the effects for light expectation bias.

Mediation of Effects of Student Characteristics on Student Performance by Teacher Expectation Bias

The models tested thus far, reported in Table 3 and Table 4, reveal that teacher expectation bias mediates the effects of student characteristics on student performance. To establish mediation, we applied the procedure defined by Baron and Kenny (1986). First, we tested whether variations in both student characteristics and expectation bias separately predicted student outcomes (Models 2

Table 3
Student Characteristics and Their Effect on Teacher Expectation Bias

Characteristic	Model			
	1		2	
	β	SE	β	SE
Intercept	-.014	.009*	-.025	.009*
Prior achievement			-.200	.009*
IQ			-.052	.008*
Socioeconomic status			.054	.005*
Gender			.056	.009*
Ethnicity			-.030	.014
Achievement motivation			-.027	.005*
Parents' aspirations			.329	.007*
Grade repetition			-.083	.013*
Variance at school level	.133	.006*	.069	.004*
Variance at student level	.220	.003*	.187	.003*
Total variance	.353		.256	

* $p < .01$.

Table 4

Teacher Expectation Bias and Student Characteristics and the Effects on Student Performance After 5 Years

Bias or characteristic	Model									
	Empty		1		2		3		4	
	β	SE	β	SE	β	SE	β	SE	β	SE
Intercept	8.049	.074*	8.200	.029*	8.115	.021*	8.223	.021*	8.124	.020*
Prior achievement			.498	.013*	.358	.013*	.549	.013*	.439	.013*
IQ			.302	.012*	.283	.012*	.298	.012*	.296	.012*
Severe negative expectation bias							-.635	.034*	-.479	.034*
Moderate negative expectation bias							-.313	.022*	-.227	.022*
Light negative expectation bias							-.139	.022*	-.101	.021*
Light positive expectation bias							.180	.021*	.143	.021*
Moderate positive expectation bias							.309	.021*	.236	.021*
Severe positive expectation bias							.557	.040*	.426	.040*
Socioeconomic status					.119	.007*			.103	.007*
Gender					.198	.014*			.179	.013*
Ethnicity					.055	.021*			.067	.021*
Achievement motivation					.033	.007*			.043	.007*
Parents' aspirations					.255	.010*			.153	.011*
Grade repetition					-.031	.020			-.002	.019
Variance at school level	.589	.081*	.084	.012*	.032	.005*	.032	.005*	.021	.004*
Variance at student level	.884	.012*	.548	.007*	.498	.007*	.501	.007*	.474	.006*
Total variance	1.473		0.632		0.530		0.533		0.495	

* $p < .01$.

and 3 of Table 4). Second, we tested whether teacher expectation bias depended on variations in student characteristics (see Table 3). Finally, we tested whether the effects of student characteristics on student performance decreased after taking teacher expectation bias into account (effects of Model 4 compared with effects of Model 2 of Table 4). In particular, the effect of parents' aspirations decreased after we corrected for teacher expectation bias. The exact decrease in explained variance of student characteristics on student performance after correction for expectation bias was 62.75% (explained variance of Model 2 compared with Model 1, minus explained variance of Model 4 compared with Model 3, divided by explained variance of Model 2 compared with Model 1; all models from Table 4).

Moderation of Teacher Expectation Bias Effects on Student Performance by Student Characteristics

We conducted additional analyses to test whether teacher expectation bias effects on student performance were moderated by

student characteristics. Interaction terms for each student characteristic with teacher expectation bias were added, one by one, to Model 4 of Table 4. The results are presented in Table A1, which can be found as an online supplement. In the first column, Model 4 of Table 4 is reported once again. In the other columns, the interaction effects are presented.

Table A1 shows that there were significant effects of the interactions between teacher expectation bias and, respectively, prior achievement, IQ, socioeconomic status, parents' aspirations, and grade repetition in primary school. There were no significant effects of interactions between teacher expectation bias and gender, ethnicity, or achievement motivation.

To get a better impression of the interaction effects, see Table 5 for an overview of the estimated performance scores for two models with some stronger interaction effects: the ones including the interactions between teacher expectation bias with, respectively, prior achievement and parents' aspirations. The score *Mid-*
dle refers to the mean score on the variable, *Low* refers to a score

Table 5

Estimated Student Performance Scores for the Interactions of Teacher Expectation Bias With Prior Achievement and Parents' Aspirations

Teacher expectation bias	Prior achievement			Parents' aspirations		
	Low	Middle	High	Low	Middle	High
Severe negative	7.46	7.74	8.03	7.61	7.67	7.72
Moderate negative	7.63	7.98	8.33	7.87	7.97	8.07
Light negative	7.66	8.13	8.59	7.97	8.12	8.27
None	7.77	8.22	8.68	8.04	8.22	8.41
Light positive	7.91	8.37	8.82	8.20	8.37	8.53
Moderate positive	8.01	8.46	8.91	8.23	8.44	8.65
Severe positive	8.23	8.63	9.03	8.46	8.64	8.81
Difference	0.77	0.88	1.00	0.85	0.97	1.09

of one standard deviation below the mean, and *High* refers to a score of one standard deviation above the mean. For all other variables in the model, the mean score is used in the regression equation to get to the predicted performance scores. In the row labeled *Differences*, the differences between the highest and lowest score are reported.

The *Differences* row in Table 5 shows that teacher expectation bias effects on student performance increased as prior achievement and parents' aspirations increased. Teacher expectation bias effects were about 0.25 points smaller for students with low scores than for students with high scores on these variables. This difference in teacher expectation bias effects is equal to 2.5 months of education. Table A1 shows that these differences in effect were only significant for students with severe or moderate negative teacher expectation bias. For the other significant interaction effects, the following can be concluded: For students with severe or moderate negative teacher expectation bias, the effects on performance increased, and for students with severe positive teacher expectation bias, the effects decreased as the score on IQ increased. The effect of moderate negative teacher expectation bias increased as the socioeconomic status increased. The effect of moderate negative teacher expectation bias was less detrimental for students who repeated a grade than for students who did not repeat a grade. The interaction effects show that there are differences in susceptibility to teacher expectation bias effects that are related to student characteristics.

Teacher Expectation Bias Effects on Student Performance Over Time

The final analysis in this study focused on the question of whether teacher expectation bias effects on student performance accumulated, dissipated, or remained stable over time. Students were followed for 5 successive years, and for every year we analyzed the effects of teacher expectation bias on that year's performance score on the education ladder. We also included student characteristics in the models, so possible effects of these characteristics were filtered out. The results of these analyses are presented in Table A2, which can be found as an online supplement. The column labeled *Year 0* reports the model for the effects on the performance score based on teachers' recommendation for track placement in secondary education. The last column reports the eventual effects of teacher expectation bias on student performance after 5 years, as already presented in Table 4.

The column *Year 0* in Table A2 presents the deviation in performance scores due to teachers' secondary school track recommendations for students with a negative and positive expectation bias compared with students for whom the teacher expectations were unbiased. As might be expected, the coefficients resemble the mean expectation bias for each category of teacher expectation bias as presented in Table 2. Comparing the differences in scores on the education ladder between students with severe negative and severe positive expectation bias in Year 0 with those in Year 5 shows that differences in performance became smaller over time. In Year 0, the difference in the score on the education ladder was 2.44 points, whereas in Year 5, this difference was reduced to 0.91 points. As the decrease in size of the expectation bias effects over time shows, students for whom there is expectation bias caught up or lost more than half of the initial

difference in performance. Particularly in the first two years, students for whom there was a negative expectation bias made up for some of their initial disadvantage, and students for whom there was a positive expectation bias lost some of their advantage. The largest gain or loss occurred in the first year of secondary school. On average, students for whom there was a negative teacher expectation bias and thus a lower track recommendation than appropriate (considering their prior achievement, IQ, and achievement motivation) started secondary school in a higher track than recommended, and students for whom there was a positive expectation bias started in a lower track than recommended. Because the initial differences did not disappear completely, however, students for whom the teacher's expectation was negatively biased still started in a lower track, and students for whom the teacher's expectation was positively biased started in a higher track than what would be most appropriate. This can be deduced from the comparison of the coefficients in Year 0 with Year 1. After two years, there were only small fluctuations in the performance scores per category of teacher expectation bias. These results indicate that in the first two years, teacher expectation bias effects on student performance partly dissipated but after that remained quite stable over time. The development of teacher expectation bias effects on student performance over time is displayed in Figure 1.

Discussion

Despite the vast body of research on teacher expectation bias, there are still uncertainties about the precise effects of biased teacher expectations on achievement and educational performance, largely because many of the studies have been based on relatively small samples. Also, most studies were conducted in the United States, so it is unclear whether the results can be generalized to other countries. Another complicating factor is the measurement of the bias. The extent to which teacher expectation bias effects can be defined as self-fulfilling prophecy effects depends on the accuracy of their measurement. In the case of a faultless measurement, all expectation bias effects are a self-fulfilling prophecy, but if not, the size of the self-fulfilling prophecy effect is probably smaller.

Jussim and Harber (2005) reviewed the literature on teacher expectations and self-fulfilling prophecies. Based on this review, they identified four topics that need more research. First, they proposed further exploration of the relationship between teacher expectation bias and the characteristics of the students. Second, they concluded that little is known about whether self-fulfilling prophecies have mainly a positive or a negative influence on achievement. Third, they stated that more research is needed to find out which student characteristics moderate self-fulfilling prophecies. And finally, they proposed to study the accumulation of biased teacher expectation effects over time. In this article, we focused on these four topics, or questions, concerning bias in teacher expectations. We used a large Dutch cohort study to answer these questions by means of multilevel analysis. Teacher expectation bias was defined as the difference between observed and predicted teacher expectation. The measurement of the teacher expectations took place at the end of the school year of the final grade of primary school, which resulted in more reliable expectations than when expectations are measured at the beginning of a school year. The predicted expectations were estimated from a

Figure 1. Mean effects of teacher expectation bias on student performance over time.

model in which teacher expectations of students' future performance in secondary education were regressed on three indicators of future achievement, namely students' prior achievement, IQ, and achievement motivation. We used multiple indicators in order to minimize measurement error as much as possible. Teacher expectations were interpreted as accurate when the difference between the observed and predicted teacher expectation was close to zero.

The first analysis in this study, in which we examined the relationship between student characteristics and the accuracy of teacher expectations, revealed that student characteristics accounted for 27.48% of the variation in teacher expectation bias.¹ Teacher expectation bias was more positive for students with lower prior achievement, students with a lower IQ, students with a higher socioeconomic status, students who were girls, students with lower achievement motivation, students with higher parents' aspirations, and students who did not repeat a grade in primary school. This was in contrast to students with higher prior achievement, students with a higher IQ, students with a lower socioeconomic status, students who were boys, students with higher achievement motivation, students with lower parents' aspirations, and students who did repeat a grade in primary school. Parents' aspirations had a fairly strong effect on teacher expectation bias. The effect of achievement level on teacher expectation bias was probably, at least partly, the result of the fact that low-achieving students had less of a chance of getting lower teacher expectations than their achievement level indicates than did high-achieving students (regression to the mean). An explanation for the relationship between teacher expectation bias and the other student characteristics might be that the expectation bias is more negative as the discrepancy between students' background and school culture is more pronounced. At school, the culture of the middle and higher socioeconomic status groups prevails.

The next analysis showed that there was a significant relationship between teacher expectation bias at the end of primary school and student performance in the 5th year of secondary school. Teacher expectation bias accounted for 6.72% of the variance in student performance,² resulting in an effect size of Cohen's $f^2 = 0.19$ (or to use the same effect size as reported in the introduction, $r = .26$). This is slightly higher than the average effect size of $r = .10$ to $.20$, found in prior research (Brophy, 1983; Jussim & Harber, 2005). In comparison with students for whom the expectations were accurate, students for whom there was a negative teacher expectation bias ended up after 5 years in lower educational positions, and students for whom there was a positive expectation bias ended up in higher educational positions. The extent to which the performance differed between students for whom teacher expectations were accurate and those for whom these were inaccurate was related to the degree to which the expectations were biased. There was no clear trend that negative expectation bias was more harmful for students' performance than positive expectation bias was beneficial for students' performance.

¹ Tables 3 and 4 show that the explained variance is higher at school level than at student level. This is probably a consequence of the tracked Dutch education system. Students in the lowest and the highest tracks have, on average, different student characteristics. For example, the average socioeconomic status is lower for students in the lowest track type than for students in the highest track type. Teacher expectation bias probably also differs because students in the lowest track have more chance for a positive bias and students in the highest track have more chance for a negative bias due to regression to the mean. Because not all schools offer all track types, student characteristics and teacher expectation bias are related to the school. Consequently, these variables can explain part of the variance at school level.

² See Footnote 1.

The difference in performance scores between students with the most negative and the most positive expectation bias was approximately 1 point. This equals 1 school year.

The results show that teacher expectation bias partly mediated the effects of student characteristics on educational performance. This was most obvious for parents' aspirations. We also tested for moderation effects of student characteristics. We found that the effects of teacher expectation bias on student performance were moderated by prior achievement, IQ, parents' aspirations, socioeconomic status, and grade repetition in primary school. This finding demonstrates that there were differences in susceptibility to expectation bias effects between students with different background and abilities. However, there were no moderating effects of gender, ethnicity, or achievement motivation found. Madon et al. (1997) also found moderating effects of prior achievement, but in contrast to their results, we found that teacher expectation bias effects were smaller for low-achieving students than for high-achieving students. This can be explained by the fact that they studied differences in educational performance after 1 year, whereas we studied performance after 5 years. In an additional analysis of the moderating effects of prior achievement after 1 year, we also found that teacher expectation bias effects were smaller for high-achieving students than for low-achieving students. After 5 years, however, this situation had reversed and compared with the moderating effect of prior achievement after 1 year, differences between low and high achievers were more than twice as large. In this study, parents' aspiration was one of the stronger moderators. Because parents' aspirations were also quite strongly related to teacher expectation bias, this variable is a factor that can create educational differences between students that are not based on students' abilities. Students whose parents have low aspirations are disadvantaged. Teacher expectation bias for these students is more often negative, which is harmful for students' performance, and in cases in which the teacher expectation bias is more positive, the positive effects on performance are relatively smaller.

We concluded this study with an analysis to examine whether teacher expectation bias effects on educational performance accumulate, dissipate, or remain stable over time. The results of this analysis show that in the first 2 years of secondary school, teacher expectation bias effects partly dissipated but afterwards remained quite stable over time. This finding corresponds to findings of prior research (Smith et al., 1999). Students for whom there was a negative expectation bias made up for some of their initial disadvantage in educational position, and students for whom there was a positive expectation bias lost some of their initial advantage, but the initial differences due to inaccurate teacher expectations decreased only partly.

Based on Kluger and Denisi's (1996) feedback intervention theory and on prior research on recommendation and track placement in secondary school and on expectation effects, our hypothesis was that we would find a significant effect of teacher expectation bias on secondary school performance. In line with this theory and prior research, we suggested two mechanisms to explain why teacher expectation bias serves as a self-fulfilling prophecy. The first mechanism, deduced from Kluger and Denisi's theory, was that teacher expectations function like feedback. We reasoned that positive expectation bias would result in beginning secondary school in a higher track. Consequently, we hypothesized that students for whom the expectation bias was positive would get lower grades, which can be seen as negative feedback. As a reaction to this negative feedback, these students should exert more effort to raise their performance.

Thus, we expected that positive teacher expectation bias would result in higher performance. Following the same line of reasoning, we expected that negative teacher expectation bias would result in lower performance. The results of this study show that students for whom the expectation bias was positive indeed started secondary school at a higher level, and students for whom the expectation bias was negative started secondary school at a lower level than did students with unbiased teacher expectations. The results also prove that educational performance (at least up to the 5th year) was higher when the expectation bias was positive and lower when the expectation bias was negative. However, students for whom the expectation bias was positive were not fully able to maintain the higher level of performance, and students for whom the expectation bias was negative did not fully stay on a lower performance level. The second mechanism, deduced from prior research (Kuyper & van der Werf, 2003; Rubie-Davies et al., 2006; Smith et al., 1999; Weinstein, 2002), implied that negative or positive teacher expectation bias would induce, respectively, less or more learning opportunities. The results show that students for whom the teacher expectation was negatively biased were placed in a lower track type, which offers a less challenging curriculum than a higher track. These students were able to make up for this disadvantage in track placement partly but not fully. On the contrary, students for whom the teacher expectation was positively biased were placed in a higher track, providing students with more learning opportunities. These students lost some of their initial advantage in track placement but still had higher educational performance scores than did students with no positively biased teacher expectations. Therefore, the primary school teacher's expectation still influenced secondary school performance. Also possible is that secondary school teachers took over the biased expectation of the primary school teacher, which influenced their behavior toward students. The results of this study, however, do not give direct insight into the underlying mechanisms by which teacher expectation bias results in a self-fulfilling prophecy. The results only prove that both of the aforementioned mechanisms are plausible.

The size of the teacher expectation bias effects in this study was quite convincing. Even if the effects would be somewhat overestimated due to measurement error of the teacher expectation bias, they would probably still be largely significant in reality. However, the effects found should be quite reliable, because in measuring bias in teacher expectations, three indicators of future achievement were used. Furthermore, the data set used for the analyses consisted of many students, for whom detailed information was gathered about their performance for 5 successive years in secondary school as well as their background and other characteristics. The effects found yield the conclusion that to avoid negative expectation bias and its effect on educational performance, schools and teachers should be more aware of the positive effect of positive expectation bias and that they might maximize their expectancies, within certain limits, for each student. Maximizing expectations helps to fully develop students' talents.

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