Should Sixth Grade be in Elementary or Middle School? An Analysis of Grade Configuration and Student Behavior

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Abstract

Using administrative data on public school students in North Carolina, we find that sixth grade students attending middle schools are much more likely to be cited for discipline problems than those attending elementary school. That difference remains after adjusting for the socioeconomic and demographic characteristics of the students and their schools. Furthermore, the higher infraction rates recorded by sixth graders who are placed in middle school persist at least through ninth grade. An analysis of end-of-grade test scores provides complementary findings. A plausible explanation is that sixth graders are at an especially impressionable age; in middle school, the exposure to older peers and the relative freedom from supervision have deleterious consequences. These findings are relevant to the current debate over the best school configuration for incorporating the middle grades. Based on our results we suggest that there is a strong argument for separating sixth graders from older adolescents.

Keywords: Education, peer influence, adolescence

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INTRODUCTION

Is there a "best" grade configuration for schools that serve early adolescents? If so, what is it? Using past policy decisions as a guide, conventional wisdom on the answers to these questions has changed several times over the past century. At the beginning of the twentieth century, school configuration in the United States began moving away from an eight-year primary and four-year secondary model, toward a definition of secondary education as beginning in the seventh grade. At that time and continuing through mid-century, middle schools known as "junior high" (grades 7-9 or 7-8) were the norm (Goldin 1999). This arrangement was intended to create a transitional period between the sheltered elementary school and the more demanding high school environment (Juvonen et al. 2004).

In recent decades there has been a marked shift away from junior high school, toward the middle school configuration of grades 6-8, or occasionally 5-8. In the early 1970s, less than one-quarter of middle schools incorporated sixth grade: by 2000, three-quarters of all middle schools enrolled sixth grade students (see Figure 1). North Carolina's public middle schools, which form the basis for the analysis that follows, have led the national trend of incorporating sixth grade. In the 1999-2000 school year, more than 90 percent of the state's 379 middle schools served grades 6-8 (McEwin, Greene and Jenkins 2001).[1]

Figure 1

Why is the current generation of sixth graders attending middle school while preceding generations attended elementary school? The practical problem of dealing with swelling cohorts of students was a factor in promoting the shift in the 1970s, but there was also support from

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[1] In 2000-1, 46 North Carolina public schools were structured as K-8, or "elemiddle." We have not included these schools in our study, as our goal is to analyze the outcomes associated with middle school transition.

educators. In a survey of middle grade school administrators in 2000, 65 percent of respondents selected the 6-8 grade configuration as the "ideal" form of organization (Valentine et al 2002). Grade span re-configuration was part of a new paradigm for middle grade education that moved away from the "bridging" concept, toward focused consideration of the unique challenges faced by young teens (Juvonen et al 2004; National Middle School Association 1995). The debate over the proper configuration of grades has heated up again in recent years, with researchers and practitioners challenging the rationale of a separate middle school. One influential proposal has been to reduce the number of school transitions through a configuration that combines elementary and middle grades (Hough 1995; Juvonen et al 2004; Gootman 2007a,b; Zernike 2007).

What has been for the most part lacking in this debate, and what we seek to provide, is direct evidence concerning what difference the grade configuration is likely to make for students.[2] Using unique data on disciplinary infractions and end-of-grade (EOG) standardized test scores for North Carolina public school students, we exploit variation in grade configuration across and within the state's school districts. Specifically, we compare the behavioral and academic outcomes of students who attend different types of schools in sixth grade. Despite constituting a lower-risk population along several observable dimensions, students who attend middle school in sixth grade are more than twice as likely to be disciplined relative to their counterparts in elementary school. These significant differences persist beyond the sixth grade year. Sixth graders in elementary school also make gains in standardized test scores relative to

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[2] One exception is a study by Weiss and Knipes (2006) that examines academic outcomes and behaviors in middle schools, finding few differences among eighth graders in middle and K-8 schools. These results are based on survey data and refer to a single urban district that has implemented a policy of phasing out traditional middle schools. Of greater relevance to our project are the results of Bedard and Do, who demonstrate using national data that moving to a middle-school configuration that includes sixth grade has the effect of reducing on-time high-school completion rates by approximately 1-3 percent (Bedard & Do 2005).

their peers in middle school. The results suggest that exposing sixth graders to older peers has negative and lasting consequences on their academic trajectories.

We begin by providing further background on middle schools. The next section motivates our analysis and describes several mechanisms by which grade configuration may influence students. We then characterize the data set and the matching procedure used to select schools to be included in the analysis. Subsequent sections provide results on infraction rates and EOG scores, followed by a concluding discussion.

THE MIDDLE SCHOOL DIFFERENCE

The middle school educational environment is different from the elementary school environment in several ways. A sixth grader in an elementary school will typically be assigned to one teacher and spend much of the day in that teacher's classroom with the same group of students. A sixth grader in middle school will typically be assigned to a team of teachers and move from classroom to classroom over the course of the school day, with somewhat different groups of students in each. Middle schools place greater emphasis on discipline and academic accomplishment (including greater use of between-classroom ability grouping), with less opportunity for close relationships to specific teachers (National Center for Education Statistics 2000; Mills 1998).

The decision of whether to locate sixth grade in middle school or keep it in elementary school should take account of the behavioral and academic consequences for the sixth graders themselves, as well as for the younger grades in elementary school, and the older grades in middle school. It is a difficult time of life at best. Between the ages of 10 and 14, students typically must adjust to puberty, as well as to changes in social relationships with peers, family,

and authority figures (NMSA, 1996; Elias et. al, 1985; Eccles et al. et al., 1993; Rudolph et al., 2001). Research suggests that difficulties in coping with multiple transitions may underlie some of the negative effects that many students experience during the transition from elementary to middle school (Eccles et al. et al., 1993). These effects include a decline in motivation and a loss of self-esteem, particularly when the transition occurs at younger ages (Simmons and Blythe, 1987; Rudolph et al., 2001); decline in academic achievement (Alspaugh and Harting, 1995; Alspaugh, 2001; Hanushek, Kain & Rivkin, 2004); strains on interpersonal functioning (Barber and Olsen, 2004); and in the long term, increased risk of dropping out of school (Alspaugh, 1998; Rumberger, 1995).

Perhaps the most important difference is that a sixth grader in elementary school is among the oldest students in the school; a sixth grader in middle school is among the youngest, with daily exposure to older adolescents. In terms of both the developmental changes experienced by early adolescents, and the social and academic challenges that they face in the middle school environment, the influence of the peer group on behavior is particularly important. Research on adolescent delinquency suggests a developmental pattern of delinquent peer influence: the influence of peers on behavior already is significant in early adolescence, peaks during middle adolescence, and then begins to decline (Jang 1999). Peer influence may take a variety of forms, both direct and indirect. Direct influence may include bullying and initiation of fights, recruitment into delinquent gangs, an enhanced supply of drugs and alcohol, seduction and sexual importuning, an appreciative audience for rowdy behavior, companionship in truancy, and so forth. Indirect influence may occur through modeling illicit behavior (Reinke & Walker 2006).[3]

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[3] For an interesting discussion of peer influence in drug use in particular, see Jacobson (2004).

School characteristics have been shown to influence peer effects on student behavior. . The influence of peers on individual substance use tends to be strongest in schools with higher rates of substance use (Cleveland and Wiebe, 2003). School mobility rates can adversely affect achievement gains is schools, for students who themselves are new to a school, as well as for their school peers (Hanushek, Kain & Rivkin, 2004). Other school context characteristics, including the size of the school population, racial composition, poverty levels, and levels of parental education also have been linked to peer influences on behavior (Teitler and Weiss, 2000; Ellickson et al., 2003; Hardy, Bukowski & Sippola 2002).

CONCEPTUAL FRAMEWORK

In this study, we estimate the impact of school grade span on EOG test scores and on the prevalence and incidence of reported disciplinary infractions by North Carolina public school students. Our main interest is on the infractions data; the data on EOG test scores, while of intrinsic interest, serve here as a check on the validity of our findings concerning behavior. Research shows that disciplinary problems in school have a significant impact on academic achievement (Maguin & Lowber, 1996; South & Messner, 2000) as well as on late adolescent and adult outcomes (McLeod & Kaiser, 2004; Sampson & Laub, 1992).

We presume that the behavior of student i attending school j in year t can be measured with a latent variable B_{ijt}. When this variable exceeds some threshold level, which we normalize to zero, we observe an indicator variable R_{ijt} indicating that a report of a negative behavior has been filed. Our conceptual model thus takes the form:

(1) $R_{ijt}=1$ if $B_{ijt} = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_j + \varepsilon_{ijt} > 0,$

where X_i denotes a vector of student-level characteristics, and Z_j a vector of school

characteristics. Our central hypothesis is that a particular school characteristic, the grade span, influences behavioral outcomes. The final term, ε_{ijt}, is a residual reflecting unobserved individual and school-level characteristics that determine whether a report is filed, plus any true idiosyncrasies that operate in the report-generating process. There is a possibility that elements of ε_{ijt} are correlated with observed school-level characteristics, in which case estimates of the coefficient vector α_2 will be biased. That problem is generic to this sort of non-experimental analysis, arising most likely because of the possibility that unmeasured qualities of the students or their schools are important and distributed differently among the two groups of schools. One way in which we address this problem is by use a pseudo-longitudinal analysis. We discuss this approach in more detail in the subsequent section.

Why might school grade composition affect student behavioral outcomes? Based on the discussion in the previous section, we can identify at least three potential causal mechanisms.

a) Social control effects. The overall rate of behavioral problems in a school can be influenced by various features of the school environment. The degree of freedom accorded the students, the capacity of the faculty and administration to monitor and control behavior, and the composition of the student body are all plausibly important. Elementary and middle schools tend to differ in all these dimensions.[4]

b) The transition effect. This mechanism suggests that student behavior will tend to deteriorate in the first year of exposure to a new school environment, particularly when

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[4] It should be noted that among the environmental attributes that distinguish the two types of schools, not all are intrinsic to the form. For example, if sixth-grade teachers tend to prefer an elementary-school environment to a middle-school environment, then those who have a choice (including the teachers with most seniority) will tend to concentrate in elementary schools. In that case the lower infraction rate in elementary schools would in part reflect the superior classroom-management ability of the teachers there. In that case moving sixth grades into middle school would not have an effect on the average behavior of students in the state unless the most able teachers were induced to retire or leave the state as a result.

that environment is less closely supervised than previously experienced, simply because it may take time to learn the rules and stay out of trouble in the new environment. This mechanism predicts a spike in behavioral problems for sixth grade students entering middle school, followed by a reversion to the usual age-based trajectory as the student learns to meet the new expectations. Seventh grade students entering middle school for the first time should also exhibit a spike in behavioral problems.

c) Deviant peer-influence effects. Sixth graders might also display elevated levels of behavioral problems if they are unduly influenced by older peers who act in a similar fashion. This is a true "social" effect (Manski, 1993): placement with a set of well-behaved older peers would not lead to increased behavioral problems. Deviant contagion effects could possibly lead to persistently elevated levels of behavior problems, to the extent that such behaviors are self-reinforcing.

In addition to these hypothesized causal mechanisms, it is possible that any correlation between school grade span and the measured infraction rate reflects nonrandom sorting of students. Parents may choose where to live or whether to keep their children in the public schools based in part on the configuration of grades. That sort of selection process may influence the characteristics of the student body in ways not necessarily reflected in observed indicators.

Yet another possibility is that the likelihood that student misbehavior will be reported by school officials differs between elementary and middle school. In the context of our model, variation in standards of reporting across schools is one component of the error term ε_{ijt}. Thus a finding of higher rates of disciplinary infractions in these schools need not reflect any differences in actual student behavior during sixth grade. The finding may still be of interest, since at a

minimum it tells us something about the likelihood that a student will acquire a "record." This concern is mainly relevant to the results for sixth grade *per se*, since by seventh grade all students in the sample are in middle school.

In addition to the analysis of student infractions, we estimate standard linear models for the determination of EOG test scores, incorporating the same covariates as in equation (1). EOG tests are administered and scored the same for sixth graders whether they are in elementary or middle school. As a result, observed differences in performance in sixth grade are not an artifact of the measurement system.

DATA AND MATCHING PROCEDURE

Our analysis makes use of an administrative database covering all public schools and students in the state of North Carolina for a number of years. The data were provided by the North Carolina Education Research Data Center (NCERDC). The indicators of behavioral problems are derived from a statewide database of disciplinary infractions recorded during the 2000-1 academic year. Each disciplinary report reflects a decision on the part of a school official (usually a teacher) of whether to "write up" a student for misbehaving, and then a decision on the part of the principal of whether to report to the state. (Schools are required to report incidents in the event that they result in the out-of-school suspension of one or more students, or if the offense is severe enough to warrant the contact of law enforcement officials, but reporting is otherwise left to the discretion of school officials.)

In our statistical analysis we work with a sub-sample of all public-school sixth graders for the 2000-1 school year. We omit charter schools, and drop 11 of North Carolina's 117 school districts for which over 25 percent of the infraction reports had incomplete or inaccurate student

identifiers, and therefore cannot be matched to students included in the NCERDC data base.

(For the remaining districts about 85 percent of infraction reports were identified with a specific

student.) An additional 7 districts are dropped because all of the sixth graders are attending a K-

8 school or some variant thereof, which is outside the scope of our analysis. The remaining 99

districts constitute our district sample. Of these, there are nine in which all sixth graders attend

elementary school, eight in which schools differ with respect to grade configuration, and 82

where all sixth graders attend middle schools. Here is a summary:

	Districts
All 6th graders in elementary school	9
6th graders divided between elementary and middle	8
All 6th graders in middle school	82
Subtotal districts in working sample	99
Incomplete data on infractions	11
K-8 grade configuration	7
Total public school districts	117

In our statistical work we used a matching procedure to address the concern that sixth

graders are not randomly assigned to elementary or middle schools in North Carolina.. First we

ran a logit regression analysis on the 342 schools that included sixth grade (both middle and

elementary schools) in our district sample to predict the likelihood that the school was a middle

school on the basis of its locale, per-pupil expenditure levels, and student socioeconomic

characteristics. We then excluded schools where the imputed probability was very high (higher

than for any of the elementary schools in the sample) or low. In our subsequent analysis we

experimented with two standards for the matching procedure. The "stringent" matching standard

retained only those schools where the imputed probability was between .6 and .9, leaving just

140 schools in the matched sample. The "loose" matching standard retained schools where the

imputed probability was between .3 and .9, which retained 243 schools and a majority of the

students. As it turns out the two matched samples produce very similar results with respect to

the effects of grade configuration on infractions and EOG scores. The results reported in

subsequent sections are for the "loose" matching standard.

Table 1

Table 1 reports the results of the logit regression analysis of the 342 schools. The

specification includes both school- and district-level variables. The results suggest that the

middle schools tend to have a higher concentration of blacks and Hispanics, and be located in

larger, better funded districts. Rural concentration has little influence.[5] Based on this

regression, Figure 2 depicts the distribution of imputed probabilities for the two categories of

middle school.

Figure 2

The matched sample includes 243 schools with 44,709 sixth graders. Just 11 percent of

the students in the matched sample are in elementary schools. Table 2 compares the sixth

graders in elementary school with those in middle school along a number of individual-, school-,

and district-level variables. The sixth grade students in middle schools are less likely to be poor

(as indicated by qualification for a free lunch), are more likely to have a college-educated parent,

and have somewhat higher EOG scores on average. The matching procedure has the effect of

reducing differences between the two groups with respect to race, per-pupil expenditures, and

size of the district.

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[5] The schools included in this analysis include a range of locales from rural to mid-size city. The largest city in North Carolina, Charlotte, is excluded from the analysis due to limitations of the infractions data for that district. Five schools in locales designated as "large towns" (more than 25,000 population but outside of a Metropolitan Statistical Area) were excluded because they all had the same configuration.

Table 2

ANALYSIS OF INFRACTION RATES

A total of almost 20,000 infractions by sixth graders were recorded in the matched sample during the school year 2000-1. The statistics shown in Table 3 and Figure 3 demonstrate that while many of the infractions were for minor events or rowdiness, violence played a prominent role. The incidence for middle school students was .47, or about 1 infraction for every two students – although in fact infractions were quite concentrated, and only 16.5 percent of students appear in the infractions database. Most notable for our purposes is that both the incidence and prevalence rate for every type of infraction were considerably higher for sixth graders in middle-school than for elementary-school students. The overall incidence was three times as high for middle school students, and the prevalence rate twice as high.

Table 3 and Figure 3

The large differences in the infraction rate may actually *understate* the effect of sending sixth graders to middle school, since in our sample the middle-school sixth graders are more privileged on average. We used regression analysis in an attempt to adjust for these remaining post-match differences, and report the results in Table 4. The sample for this analysis consists of sixth grade students in North Carolina in 2000-1 that are in our matched sample. For columns 1-3, the results are from logistic regressions where the dependent variable indicates whether (1) the student appears in the infractions database; (2) the student appears in the database for a violent infraction; and (3) whether the student appears in the database for a drug-related infraction. For column 4 the results are from a negative binomial regression where the dependent variable is the number of infractions of any sort.

Table 4

The results confirm that attending middle school in sixth grade is associated with greatly elevated odds of an infraction and of infraction rates. Our point estimates imply that other things equal, the odds of having at least one infraction in sixth grade are increased by a factor of 2.2 if in middle school; the odds of a violent infraction are increased by a factor of 2.1, and the odds of a drug infraction by a factor of 3.8. The results from the negative binomial regression indicate that the incidence of violations is also greatly elevated.

In these regressions, individual-level control variables include sex, race, parent's education and poverty status, old for grade, and preceding year's EOG scores. Most of these prove significant and quite influential for the prevalence and number of infractions. It is noteworthy that Hispanics tend to have lower infraction rates than non-Hispanic whites, other things equal. Also included are school- and district-level characteristics, although with a few exceptions they do not prove significant. In particular it is interesting that the number of students in the sixth grade has a negligible effect on infraction rates.

In results not shown here, we also assessed the possibility that the effect of placing sixth grade in middle school may have different effects on different demographic groups. We re-ran the "any infraction" logistic regression with the addition of three indicator variables capturing interactions between "in middle school" and each of the following: black, Hispanic, and male. The coefficient estimates of the interaction terms were small relative to standard errors, and inclusion of these variables had little effect on other coefficient estimates. We conclude that the effect of middle school placement on sixth grade infraction rates is more or less uniform.

Behavior Before and After Sixth Grade

It would be informative to follow these students over several years of schooling before

and after sixth grade. Infractions in fourth and fifth grade would provide an individualized

baseline on misbehavior. Infraction rates after sixth grade would allow a check on whether the

elevated rate for the middle-school sixth graders is simply the result of problems resulting from a

transition to a new school, or rather sustained over time. As it turns out, we are only able to use

infractions data for the single academic year (2000-1), so it is not possible to follow the behavior

of individual students over time. [6] However, we are able to perform a pseudo-longitudinal

analysis of behavior based on the fact that our database, while only including one year of

infractions data, does include a number of years' worth of data on other aspects of each student's

career. In particular we know what sort of school the students who are in fourth or fifth grade in

2000-1 are destined to spend sixth grade, and we know in what sort of school older students in

that year did spend sixth grade. Using this information, we sort all students in grades 4-9 in

2000-1 into two groups, which we identify as 6Es and 6Ms. For example, a ninth grader is a

"6M" if she spent her sixth grade in middle school; a fourth grader is a "6E" if he subsequently

attends sixth grade in an elementary school.

Table 5 and Figure 4

Figure 4 graphs the trajectories for the two groups with respect to probability of an

infraction. These prevalence trajectories are computed for the same set of values for the

regression covariates, shown in Table 5; the difference in trajectories reflects the proportional

effect on the infraction probability estimated from the logistic regression, and the 95 percent

confidence interval represents the uncertainty in that estimate.[7] We see that in the baseline

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[6] Infractions data are available for later years, but changes in the reporting format of the data render it considerably more difficult to match these reports to student records.

[7] The values assumed for the covariates generally refer to an average male student. Parental education is specified as high school graduate, and the race variable is 25 percent black (in line with the sample). Any changes in these or other covariates would only serve to shift both lines

period, grades 4 and 5, 6Es actually have a slightly higher infraction rate than 6Ms. But a large gap in the other direction opens up in sixth grade, when 6Ms have a much higher infraction rate than 6Es. The gap narrows a bit through eighth grade, at which point both 6Es and 6Ms are enrolled in middle school, a statistically significant gap persists as far as the ninth grade. We found similar patterns in our analyses of violent and drug infractions.[8]

These results do not rule out the logical possibility that the observed differences in sixth grade are partly due to differences in school reporting practices rather than in the actual behavior of the students. It seems reasonable to suppose that middle schools tend to be more formal and severe than elementary schools, which might explain the infraction gap between 6Es and 6Ms in sixth grade. However, it does not explain why that gap persists in seventh, eighth, and ninth grades, when all the students have moved on past elementary school. Hence we believe that the observed behavior gap is not an artifact of different school reporting practices.

End-of-Grade Test Scores

We performed a similar pseudo-longitudinal analysis of standardized end-of-grade (EOG) test scores for math and reading, using the same sample and specification. The results are of interest in their own right, and serve as a generalized check on the infractions results: In particular, the EOG scores have the advantage over infraction data of not being influenced by the standards or operating procedures of the school administration. Observed differences directly reflect differences in student performance.[9]

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either up or down by the same proportional amount. The key is the significant difference across the groups holding all else equal.

[8] We do not trace this gap beyond 9th grade because students 16 years of age and older have the option of dropping out of school. Infraction rates decrease dramatically after 9th grade, presumably because students with the worst behavioral patterns are most likely to drop out.

[9] Of course, this statement presumes that the school administrations do not exercise substantial discretion in how the tests are administered and do not cheat in the scoring. In fact the

The EOG tests have been required by the State Board of Education for all public-school students in grades 3-8 since 1992-3. These multiple choice tests are administered during the final weeks of the school year. For students in third, fifth, and eighth grades, adequate performance on the reading and math EOGs is required for promotion.[10] For analysis purposes, we normalize the EOG test scores to have a mean of zero and a standard deviation of one.

As is evident in Table 6, the combination of matching and regression adjustments leaves significant differences in EOG scores between fourth and fifth graders destined to attend sixth in middle school, and those destined to attend sixth in elementary school. The former group has higher scores in both math and reading. We are inclined to interpret these differences as reflecting differences in characteristics of the students that are not captured by the covariates. Note that the coefficients on the indicator for sixth grade in middle school drop to near zero in sixth grade and thereafter. A natural interpretation of this difference-in-difference result is that the 6Ms as a group tended to have an advantage (even after adjusting for a variety of measured characteristics) that is evident in elementary school but negated by the "early" move to middle school. The move to middle school not only leads to behavior problems but also reduced academic performance.

Table 6

The advantage lost by 6Ms when they move into middle school is about 10% of a standard deviation. The magnitude of this effect is substantial; the disadvantage associated with moving to middle school in sixth grade is roughly equivalent to the disadvantage associated with having an inexperienced rather than experienced teacher for a year (Clotfelter, Ladd and Vigdor

administration of EOG tests is tightly regulated in North Carolina and there is no evidence of cheating, and has apparently occurred in other jurisdictions (Jacob and Levitt 2003: Cook 2003).
[10] For details, see "Assessment Brief: Understanding North Carolina end-of-grade testing" (March 1, 2004) at www.ncpublicschools.org/accountability/testing.

2006).

The fourth and fifth rows of Table 6 provide some suggestive evidence that the immediate impact of attending middle school in sixth grade attenuates over time. The estimated impact of sixth grade middle school attendance on 7th and 8th grade EOG scores is positive in each instance, though never statistically significant. These coefficient estimates continue to contrast with the 4th and 5th grade estimates, which are of larger magnitudes and statistically significant. The difference between them continues to be a significant drop and point to a conclusion that students who make the transition to middle school in sixth grade suffer long-term academic as well as behavioral handicaps.

DISCUSSION

The causal mechanisms that account for the inter-grade patterns of infractions and EOG scores cannot be identified directly from our data. Several differences between elementary and middle school may be relevant. In comparison with elementary school, middle school provides students more freedom and lacks the continuity and close connection provided by having one primary teacher. Most obviously, middle school brings sixth graders into routine contact with older adolescents who are likely to be a bad influence: older adolescents as a group are more rebellious and more involved in delinquency, sex, illicit drugs, and other activities that violate school rules. Of greatest concern is that the negative influence of middle school on sixth graders appears to linger through ninth grade.

Our results complement the recent finding that school systems that move sixth grade from elementary to middle school experience a 1-3 percent decline in on-time graduation rates (Bedard & Do 2005). We conclude that placing sixth grade in middle school increases behavior problems and reduces academic performance, both in sixth grade and subsequently. It is entirely

plausible that these effects could have the effect for some students of leading to retention in grade or dropout. Together these findings cast serious doubt on the wisdom of the historic nationwide shift to the middle school format.

Of course the results reported here are not based on random assignment, which leaves open the possibility that the true causal process has not been adequately identified. (The consistency and strength of the findings suggests otherwise.) It should also be noted that the analysis is based on data that are limited in time and place, and in particular do not include any large cities.

Decades ago the "middle school" movement was launched on the basis of plausible speculations concerning potential benefits but without much direct evidence on the effects on student behavior and performance. As it turns out, moving sixth grade out of elementary school appears to have had substantial costs. The best school configuration in which to incorporate the adolescent grades is now being reconsidered by policymakers and experts. Our results suggest that the middle school configuration that brings seventh and eighth graders into regular contact with sixth graders is problematic.

The implications of our research for the related debate over K-8 schools are less certain. As a school moves from a K-5 to K-6 configuration, 6th graders get one more year of a "childhood" culture. But when a school moves from K-5 to K-8, it exposes all the younger ages to 7th and 8th graders who are entering adolescence. Whether the benefits to the 6th graders would be offset by the exposure effects on younger students is an open empirical question.

Acknowledgements

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Table 1
Logistic regression results for matching procedure
Dependent variable: Indicator for 6th grade in Middle School
Coefficient estimates and standard error estimates

	Coefficient.	SE
School level		
% black	**2.4263**	0.9911
% Hispanic	**9.5101**	4.2418
% parents without HS diploma	-1.8795	2.0366
% students receiving free or reduced lunch	-1.0177	1.4583
District level		
Number of 6th graders	**0.0012**	0.0003
5-year growth rate in number of 6th graders	-0.2281	1.1842
% rural	-0.0789	0.7405
Per-pupil expenditure, local ($000)	**0.0026**	0.0007
Per-pupil expenditure, federal ($000)	0.0007	0.0013
Constant	**-3.4368**	1.6204
N	342	
Pseudo-R^2	0.25	

Table 2
Summary Statistics for 6th Graders, 2000/2001
North Carolina Public Schools in Matched Sample

	Middle School	Elementary School	Difference
Number of students	39,596	5,113	
Individual level variables			
% Male	50.8	50.7	0.1
Race			
% White	67.6	65.8	1.8
% Black	25.1	23.5	1.7
% Hispanic	3.9	3.0	1.0
% Asian	1.2	2.1	-1.0
% other	2.2	5.6	-3.5
Parent's education			
% High school grad	46.5	48.6	-2.2
% 2-year college grad	19.0	19.7	-0.7
% 4-year college grad	19.0	15.1	3.9
% Reduced/free lunch	42.9	49.9	-7.0
Avg. math EOG score	159.7	158.9	0.8
Avg. Reading EOG score	155.2	154.9	0.3
School level variables			
Number of grades	3.0	6.3	-3.3
Number of 6th graders	257	117	139
District level variables			
Per-pupil expenditure local*	$1,271	$1,146	$125
Per-pupil expenditure federal	$530	$574	-$ 44
% rural	47.5	53.6	-6.1
Number of 6th graders	1045	781	264
5-year growth rate in number (%)	19.2	15.7	3.4

*The bulk of expenditures are state funds

Table 3
Infraction rates for Sixth Graders in Matched Sample, 2000-2001

	Middle School Incidence	Elementary School Incidence	Middle School Prevalence*	Elementary school Prevalence*
Overall (count)	0.476 (18,833)	0.161 (824)	0.175 (6,943)	0.085 (437)
Violence	0.130	0.057	0.087	0.044
Drug	0.002	0.001	0.002	0.001
Weapon possession	0.003	0.001	0.003	0.001
Truancy	0.006	0.0002	0.005	0.0002
Rowdy behavior	0.147	0.064	0.066	0.034
Minor	0.170	0.034	0.088	0.026
Property	0.011	0.003	0.010	0.003
Sexual	0.002	0.0004	0.002	0.0004

*At least one infraction during the school year

Table 4
The effect of school configuration on infractions
Matched sample, North Carolina 6th graders, 2000-1
Coefficient estimates (Standard Error estimates)

	1. Any infraction *Logit*	2. Violent infraction *Logit*	3. Drug infraction *Logit*	4. Number of infractions *Negative binomial*
In middle school	**0.799** (0.195)	**0.730** (0.189)	**1.330** (0.654)	**0.919** (0.210)
Male	**1.122** (0.043)	**1.231** (0.052)	**0.955** (0.279)	**1.247** (0.042)
Race (white omitted) Black	**0.632** (0.050)	**0.658** (0.070)	-0.602 (0.358)	**0.619** (0.057)
Hispanic	-0.431 (0.081)	-0.478 (0.103)	0.045 (0.488)	**-0.480** (0.092)
Asian	-1.379 (0.245)	-1.155 (0.278)		**-1.444** (0.252)
Other	0.147 (0.115)	0.289 (0.150)	-0.409 (0.613)	0.178 (0.108)
Parent's education (High school grad omitted) High school dropout	**0.318** (0.044)	**0.298** (0.051)	**0.734** (0.309)	**0.306** (0.041)
Trade school	**-0.199** (0.085)	-0.199 (0.103)		-0.154 (0.121)
Community college	**-0.143** (0.059)	-0.132 (0.074)	-0.214 (0.431)	**-0.222** (0.065)
4-year college	**-0.489** (0.067)	**-0.640** (0.081)	**-0.923** (0.450)	**-0.563** (0.067)
Graduate degree	**-0.865** (0.156)	**-1.048** (0.207)		**-0.923** (0.179)
Reduce/free lunch	**0.436** (0.043)	**0.408** (0.050)	0.505 (0.263)	**0.499** (0.044)
Old for grade	**0.372** (0.044)	**0.329** (0.054)	0.535 (0.200)	**0.406** (0.047)

Math EOG score, 5th grade	**-0.211** (0.029)	**-0.203** (0.038)	**-0.312** (0.157)	**-0.259** (0.032)
Reading EOG score, 5th grade	**-0.204** (0.028)	**-0.141** (0.034)	-0.158 (0.143)	**-0.192** (0.028)
School-level variables % reduced/free lunch	-0.615 (0.632)	0.050 (0.561)	-1.235 (1.777)	-0.866 (0.695)
% black	0.850 (0.460)	**0.831** (0.407)	-1.109 (2.076)	**1.160** (0.528)
% Hispanic	-0.527 (1.852)	-2.578 (1.584)	-2.774 (5.094)	-0.254 (1.653)
% parents without HS diploma	-0.300 (1.042)	0.467 (0.984)	0.453 (3.896)	-0.587 (1.195)
District level Number of 6th graders	-0.053 (0.112)	-0.068 (0.101)	-0.174 (0.305)	-0.023 (0.100)
Per-pupil expenditure, local	**0.572** (0.237)	**0.616** (0.231)	-0.052 (0.602)	0.408 (0.272)
Per-pupil expenditure, federal	-0.356 0.488	**-1.066** (0.541)	0.685 (1.343)	-0.532 (0.539)
Constant	**-3.806** 0.562	**-4.589** (0.527)	**-7.670** (1.513)	**-3.214** (0.593)
Sample size	44,709	44,709	40,715	44,709

Note: bold font indicates that the coefficient estimate is significantly different from zero, $p<.05$.
All standard errors are cluster corrected by school.

Table 5

Pseudo-Longitudinal analysis of school configuration on infractions
Matched sample, North Carolina, 2000-2001
OLS Coefficient estimates (SE estimates)

	Any Infraction *Logit*	Violent Infraction *Logit*	Drug Infraction *Logit*
Fourth Graders: will attend 6th grade in middle school	**-0.446** (0.190)	**-0.606** (0.177)	-1.211 (0.927)
Fifth graders: will attend 6th grade in middle school	-0.223 (0.156)	**-0.381** (0.170)	-0.415 (0.688)
Sixth graders: attending 6th grade in middle school	**0.799** (0.195)	**0.730** (0.189)	**1.330** (0.654)
Seventh graders: attended 6th grade in middle school	**0.370** (0.166)	0.199 (0.139)	-0.482 (0.248)
Eighth graders: attended 6th grade in middle school	0.246 (0.162)	0.078 (0.142)	0.307 (0.267)
Ninth graders: attended 6th grade in middle school	**0.412** (0.178)	-0.022 (0.204)	**0.810** (0.324)

Note: Each cell includes the coefficient and standard error (cluster corrected by school) from a separate regression. The coefficient in each cell is the estimated effect of an indicator of whether the student will attend sixth grade in middle school (for the fourth and fifth graders), is attending sixth grade in middle school, or did attend sixth grade in middle school (seventh and eighth grade); in every case the contrast is with attending sixth grade in elementary school.
Note: bold font indicates that the coefficient estimate is significantly different from zero, p<.05.
All standard errors are cluster corrected by school.

Table 6
Pseudo-Longitudinal analysis of school configuration on EOG scores
Matched sample, North Carolina, 2000-1
OLS Coefficient estimates (Standard Error estimates)

	EOG math	EOG Reading
Fourth Graders: will attend 6th grade in middle school	**0.155** (0.031)	**0.123** (0.030)
Fifth graders: will attend 6th grade in middle school	**0.107** (0.035)	**0.090** (0.026)
Sixth graders: attending 6th grade in middle school	0.000 (0.041)	-0.041 (0.033)
Seventh graders: attended 6th grade in middle school	0.028 (0.042)	0.020 (0.038)
Eighth graders: attended 6th grade in middle school	0.082 (0.049)	0.025 (0.033)

Note: Each cell includes the coefficient and standard error (cluster corrected by school) from a separate regression. The regression specifications are the same as those in Table 4, except that the "EOG scores in 5th grade" are dropped. The coefficient in each cell is the estimated effect of an indicator of whether the student will attend sixth grade in middle school (for the fourth and fifth graders), is attending sixth grade in middle school, or did attend sixth grade in middle school (seventh and eighth grade); in every case the contrast is with attending sixth grade in elementary school.
Note: bold font indicates that the coefficient estimate is significantly different from zero, p<.05. All standard errors are cluster corrected by school.

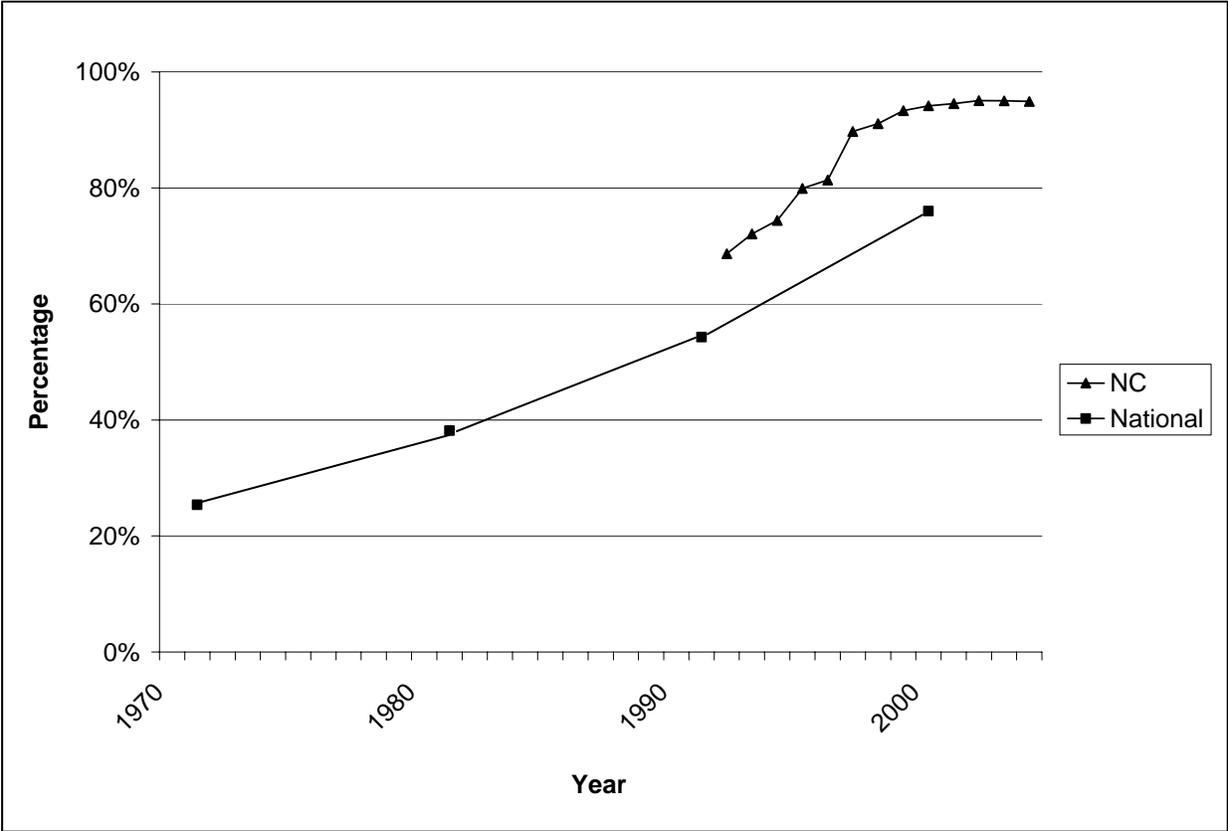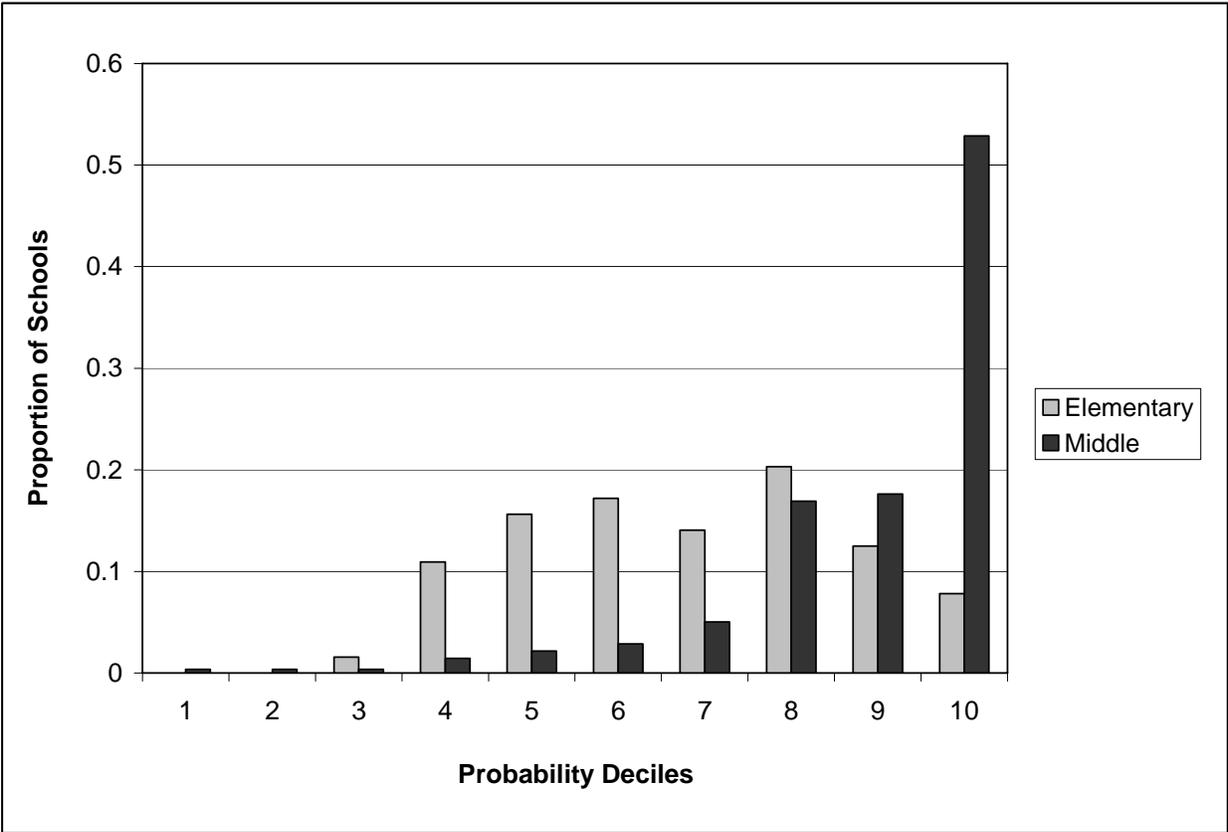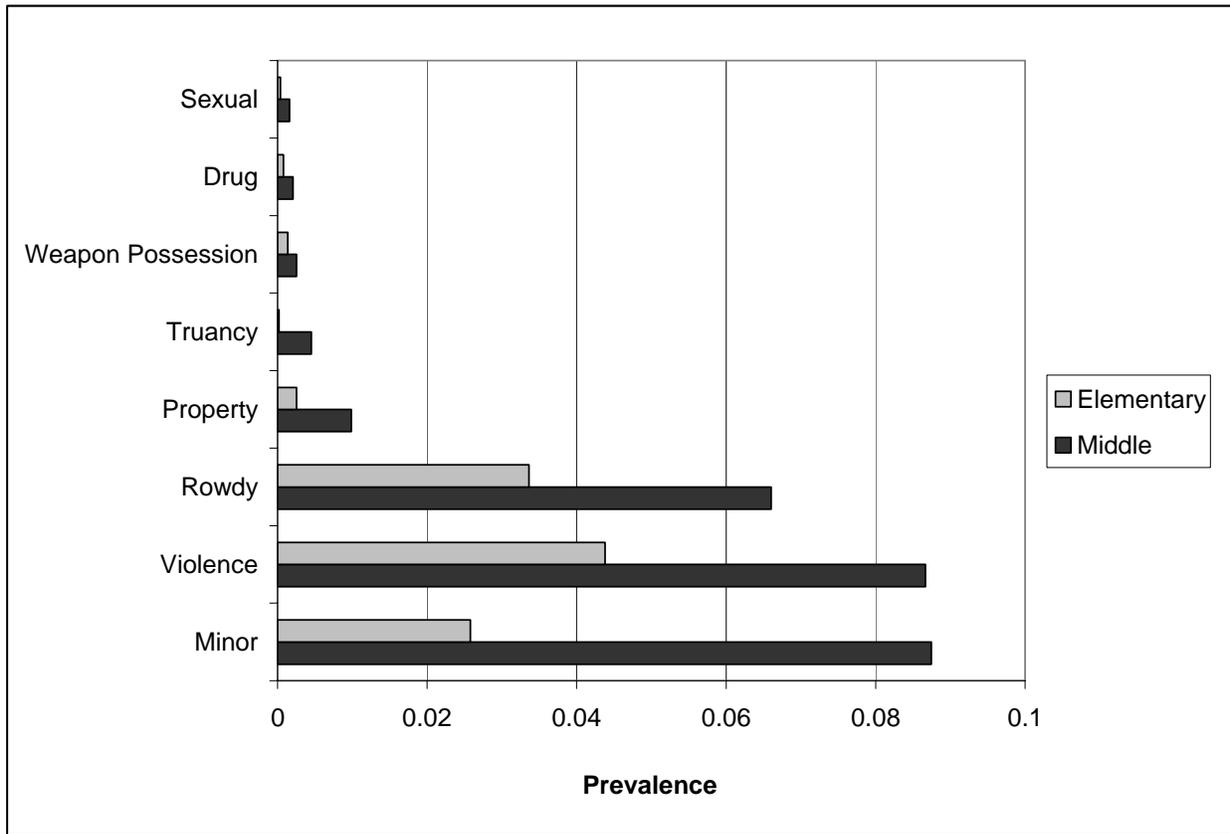Figure 1. % 6th Graders Attending Middle Schools - NC & National Trends

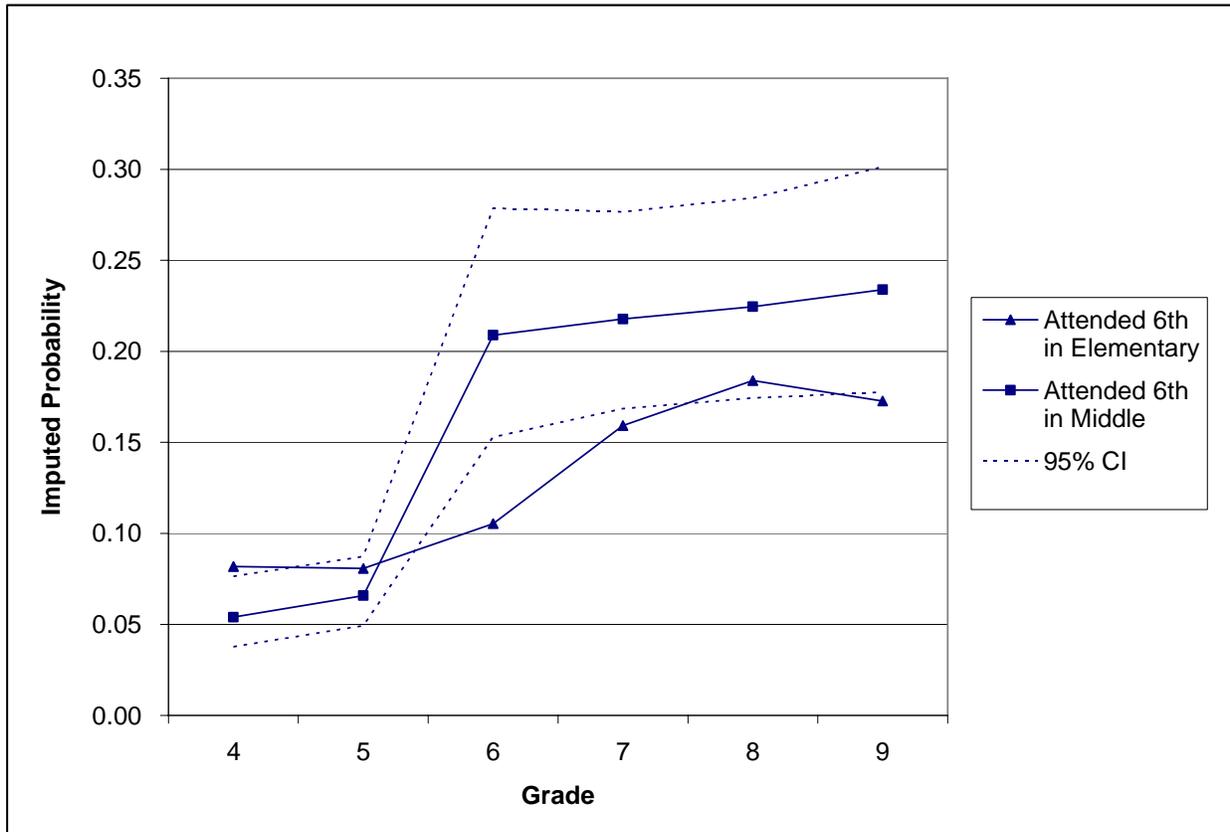Figure 2. Predicted Probability of 6th Grade in Middle School (vs. Elementary School)

Source: Imputed values using equation from Table 1.

Figure 3. Infraction Prevalence - 6th Grade

Source: See Table 3. Note that some students appear in more than one category.

Figure 4. Probability of at Least One Infraction

Source: See Table 4. All points are fitted values from equation (1) for a male student with average characteristics. (See text for additional detail.)