

Changing Times: Findings From the First Longitudinal Study of Later High School Start Times

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In the early 1990s, medical research found that teenagers have biologically different sleep and wake patterns than the preadolescent or adult population. On the basis of that information, in 1997 the seven comprehensive high schools in the Minneapolis Public School District shifted the school start time from 7:15 a.m. to 8:40 a.m. This article examines that change, finding significant benefits such as improved attendance and enrollment rates, less sleeping in class, and less student-reported depression. Policy implications are briefly discussed, acknowledging this to be a highly charged issue in school districts across the United States.

Recent research information about the sleep needs of adolescents and the influence of sleep on learning and behavior has captured the attention of school districts across the United States. Physicians, parents, school board members, and others are asking school administrators and policymakers to acknowledge the medical evidence about the biological sleep patterns of teenagers and to adjust school schedules accordingly. The discussions and debates have been intense because this is a multifaceted issue. School administrators are being asked to weigh the factual information about the biology of adolescents' sleep patterns against the competing demands of teachers' work preferences, athletic and afterschool activity schedules, and bus transportation schedules. This article presents findings from a 4-year study in a large, urban school district that altered high school start times significantly from 7:15 a.m. to 8:40 a.m. This change affected more than 12,000 secondary students within a total K–12 population of nearly 51,000 students.

Theoretical Perspectives

The findings of adolescent sleep researchers have, within the past 12 years, provided compelling evidence that sleep deprivation and sleep lag syndrome are common problems among U.S. teenagers. Adolescents are substantially

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sleep deprived when high schools begin classes much before 8:15 a.m. Sleep deprivation can have many negative consequences on cognition. Sleep deprivation is associated with memory deficits (Anderson, Petros, Beckwith, Mitchell, & Fritz, 1991; Dahl, 1996), impaired performance and alertness (Barron, Henderson, & Spurgeon, 1994; Carskadon, 1994; Pilcher & Huffcutt, 1996), as well as time-on-task decrements and optimum response shifts (Cooper, 1994; Wolfson & Carskadon, 1996). The specific loss of REM (rapid eye movement) phase sleep also results in memory loss (Poirel & Larouche, 1987). Callan (1995) found that REM sleep affects information processing, whereas Maas (1995) listed the consequences of REM sleep loss for adolescents to include unintended sleep; increased irritability, anxiety, and depression; decreased socialization and humor; hypersexuality; mental fatigue; and decreased ability to handle complex tasks and be creative.

Previous research conducted in the first year of the change to a later start in Edina, Minnesota (see Fredrickson, Wahlstrom, & Wrobel, 1999; Wahlstrom, 1999b; Wahlstrom & Freeman, 1997), and in Rhode Island (see Carskadon, Wolfson, Tzischinsky, & Acebo, 1995) has documented initial outcomes, finding clear statistical evidence that students who do not experience a sleep lag syndrome report higher grades, less depression, and fewer at-risk behaviors for dropping out of school. However, the examination of longitudinal data to determine the relationships among student achievement, behaviors, and temporal learning conditions has been, up until now, an uncharted area of inquiry.

If changing the high school start time to a later hour appears to result in positive outcomes, then why are schools not quickly moving to that course of action? From an educational administrative and policy perspective, making such a change is difficult because there are many interrelated factors that determine when schools begin the school day. Districts administrators who have considered starting the high school day later have encountered intense resistance from individuals and groups that assume that their interests will be negatively affected (Wahlstrom, 1999a).

Background

Effective with the 1997–1998 school year, the Minneapolis Public School District changed the starting time of its seven comprehensive high schools to 8:40 a.m. and changed the dismissal time to 3:20 p.m. Prior to 1997, classes began at the high schools at 7:15 a.m. and were dismissed at 1:45 p.m. In the 1997–1998 school year, the Minneapolis School Board asked the Center for Applied Research and Educational Improvement (CAREI) in the College of Education and Human Development at the University of Minnesota to examine the impact of the later start on its students, staff, families, and community members. (The information from that study can

be found online at http://education.umn.edu/carei/Programs/start_time/default.html).

In the fall of the 2000–2001 school year, the Minneapolis Public School District asked CAREI to examine the longitudinal data about student grades and attendance and to readminister the School Sleep Habits Survey (developed in 1994 by researchers at the Bradley Hospital/Brown University Research Lab; see www.sleepforscience.org/contentmgr/showdetails.php?id=93) to high school students. The district was interested in knowing whether the positive outcomes that were evident during the first year of the change were persisting over the long term.

Method

The quantitative data for the longitudinal study came from several sources. The school district provided data files on all letter grades earned by all students in the seven high schools over the course of 6 years—3 years prior to the change and 3 years after the change. The district and the Minnesota State Department of Education provided data on attendance, ethnicity, tardiness, graduation rates, and rates of continuous enrollment.

In addition, longitudinal data is available from a stratified random sample of 1,200 Minneapolis secondary students in grades 9–12 (of a total population of 12,000 students). These students twice completed a norm-referenced written questionnaire, the School Sleep Habits Survey (once in Year 1, in 1997, and again in Year 4, in 2001), about their study, work, sleep, and school habits as well as their preferences. Qualitative data were also collected in student focus groups in each of the seven high schools in Year 1 and again in Year 4. Additional individual interviews were conducted with teachers, administrators, and parents. These interviews are discussed in detail in the Findings section.

The source for the attendance data analyzed in this study is the data repository for the State of Minnesota, the Minnesota Automated Reporting Student System (MARSS). Data are entered into the MARSS database for every school district in the state. Attendance data for the Minneapolis Public School District were available and retrievable for a 5-year period, from 1995 to 2000. Therefore, the study team has data for 2 years when the school district high schools began classes at 7:15 a.m. (the 1995–1996 and 1996–1997 school years) and data for 3 years when high school began at 8:40 a.m. (the 1997–1998, 1998–1999, and 1999–2000 school years). Thus, the data set used in these analyses contains a total of 50,962 students, enrolled in grade 9–12 in seven Minneapolis high schools over 5 years. Finally, the urban district of Minneapolis—as measured by demographic characteristics such as ethnic composition, poverty rates, and family mobility rates—is considered to be typical of other major urban areas throughout the country.

Ethnic categories are established by the MARSS system. School districts are required by law to report annually the numbers of enrolled students into the following categories as labeled by MARSS: American Indian/Alaskan Native; Asian/Pacific Islander; Hispanic; Black, not of Hispanic origin; and White, not of Hispanic origin.

Caveat About Grade 12 Data

The numerical findings listed for grade 12 students may often seem inaccurate or not possible. This is due to several factors. First, students in grade 12 often carry lighter class loads if they have completed most of their required classes, and so attend school for only part of a day. Furthermore, many students in grade 12 are past the mandatory age for attending school, hence the total enrollment in 12th grade often declines significantly from enrollments reported for 11th grade.

Another confounding characteristic is that students in grade 12 voluntarily choose to come to school and, as a result, are generally motivated to be there, tending to have rather high levels of attendance. Students who struggle academically with school have often chosen to drop out of school by 12th grade, thereby making the group of students who remain appear more capable. In reviewing the data from this study, one will notice that findings for grade 12 students are rarely statistically significant.

Continuous Enrollment

Continuous enrollment is a numerical measure that tracks the frequency with which students stay in a given school or stay within the high schools in the district, as opposed to transferring into and out of a school or the district multiple times. Several studies of student performance conducted by the Minneapolis Public School District Department of Research, Evaluation, and Assessment have found that students who remain in their schools or remain in the district have much higher scores on achievement tests and have much higher rates for graduation and school completion than do those students who move from school to school (see www.mpls.k12.mn.us/departments/REA/index.html). For the longitudinal evaluation reported here, continuous enrollment refers to a student staying in the same high school within the Minneapolis district for 2 contiguous years.

One of the factors in this variable that may contribute to a student not remaining continuously enrolled is the district's tardiness policy. In that policy, a student who has more than eight unexcused absences or tardies per semester for any one class is automatically dropped from that class. Therefore, a student who oversleeps and/or misses the school bus in the morning, thereby being tardy for or missing the first hour or two of school, is automatically dropped from those classes' enrollment lists. To avoid having these dropped

classes show up on a transcript, a student will often withdraw from that school and re-enroll in a neighboring school, one still within the Minneapolis Public School District. At times, there have been so many students shuffling from school to school that the transferred transcripts could not keep up with all of the moves. Having a later start for the first hour of class appears to enable more students to not oversleep and to arrive at school on time.

Findings

Enrollment

A key finding of this study is that the percentage of high school students who were continuously enrolled in the same district or in the same school had statistically significantly risen since the 1995–1996 school year. Concurrently, the percentage of students who were not continuously enrolled had decreased significantly. This means that an increasing number of students were staying in the same district or in the same school for 2 or more years, and the number of students who moved in and out of the district or moved from school to school declined steadily.

As previously noted, students in grades 9 and 10 change schools often for various reasons, including poor attendance or poor grades. By the time students reach grades 11 and 12, they often remain in the same school because they are near completion and discover it is no longer to their benefit to change schools. Also, students in grade 12 typically are past the mandatory age requirement for attending school, therefore they voluntarily choose to attend school. The researchers expected that the percentage of students continuously enrolled would be greater for those in grades 11 and 12 than for students in grades 9 and 10; but they also found that there was a statistically significant increase in the percentage of students in grades 9 and 10 who remained in the same school for 2 or more years (see Table 1).

It is important to note that during this time there were no other significant policy changes in the school district that might have compromised or otherwise affected the students' choices to stay in the same school. Minneapolis Public School District has a history of providing many choices for students, including open enrollment options and magnet schools. All of those opportunities were in existence both before and after the start time was changed. In other words, initiatives to keep students engaged in school were already in place before 1995, and yet the later start time still appears to have made a significant difference in keeping students in the same school.

Attendance

Attendance findings by grade level. Attendance patterns of students enrolled in grades 9–12 in Minneapolis high schools were categorized into two

Table 1. Percentage of Enrollment Rate in the Same School

School year	Grade 9		Grade 10		Grade 11	
	Continuous	Noncon	Continuous	Noncon	Continuous	Noncon
1995–1996	49.0	51.0	54.4	45.6	60.8	39.2
1996–1997	52.2	47.8	58.7	41.3	64.0	36.0
1998–1999	58.1	41.9	63.4	36.6	66.8	33.2
1999–2000	57.8	42.2	65.6	34.4	68.5	31.5

Note. Noncon = noncontinuous enrollment.

groups: students who were continuously enrolled in the same high school for 2 or more years and students whose enrollment was discontinuous (students who made frequent moves into and out of many high schools over the course of their 4-year high school career). Researchers examined data regarding attendance behavior before and after the changes in school start time. The findings for the second group are notable.

Students in grades 9 to 11 who remained in the same high school for 2 or more continuous years had consistently high rates of attendance, between 93% and 95%. Attendance for high school seniors was slightly more variable, with a range from 89% to 93% (see Table 2.) There were no significant differences between the years with the early start and the later start for any of the groups in grades 9 to 12 who were continuously enrolled in the same school.

Notable differences occurred, however, in the average attendance rates for students in grades 9 to 11 who were not continuously enrolled for 2 consecutive years in the same high school (see Table 2.) In the 2-year period (school years 1995–1996 and 1996–1997) when school started at 7:15 a.m., the average rate of attendance rate for noncontinuously enrolled students in grade 9 was 72%. During the 3 years after the later start time was in effect, the average rate climbed to nearly 76%. This change in attendance rate was highly statistically significant (at the .001 level). That is, the change in rate is not likely to be merely a chance occurrence. Equally notable were the improvements in attendance rates for students in grades 10 and 11. Their combined rates moved from an average of 73.7% with the early start to 77.5% with the later start, with the largest gains seen among students in grade 11.

Attendance rates for all high school seniors were variable by year, without significant differences after the later start time was initiated. This is likely attributable to the fact that those students chose to remain in high school when they otherwise could have legally withdrawn. They were committed to finishing high school regardless of what time of day school began.

Table 2. Percentage of Average Attendance Rates for Students in the Same School

Period	Grade 9		Grade 10		Grade 11		Grade 12	
	Enrolled	Not	Enrolled	Not	Enrolled	Not	Enrolled	Not
Prechange								
1995–1997	93	72	95	76	93	72	93	88
Postchange								
1997–1999	94	76	95	78	94	78	91	89
1998–2000	94	75	94	78	94	77	89	89

Note. Not = not enrolled for 2 consecutive years in the same school.

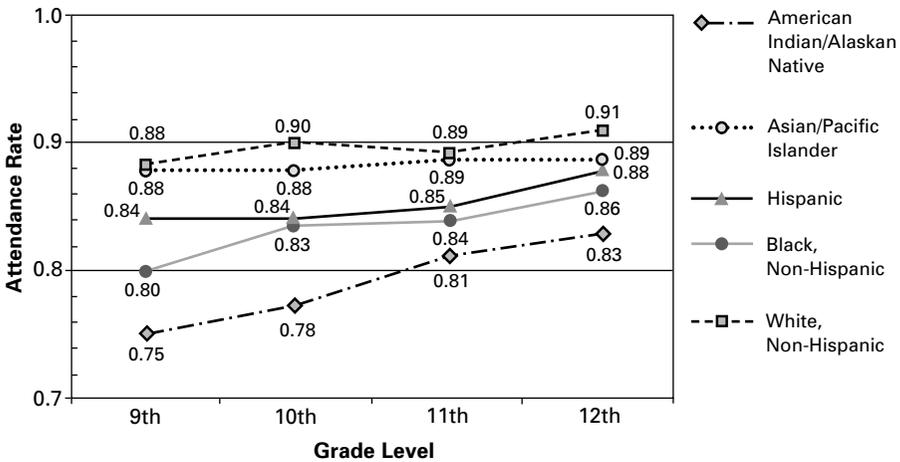
Attendance by ethnic group. All school districts report attendance data to the state annually. The state classifies students into one of five ethnic groups: American Indian/Alaskan Native; Asian/Pacific Islander; Hispanic; Black, not of Hispanic origin; and White, not of Hispanic origin. In examining the Minneapolis Public School District data for attendance rates of students by ethnic group, researchers observed two notable reasons for improvement in the attendance rates from pre- to postchange in start time. First, attendance improved as students progressed through grade level (e.g., 11th graders had better attendance than 9th graders). Second, after the change in start time, attendance improved for Asian, Hispanic, Black, and White students in grades 9 to 11. Among American Indian students, there was improvement in attendance grades 9 and 10, with a slight decrease in grade 11. Attendance rates for all ethnic groups in grade 12 were the same before and after the change in start time. The rate remains relatively high for 12th graders for all years, although the actual enrollment numbers of students enrolled in school have diminished steadily each year.

This information is summarized in two graphs. Figure 1 portrays data during the early start time, showing average attendance rates by ethnic group for the 2 years when the high schools started at 7:15 a.m. Again, one can see that attendance rates usually to improve as the students progress through grade level. Figure 2 illustrates the average attendance rates by ethnic group during the 3 years after the start time had been changed to 8:40 a.m. Attendance rates improved for Asian, Hispanic, Black, and White students in grades 9 to 11 from prior and after the change in start time.

Impact on Grades Earned

An analysis of letter grades earned in classes during the 3 years prior to and the 3 years after the change to a later start time was completed. This task was more complex and difficult than anticipated; there were more than a million data points. Data were anonymous, listed by student identification number. Issues of fair comparison within the data set arose for several reasons:

Figure 1. Early Start: Comparison of Average Attendance Rate by Ethnic Group



Course name. Titles of classes differed from school to school, so it was difficult to compare classes. For example, there were 642 differently named math classes among the seven high schools. This was also a problem in most other content areas (e.g., English, sciences, and social studies).

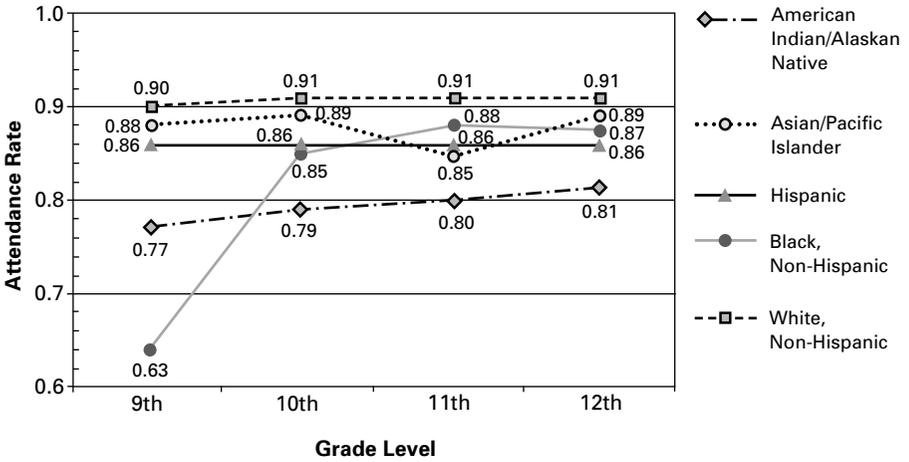
Schedule differences. Length of class periods (four periods of 90 minutes on the block schedule, versus a six- or seven-period day) and number of grading periods (semesters vs. trimesters) differed from school to school, making equitable comparisons difficult or impossible.

Student transience. Grades are kept by school, so if a student began a semester in one school and then moved in the middle of a semester to another school, then the class entries in the first school might be left blank for the listed courses, with the same student showing up in a different set of classes in the second school.

Data entry. If school personnel used a different spelling of a student's name when making an entry into the student record-keeping system or used an incorrect birth date, the assigned a new student identification number. Even with anonymous data, it was often apparent that the same student information had been entered into the system multiple times.

Missing data. Several hundred thousand data points (grades earned) were missing in the overall database. Grades earned were entered at the school level, and different schools achieved different levels of completeness in entering grades.

Figure 2. Later Start: Comparison of Average Attendance Rate by Ethnic Group



Given the numerous obstacles to obtaining “clean” data, the analysis took nearly a year. In the end, the comparison of students’ letter grades for 3 years prior to the change (starting time of 7:15 a.m.) and 3 years after revealed a slight improvement in grades earned overall, but the differences were not statistically significant. The trend lines for letter grades earned for all grade levels 9 through 12 for the years of the later start time are on an upward (positive) slope. Students’ self-report from a written survey on their grades earned corroborate this finding.

Grading is often a subjective action by teachers. Having a rubric in place to judge a student’s output fairly is one way to guard against uneven assignment of letter grades for student work. It is also important to recognize that few teachers use a rubric for evaluating every student assignment. The possible variability in teachers’ perceptions, therefore, adds incredible instability to the valid use of grades as a primary measure of impact for a new policy initiative, such as instituting a later high school start time. Additional issues complicating fair comparisons include possible grade inflation, grading policies that differ from district to district, and teacher turnover. A conclusion from the time-consuming and intensive data analysis examining actual grades earned is that districts will find it difficult to use letter grades when judging the efficacy of school start time changes.

Of the students who remained enrolled in Minneapolis high schools, few take either the SAT or the American College Test (ACT). Those students who do take these tests typically tend to be the most academically able, attend classes regularly, and are likely have study habits that supercede any tiredness they experience. As a result, it is difficult to compare their

scores with those of their suburban counterparts on nationally normed tests. It is equally problematic to compare the earned grades of Minneapolis students who took the SAT/ACT before and after the start time change because those students are a subsample of the total Minneapolis student population. They are likely to be academically successful no matter what the local policy is about the starting time of the school day.

Sleep Habits Survey: Selected Results

The School Sleep Habits Survey was administered to a stratified random sample of students in grades 9 through 12 in the Minneapolis Public School District in December 1997 (school year 1997–1998) and again in January 2001 (school year 2000–2001). In both years, all students surveyed attended schools with 8:40 a.m. start times. The survey was also administered in December 1997 to a stratified random sample of high school students in a demographically similar urban high school (anonymously identified as District B) who had a school start time of 7:30 a.m. Analysis of the complete data set, including all urban and suburban sites for which student survey data exists, is still in process; a sample of what has been found thus far is presented in Table 3.

Students in 1997 reported a mean weekend bedtime of 12:40 a.m., statistically similar to the weekend bedtime of 12:42 a.m. reported by students in 2001. Students in 1997 reported a mean weekend wake-up time of 9:51 a.m., and students in 2001 reported a mean weekend wake-up time of 9:49 a.m., not a statistically significant difference. The impact of circadian rhythms and similar weekend schedules (i.e., work, social life, and family time) in both years are likely contributing to the similar wake-up and bedtimes. That is, students in 1997 and 2001 were spending their time doing the same things during the same hours on the weekend and were therefore feeling tired, going to bed, and waking up at the same time.

Before the later school start time was instituted, many parents and administrators expressed a fear that students would merely use the later morning start time as an excuse to stay up an hour later on school nights. The data, however, show that this did not happen. Students continued to go to bed at the same time (approximately 15 minutes before 11 p.m.). This finding makes sense from a biological perspective, as it is likely that nighttime circadian rhythms were contributing to feelings of sleepiness around 11 p.m., regardless of what time the students woke up in the morning. Minneapolis students slept about an hour more each school night (due to the later school start time) than their peers whose school began at 7:30 a.m.

When additional data from the School Sleep Habits Survey were compared between those respondents whose high school started between 7:15 and 7:30 a.m. and those whose high school began at 8:30 a.m. or later, some of the

Table 3. A Comparison of Selected Sleep Survey Mean Scores From Minneapolis and District B High School Students

Survey items/scales	Minneapolis high schools (8:40 a.m. start) N = 467	District B (7:30 a.m. start) N = 169
School day rise time		
1997–1998	7:12 a.m.***	6:13 a.m.***
2000–2001	6:40 a.m.	6:19 a.m.
School night bedtime		
1997–1998	11:19 p.m.*	11:05 p.m.*
2000–2001	10:41 p.m.	11:18 p.m.
School night sleep total		
1997–1998	7 hr, 53 min***	7 hr, 7 min***
2000–2001	7 hr, 59 min	7 hr, 1 min
Daytime sleepiness	2.21**	2.50**
Sleepiness (10-item total)	15.38***	17.37***
Struggled to stay awake or fell asleep		
Reading, studying, doing homework	1.97***	2.39***
During a test	1.32**	1.48**
In a class at school	2.06***	2.45***
Doing work on a computer or typewriter	1.23	1.34
Sleep behavior (15-item total)	21.82*	23.26*
In the last 2 weeks		
Arrived late to class because overslept ^a	4.11**	3.77**
Fallen asleep in a morning class ^a	4.32***	3.90***
Fallen asleep in an afternoon class ^a	4.31	4.14
Depression (6-item total)	10.37*	10.89*
Days home sick over 2 weeks	0.75*	1.03*

^aHigher values indicate lower frequency.

*Row mean values significantly different, $p \leq .05$.

**Row mean values significantly different, $p < .01$.

***Row mean values significantly different, $p < .001$.

findings were striking. For example, the survey contained questions that measured feelings and behaviors often associated with depression. The survey was not designed to be a diagnostic tool in terms of clinical depression, but the students' responses were generally indicative of their overall emotional state. Students were asked the multiple-part question, "During the last two weeks, how often were you bothered by or troubled by the following: (a) feeling too tired to do things; (b) having trouble going to sleep or staying asleep; (c) feeling unhappy, sad, or depressed; (d) feeling hopeless about the future;

(e) feeling nervous or tense; (f) worrying too much about things.” Respondents replied to items a–f according to the following scale: 1 (*not at all*), 2 (*somewhat*), or 3 (*much*). The students whose high schools started at 8:30 a.m. or later reported statistically significant less depressive feelings on those questions than did the early start students (p ranged from $< .05$ to $< .001$.)

Similarly, scores on questions measuring daytime sleepiness, the struggle to stay awake in class, and sleepiness while doing homework all showed statistically significant better outcomes for the students whose school day started later. For example, students in late-start schools reported being less likely to arrive late to class because of oversleeping, or to fall asleep in a morning or afternoon class, or to feel sleepy while taking a test. They also reported statistically significant fewer feelings of sleepiness when at a computer, reading, or studying. (Detailed information about these findings can be found at: http://education.umn.edu/CAREI/Programs/start_time/VIIexec_summ.html).

Many of the benefits of the later start time were similar for both urban and suburban students, with their actual scores being nearly identical despite the differences in their local economic conditions. Again, if the need for and the benefits of more sleep are a biological phenomenon of the human body during the adolescent years, then one would expect those kinds of results, which are not related in any way to socioeconomic status.

Student Focus Group Findings

In spring of 2001, student focus groups were conducted at each of the seven Minneapolis high schools. The groups comprised either 9th and 10th grade students, or 11th and 12th grade students. Each group had about 6 respondents. Preliminary findings indicate that students cannot imagine returning to an earlier starting time because it would mean getting out of bed an hour earlier. Still, they have found that the later start time has had some negative, as well as positive, outcomes. The following quotations from students portray the range of opinions about aspects of the later start time.

About sleepiness in school, students said:

I get awake by the time I get to school, but if it's earlier, I get so much more tired. I think my sleep schedule, especially, is much more towards the middle of the day. It's like, after midnight to about noon. So, it's a lot easier with a later start time because I don't fall asleep until that time anyway, so moving it back would just compress that.

I think I'm awake at school. I've never fallen asleep at school. I don't fall asleep during the day. I just don't. I find that if I stayed

up late—like 2 o'clock doing homework or whatever—then, even though I'm sleepy, I can hear stuff. But I'm a lot more detached and tired, and I can't concentrate nearly as well. Getting to bed earlier doesn't really help, because I don't fall asleep.

Sleeping in class?... It's mostly during the earlier hours. Like first hour, a lot of people sleep, second hour some people sleep. It kind of tapers off.

Students commented about the impact of the change on sports:

The problem that I have with the later start times is that [the last class] hour for me is really hard because that is when I play softball in the spring. Every time we have a match, I end up getting out early.

Yeah. And like last semester, or last spring, I had a really hard time keeping up with my sixth hour grade because I would keep getting out of class almost every day.

Sometimes, like when I have practice for football, it's real tiring. It starts around 3:30, ends around 6 sometimes, 5:30. I catch a city bus, and sometimes I don't get home until 8 or so. Now I'm not playing football. I'd rather have more time in the afternoon to do that.

And students registered their overall perspectives:

I think school starts at a good time. It's just that it would go a lot better if it was a little later, because people would have more time to actually get up and eat breakfast and do those little things they normally do to get themselves prepared to go anywhere else during the day if it wasn't school. And we get out at a good time. I think we're in a pretty comfortable spot, actually.

After school, I have to go home and do homework. That takes up all the time. I think if school started earlier, got up earlier, [I'd] probably have the time to focus and get everything done without rushing.

I don't think it [the later start] affects my grades, but it does affect my stress level.

Teacher Perspectives

In fall of 1996, 578 high school teachers (grades 10–12) in 17 suburban school districts responded to a written survey that asked them to indicate the time they believe high school classes should begin for optimal learning by students. The results in Table 4 show that more than half believe the optimal start time is between 8:00 and 8:30 a.m. It is also important to note that 92% of the teachers who responded to this survey teach in high schools that start between 7:15 and 7:35 a.m.

In spring of 1998, at the end of the first year that Minneapolis high schools had made the shift to an 8:40 a.m. start, 335 Minneapolis high school teachers responded (response rate of 67%) to a mailed written survey asking questions about their views of the effect of a later start time. Results from that survey indicated that more than 57% of the teachers reported a greater number students being more alert during the first two periods of the day than had been the case with the earlier start time. Of the respondents, 51.4% agreed or strongly agreed that fewer students were sleeping at their desks. They had evenly divided opinions about whether or not students expressed positive feelings about the change and were also evenly divided about whether or not the later start had had a positive impact on their teaching.

In contrast, during focus groups and interviews with suburban teachers whose high school changed to an 8:30 a.m. start time, most respondents expressed having experienced a positive effect from the later start. They were nearly unanimous in the view that students were more alert throughout the day. The teachers also cited the benefit of more team planning time in the morning before students arrive, and they stated that fewer students were sleeping at their desks during class.

In all districts with the later start in the morning, afterschool athletic and other activity practices, extended-day programs, and rehearsals were shortened, with students arriving home at a later hour than they did in 1997. However, actual participation rates in afterschool activities, including sports and cocurricular activities, remained at the same levels after the implementation of the later high school start time as they had been before the change. Coaches and activity leaders were generally supportive of the change because they saw students who were less tired and seemingly more mentally alert at the end of the day. A few coaches whose sports involved long practices and traveling long distances for events were outspoken about their dislike of the later start and dismissal time for the school day.

Administrator, Counselor, and Parent Perspectives

High school principals were personally interviewed about what changes, if any, they saw in their schools as a result of the change to a later start. The most common response was that the mood of the students in the hallways,

Table 4. High School Teacher Opinions of Optimal Start Time of First Class for Majority of Students

Time	N	Percentage
6:30	2	0.3
7:00	6	1.0
7:15	12	2.1
7:30	98	17.0
7:45	35	6.1
8:00	183	31.7
8:15	53	9.2
8:30	132	22.8
8:45	9	1.6
9:00	26	4.5
9:15	0	0
9:30	4	0.7
9:45	1	0.2
10:00	7	1.2
Other	1	0.2
No opinion	9	1.6
Total	578	100

during passing times, was now calmer. They also cited that calmness as being evident in their student cafeterias during lunch. As a result, 5 of the 8 principals noted that they were dealing with fewer disciplinary referrals to their offices. With fewer students arriving tardy, their offices were much less congested in the morning, and there were fewer record-keeping tasks associated with tardiness and students dropping out of their first-hour classes.

Seventeen school counselors and 3 school nurses also provided personal comments, noting that significantly fewer students were coming to them to report peer relationship problems and/or difficulties with their parents. They echoed the principals' perceptions that the overall mood in their schools was calmer, with the students' temperaments seeming much more even.

Parents who attended their child's high school conference were asked to complete a written survey; about 92% of suburban parents supported the change. Their negative comments centered on the later time that their children were now coming home after participating in afterschool activities or sports. Urban parents were interviewed in focus groups; their reactions were more mixed, often with negative comments related to changes required in work schedules and transportation limitations. Both urban and suburban parents noted that their high school children were "easier to live with." They

found that they were having fewer confrontations with their children in the morning about getting out of bed and getting to school on time. They also commented that they were having more actual conversations with their teenage children in the morning, finding that they had new “connection time” with their child.

Summary—Who Benefits?

Numerous “beneficiaries” of a later high school start time emerge from the evidence in the study. The students benefited the most. For example, attendance rates for all students in grades 9, 10, and 11 improved in the years from 1995 to 2000, with the greatest rate of improvement for grade 9 students. Furthermore, students who did not have a pattern of continuous enrollment in the school district showed a marked improvement in their daily attendance rates after the initiation of the later start time in 1997–1998.

Perhaps the most surprising finding was the discovery that Minneapolis high school students continue to get an hour’s more sleep each school night than is the case for students whose schools begin an hour earlier. The increased sleep was a finding after the first year of the late start, and it continued to be true 4 years into the change. This is contrary to the fears and expectations that a later start would result in students staying awake an hour later on school nights. Instead, students in Minneapolis high schools get 5 more hours of sleep per week than do their peers in schools that start earlier in the day.

Educational Importance of the Study

The initial findings from this longitudinal study lead to important considerations for school administrators. Addressing the needs of students who are at-risk learners, at risk for dropping out of school, or both is a universal concern. These are often students who have insufficient credits for graduation because they have missed too many first and second hour classes. The study reveals that attendance rates improved significantly when the high schools initiated the later start time; this suggests that changing start times is one way to recapture those students who might otherwise not complete high school.

Skeptics of the possible benefits of a later start to the high school day frequently cite the need for objective evidence, such as improved grades, as proof that the initiative is worthwhile. The use of grades as a sole determinant of a new program’s success is shortsighted. In reality, grades are often a rather subjective measure due to local factors such as grade inflation, curricular changes, teacher and administrator turnover, and changes in assessing student work. A minimum of 3 years’ worth of grades is needed to gauge any possible changes, and the complicating factors noted here cause the utility of grades earned to be, at best, only one measure among many. There are other equally important measures of impact, such as student physical

and emotional well being, benefits associated with teaching and learning, and improved family relationships.

Furthermore, an important aspect of this study is the integration of the medical and educational research communities. It is not often that medical research has immediate relevance to discussions among educators. In this study, however, the biological sleep needs of adolescents and the structure of the school day become instant, and somewhat indivisible, partners. Similar studies on students have recently been completed in Brazil, Italy, and Israel (Andrade, Benedito-Silva, Domenice, Arnhold, & Menna-Barreto, 1993; Giannotti, Cortesi, & Ottaviano, 1997; Sadeh, Raviv, & Gruber, 2000). Those studies have revealed that the sleep-wake cycle for students in those countries is nearly identical to that found among students in the United States. In other words, the sleep phase shift occurring in adolescents' neurological systems is not culturally based; it is, instead, a phenomenon of human development.

The tension between acting on facts and the politics that ensue in a discussion about changing school start times is a key characteristic of this type of school reform effort. Interviews with principals, superintendents, and school board members revealed that making the decision to alter a school's start time—in effect, to alter the community's rhythm—is considered to be extremely risky behavior. This also appears to be true for the superintendent and for members of the school board, who revealed in interviews a fear of being replaced in their roles if the debate about a later start time divided and polarized the community. As a result, many districts have chosen not to change school starting times for any grade level.

Transportation costs are often cited as the reason that the change will not work in a district. In fact, neither the suburban school district of Edina, Minnesota nor the urban district of Minneapolis, Minnesota, found that the change to a later start increased their transportation costs. The same buses and routes were used; the only changes made were the times the buses used the routes.

As other districts consider the change to a later start for their high schools, it is clear that it is and will continue to be an extremely contentious decision because administrators do not want any local advocacy group or state policymaker to interfere in a decision normally made at the district level. The interrelated dynamics include the school board and their political relationship to the superintendent; the role of principals and their involvement in the decision; the role of data for and against the change; and the voices of teachers, students, and families and their perceived needs.

However, asking stakeholders in advance whether or not to make the change, without first impartially sharing and discussing the complete array of findings, will almost certainly lead to their disapproval of the idea. The process of change is unsettling to most people; change interferes with

feelings of stability and continuity. When routines are upset, it is human nature to react negatively. Thus, the mixed feelings of Minneapolis students, teachers, administrators, and parents are normal and should come as no surprise. Nevertheless, the fact that later school start times can now demonstrate some positive long-term effects should cause districts to seriously consider whether such a change might be feasible for them.

Good policy decisions are made with good data. The data from the Minneapolis study, combined with current knowledge of physiology of adolescent maturation and brain development, give some clear markers to districts concerned with the overall well being of their teenage students. This research is not intended to indict current and past practices for school start times, but rather (to paraphrase Ted Sizer) to “challenge the regularities of schooling” by better illuminating the path toward healthy policy decisions for all students. ☘

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