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Academic Impacts of Later School Start Times

Nicole Swain

nswain1@cougarmail.collin.edu

Tuyet Tran

ttran112@cougarmail.collin.edu

Daphne Carrier

Collin College, daphnercarrier@gmail.com

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Literature Review

Research in progress for PSYC 2301: Honors General Psychology

Faculty Mentor: Jennifer L. O'Loughlin-Brooks

The following paper represents research produced by students in an Honors General Psychology course. The class assignment introduces students to scientific research and writing through a team-based approach. Each individual student team, composed of two or three members, conducts a comprehensive literature review on a specific psychology topic of their choosing. They summarize and evaluate at least seven pieces of scholarly work, discuss future areas of investigation for the field, and explain how this research might add qualitatively to the existing knowledge of the discipline. In addition, student teams interview at least one expert in their research area and include that interview as a primary source of information.

Nicole Swain, Tuyet Tran, and Daphne Carrier researched sleep in teens and posited that many adolescents lack the necessary amount of sleep for their physical health and cognitive functioning (Dunietz et al., 2017). The students proposed that a significant contributing factor to lack of sleep among adolescents is early start times for middle and high school, with later school start times correlating with reduced health problems, behavioral issues, and motor vehicle accidents among adolescents (Morgenthaler et al., 2016). Schools with later start times also frequently observe improvements in attendance, grades, and standardized test scores (Marx et al., 2017). To better understand the relationship between school start times and academic achievement, the review incorporates personal interviews with sleep research experts.

Academic Impacts of Later School Start Times

Nicole Swain, Tuyet Tran, and Daphne Carrier

California governor Gavin Newsom signed a bill in October 2019 mandating that high schools in the state start no earlier than 8:30 am (Hauser & Kwai, 2019). In recent years, the movement to delay start times of middle and high schools has gained momentum with organizations like the American Psychological Association (APA, 2014) and the American Academy of Pediatrics (Adolescent Sleep Working Group, 2014) endorsing the idea that adolescents should not start school before 8:30 am. Parents and educators have historically assumed that teens have difficulty waking early in the morning because they choose to stay up too late or are lazy (Kelley et al., 2015). However, recent scientific research has shown that multiple biological changes occur during adolescence that alter the timing of sleep and make it difficult for teenagers to simply go to bed earlier. Melatonin production and the circadian rhythms shift later by up to two hours around the onset of puberty (Owens et al., 2014). In addition, the homeostatic system responsible for creating sleepiness is altered, and pressure to fall asleep builds more slowly even after increasing time awake (Kelley et al., 2015). These shifts occur at a time when adolescents still need over nine hours of sleep per night (APA, 2014).

Literature Review

Foundations for Learning

Sleep

While biological changes are pushing adolescents to go to bed and wake later, most schools require attendance early in the morning. The Centers for Disease Control and Prevention estimated that over 80% of middle and high schools in the United States start before 8:30 am, with the average start time around 8:00 am (Hafner et al., 2017). Data from yearly surveys of adolescents shows that sleep time has been decreasing over the past 20 years (Keyes et al., 2015), and recent national surveys suggest that less than one-third of high school students get at least eight hours of sleep per night (Morganthaler et al., 2016).

Sleep plays a vital role in learning, memory, and attention (APA, 2014), and insufficient sleep can interfere with these processes. Sleep may also be involved in the development of the brain, leaving adolescents more vulnerable than adults to the effects of sleep deprivation (Tarokh et al., 2016). In controlled experiments, the ability of adolescents to perform learning-related activities in simulated classroom settings was reduced after sleep deprivation (Beebe et al., 2017; Lo et al., 2016). Similar results were found in a regular classroom setting where shorter sleep time was associated with decreased attention and poorer test performance (Lufi et al., 2011). A large population-based study in Norway also found an association between longer sleep duration and better academic performance in adolescents (Hysing et al., 2016). Teens are not always aware of this effect and tend to underestimate the impact of a sleep deficit on their

cognitive abilities, which reduces their motivation to improve sleep habits (Dimitriou et al., 2015). Findings from a longitudinal survey on adolescent sleep habits suggest that adolescents from minority and lower socio-economic status groups are more likely to be unaware that they are getting insufficient sleep (Keyes et al., 2015). Combined, this area of literature suggests that adolescents need adequate amounts of sleep to be successful in their school-related activities. As such, researchers and school districts should evaluate the implementation of later school start times.

Delaying the start times of middle and high schools may seem like a simple solution to the issue of insufficient sleep during adolescence; however, changing school schedules is logistically complicated for many districts. The most common concerns voiced by school administrators and parents are related to transportation costs, child-care, and reduced time for athletics, other extra-curricular activities, or after-school jobs (Hafner et al., 2017). However, case studies of schools that have rearranged their schedules show that "anticipation is often worse than reality" (Owens et al., 2014, p. 198), and expected problems frequently fail to materialize. In addition, schools have also been able to find creative solutions such as providing before-school breakfast and study halls to students who prefer to arrive at school earlier (Meltzer et al., 2017).

Physical and Mental Health

Many arguments for delaying school start times are based on the economic benefits of these changes due to long-term decreases in health problems and increases in productivity among students who start school later (Hafner et al., 2017). For instance, delaying school start times and improving sleep are correlated with healthier weight in

adolescents (Mitchell et al., 2013) and a lower rate of motor vehicle accidents (Foss et al., 2019; Vorona et al., 2014). A recent review that focused on the relationship between school start time and mental health in adolescents found that starting school later was associated with fewer depressive symptoms and improved interpersonal relationships (Berger et al., 2018).

Attendance

Regular attendance at school is important for academic success, and many studies have found a relationship between later start times and improved attendance. For instance, Wahlstrom and colleagues (2014) found an overall increase in attendance and reduction in tardiness among six school districts with later start times. This three-year study was conducted with over 9,000 students across three states. While the effects were only statistically significant in certain schools, the authors postulated that the other schools had little room for improvement because they already had high attendance rates. In a survey of four districts (Owens et al., 2014) which averaged 45-minute-delayed start times, only one school saw a decrease in tardiness and absences. However, data suggests that longer delays may be more effective in improving attendance, especially tardiness. The longer start times are delayed, the more tardiness decreases (Wahlstrom et al., 2014).

Studies that focused on a single school or aggregated data from multiple schools also found data to support the relationship between a delay in school start time and improved attendance (Kelley et al., 2017; McKeever & Clark, 2017). Research that has analyzed data for absences and tardiness separately supports later school start times

as being more strongly correlated with tardiness and missed first classes than with days absent from school (Owens et al., 2010). It appears that this reduction in students arriving late to school persists even after students have been starting at a later time for several years (Thacher & Onyper, 2016). The long-term reductions in tardiness provided support to the hypothesis that delays were effective because they aligned the start of school with teens' biological clocks, as opposed to the novelty of new school hours having temporarily boosted on-time arrivals. Dunster and colleagues (2018) conducted a longitudinal study of students in Seattle public schools and found the largest effect on attendance, after an hour delay in start time, was seen in students in an economically disadvantaged school. This finding indicates that certain subgroups of students may benefit disproportionately from changes to school schedules.

While research has suggested a link between start time and attendance, these studies were correlational and did not allow for the determination of a causal relationship. Peter Hinrichs (2011) found that effects on attendance seen after a change in school start times may be overstated, and that reductions in absences and tardiness may be a continuation of trends present prior to start time changes. However, there are multiple mechanisms by which a delay in the school day could reduce absences and tardiness. When the start time is aligned with adolescents' natural preferences for wake time, it is easier for them to wake up in time for school. In addition, if a delay in school start times improves students' health, absences for physical and mental illnesses might decrease (Hysing et al., 2016). Overall, this area of work suggests that later start school times have benefits for adolescents and warrants further investigation.

Academic Success

Standardized Test Scores

Research supports a link between later school start times and improved scores on standardized tests, though effect sizes vary between studies. Significant increases in standardized test scores were seen in both middle school students (Edwards, 2012) and high school students (Kelley et al., 2017) following a delay in school start time. Studies of multiple school districts found a mix of data, with some schools reporting significant improvements following a start time delay and others reporting insignificant effects or no changes (Owens et al., 2014; Wahlstrom et al., 2014).

There are several possible pathways through which a delay in school start time could affect test scores. In a large cohort study, Groen & Pabilonia (2019) found statistically significant improvements on academic test scores after a delay only for female students. The authors noted that female students were more likely than males to report an increase in sleep after a start time change. Male students were also more likely to report more sleep at night with later school start times, but due to a decrease in napping total daily sleep remained unchanged, implying that the improvement in scores may be directly related to sleep duration. More research on gender differences in test performance due to sleep length is needed.

Kelly and colleagues (2017) experimented by delaying school start time in a school district for one year. They found that students' test scores rose during the trial year and that these gains persisted after the school returned to an earlier start time. This study provides evidence that increased learning appears to be taking place when

schools start later and that this learning is retained even when schedules change. The gains which students made while start times were delayed could benefit them for years later, and adolescents who start school later may have an advantage well into college and early adulthood. However, Hinrichs (2011) found no effect on ACT scores after delays in school start times and postulated that this might be due to the test being given early in the morning; this would suggest a link between sleep-wake cycles and test performance. Since the research is mixed in terms of later school start times on standardized test scores, more research is needed to evaluate this relationship.

Grade Point Average

Grades are one of the simplest academic variables to study because they can be obtained by self-report or from school records. They are also one of the most confusing variables, as grades are frequently subjective, and grading metrics vary between schools and teachers (Wheaton et al., 2016). In studies of multiple school districts, some schools experienced significant improvements in GPA following a delay in school start times and others did not report changes (Owens et al., 2014; Wahlstrom et al., 2014). A comparison of eighth grade students in early- and late-starting schools found a strong relationship between later start times and better grades (Lewin et al., 2017). Researchers studying the Seattle public schools found a 4.5% increase in GPA after an hour delay in start time (Dunster et al., 2018). However, a 30- minute start time delay at a Rhode Island high school showed an insignificant effect on grades (Owens et al., 2010), and studies from high schools in New York and South Korea that each delayed start times showed no effect on GPA (Rhie & Chae, 2018; Thacher & Onyper, 2016).

This could have occurred because the majority of students in these schools already had high GPAs, and there was not room for significant improvements (Owens et al., 2010). Moreover, students' grades in schools with later start times were compared to control schools that also saw increases in GPA (Rhie & Chae, 2018).

A study at the US Air Force Academy (Carrell et al., 2011) provided the strongest support for a causal relationship between school start time and GPA. Freshman were randomly assigned to either have a first period class at 7:00 am or to not start their day until second period; students who did not attend first period classes had a significantly higher GPA overall than their peers. This study also found that the effect was significantly reduced when first period classes were moved to 7:50 am and second period was correspondingly delayed, which implies that the most benefit for older adolescents may be derived from eliminating start times before 8:00 am. Together, this area of work suggests that later start times may positively affect grade point average (GPA) in adolescents, with older adolescents possibly benefiting most.

Interviews with Researchers in the Field

The existing research suggests that adolescents benefit when schools start classes later. However, there is scant literature on mechanisms behind the improvements in academic performance. To better understand the different ways in which sleep affects school success, we spoke with Dr. Judith Owens, Dr. Galit Levi Dunietz, and Phyllis Payne, MPH.

As many who work in the field of education question whether delaying the start times of schools will increase the amount of time adolescents sleep, we were interested

in hearing the opinions of researchers in the field on this issue. Some parents and teachers have expressed concern that students would compensate by delaying their bedtimes, and there would be no net gain in total sleep after a delay. The researchers we interviewed acknowledged that school start time is not the only factor that affects the duration and quality of sleep for adolescents. Adolescence is a time of increasing independence and new roles, and many factors can affect the timing and quality of sleep. Dr. Dunietz discussed her research that suggests a heavy academic load, extra-curricular activities, employment, screen time, and caffeine consumption could all impact the adolescents' ability to get enough sleep (G.L. Dunietz, personal communication, November 18, 2019). Similarly, Dr. Owens noted that the use of electronic devices in the evening hours can interfere with falling asleep because the blue light from screens suppresses the release of melatonin (J. Owens, personal communication, November 18, 2019). She recommends that students who study in the evenings should avoid using electronic readers or computers in the hours just before bed. Lastly, Payne stated that preparing for bed by doing something calming in a low-light setting is ideal for sleep quality, and that students would be better off studying during the day or earlier in the evening (P. Payne, personal communication, November 18, 2019). Our separate interviews across three professionals in this field show that there are many variables at work that contribute to adolescent sleep timing, and later school starts could mitigate some of these factors that negatively impact their sleep.

Despite these other influences, research has revealed that delaying school start times does usually increase the amount of time adolescents sleep. Dr. Owens pointed

out that when schools start later, even students who delay their bedtimes do not usually stay up substantially later and most students sleep longer in the morning (J. Owens, personal communication, November 18, 2019). In fact, our interview with Payne directed us to a growing body of literature that suggested that "though effect sizes varied, correlational studies indicated a positive relationship between later school start times and longer sleep times, such that students who started school later also indicated longer sleep times" (Nahmod, et al., 2017; Paksarian, et al., 2015; Patte, et al., 2017). One review of the literature on school start times found that a delay of less than 60 minutes in the start of school resulted in an average increase in total sleep time of 18 minutes, while a delay greater than 60 minutes led to an average of 52 minutes more sleep (Morgenthaler et al., 2016). Dr. Owens explained that, "*When* you sleep as well as *how much* you sleep is critical." She noted that a misalignment of the environment and the body's circadian rhythm interferes with functioning. According to Dr. Owens, the best cognitive performance would occur if teens went to bed at their natural "fall asleep time" and woke up in the morning according to their natural body rhythms (J. Owens, personal communication, November 18, 2019).

Dr. Dunietz expanded on this aspect of adolescent sleep when she discussed the concept of chronotype, which describes a genetic predisposition to awake and go to bed at certain times. While some people have a lifelong preference for being awake early in the morning or late at night, the biological changes occurring at puberty shift most adolescents toward an "eveningness" chronotype. "As a result, teens' natural sleep preferences evolve toward 11:00 pm bedtimes and 8:00 am wake times," (G.L. Dunietz,

personal communication, November 18, 2019). Studies have found that melatonin production in adolescents peaks at around 7:00 am before declining, making 8:00 am a natural rise time for this age group (Carrell et al., 2011). Payne noted that the health risks and other issues associated with shift work demonstrate how aligning sleep and activity with internal circadian rhythms is essential for functioning and that moving the start of school later helps align the school day with the most effective times for adolescents to focus and learn new information (P. Payne, personal communication, November 18, 2019). Peak times for adolescent alertness and learning occur later in the day, with adolescents scoring twice as high on tests of general attention in the afternoon as they do at 8:00 am and performing better on tests later in the day (Kelley et al., 2015). Additionally, long-term memory in adolescents also appears to improve in the late afternoon and early evening (Marx et al., 2017).

Owens pointed out that later school start times allow adolescents to remain on the same sleep schedule during the weekday and weekends (J. Owens, personal communication, November 18, 2019). Many adolescents have sleep variability between weekdays and free days; they sleep late on weekends to compensate for the sleep debt that they accumulate during the week. This variability in schedules exacerbates the disruption of circadian rhythms and reduces daytime functioning (Owens et al., 2010). Owens explained that research showing sleep pattern variability has been associated with deficits in attention, lower academic performance, and increased mental health issues (Paksarian et al., 2015).

The researchers with whom we spoke emphasized that the benefits of later school start times extend beyond academic achievement. Payne mentioned the effects of later school starts on car accident rates and sports injuries (P. Payne, personal communication, November 18, 2019). Dr. Owens reminded us of the improvements seen in adolescent mental and physical health (J. Owens, personal communication, November 18, 2019) and Dr. Dunietz noted the decreases in behavioral issues in school (G.L. Dunietz, personal communication, November 18, 2019). All of these areas are important individually for adolescent health and collectively improve the chances for adolescents to succeed academically.

Challenges

Data Collection

Investigating the relationship between delayed school start times and academic performance poses some challenges for researchers. For example, using randomized controlled trials to investigate the effects of delaying school start times is not practical. A recent attempt to implement a controlled study found that schools declined to participate due to concerns about randomization (Illingworth et al., 2019). Most research has been conducted using cross-sectional or longitudinal study designs. In their review of the school start time literature, Wheaton and colleagues (2016) note that both these study types have drawbacks. Cross-sectional studies which compare early and late starting schools have difficulty accounting for other variables like socioeconomic status of students. Longitudinal studies comparing data from the same grade and school over the years can encounter the same issue with extraneous variables; studies that follow a

cohort of students can find it difficult to differentiate changes due to start times from changes due to maturation of the cohort. In some cases, the surveys used to collect data from students, parents, and teachers were problematic. While several validated surveys regarding adolescent sleep have been published, many schools still use self-designed instruments (Ziporyn et al., 2017). These surveys may not allow for the collection of accurate data, and their use has made comparison of results between schools difficult.

Community and Parental Support

Community and parental support for school start time changes are important for successful implementation. One survey found that family support or opposition to a later school start time was primarily dependent on parental expectations of the change having a positive or negative impact on their children's lives (Dunietz et al., 2017). For example, Dunietz and colleagues (2017) found that almost 50% of parents believed seven hours of sleep was sufficient for their adolescent child, and the authors suggested that educating parents about the increased need for sleep in adolescence could increase support for later school start times. In their analysis of communities that have successfully changed school schedules, Owens and colleagues from the Adolescent Sleep Working Group (2014) noted that education of parents and other stakeholders, along with strong leadership and flexibility, was one of the most important factors contributing to a smooth transition to later school start times.

Directions for Future Research

While the relationship between school start times and academic achievement is difficult to study under controlled conditions, future research in this area should attempt to minimize confusion by using standardized measurements (Ziporyn et al., 2017). Studies should also standardize their definitions of early and late start times to determine if improvement is proportional to the amount of delay or if the largest effect is related to simply eliminating extremely early start times (Millman et al., 2016). Since academic grades are subjective and grading rubrics vary between schools and teachers (Wahlstrom, 2002), standardized tests/other validated measures should be implemented in future studies. In addition, future investigations into the benefits of delaying the start of the school day should focus on specific subgroups of students. Research has found that students of racial and ethnic minorities and from lower socio-economic areas are less likely to get adequate sleep (Keyes et al., 2015). Preliminary evidence suggests that students in economically disadvantaged schools (Dunster et al., 2018), or low- performing students (Edwards, 2012) may benefit disproportionately from later school start times. As such, future studies should investigate the impact later school start times has on racial- ethnic, low SES, and other minority groups.

In conclusion, educating both families of teens and the professionals who work with them on the physiology of sleep is crucial to improving dialogues regarding the effects of delayed school start times. Future research should also explore the most effective ways to provide the benefits of later start times to students while minimizing the disruption to communities. While shifting the school day creates issues for both

families and schools, the literature available suggests the benefits for adolescents make negotiating these challenges worthwhile.

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