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Morningness/eveningness and school performance among Spanish adolescents: Further evidence

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ABSTRACT

Adolescents shift their time of day preferences from morning to evening during puberty when school schedule becomes earlier. Given that a better performance is obtained when individuals are tested at times that are in synchrony with their chronotype, and optimal sleep duration is positively associated with academic performance, evening-types may obtain worse school performance because of both morning school schedule and a decrease of total sleep time. A group of 1133 adolescents (aged 12–16) participated in this study. School performance was evaluated using subjective level of achievement and self-reported grades measures. Controlling for total sleep time, more evening oriented young adolescents (12–14 years) performed significantly worse in school achievement. Girls among 15–16 years performed significantly better than boys. These results have important implications for intervention and prevention programs during school years.

1. Introduction

Humans differ in their time of day preferences. Morning-types (M-types) or "larks" prefer to wake up and go to bed early and feel at their best moment in the morning (mental, physical, and social activities) whereas Evening-types (E-types) or "owls" prefer later bedtimes and rise times, become progressively more alert across the day and feel at their best moment in the evening. Neither-types (N-types) show an intermediate position.

Because circadian types differ in their sleep–wake patterns as well as in their feeling at their best moment for doing different activities at different times of day, the practical implications of these findings have been applied to diverse fields, such as the design of working schedules (Pisarski et al., 2006) or sport performance (Drust, Waterhouse, Atkinson, Edwards, & Reilly, 2005). Although several studies have analyzed asynchrony between circadian typology and work schedules in adults (see Saksvik, Bjorvatn, Hetland, Sandal, & Pallesen, 2010), less attention has been given to performance among adolescents during the school year in a fixed and continue schedule (Carskadon, 1990; Clarisse, Le Floc'h, Kindelberger, & Feunteun, 2010; Randler & Frech, 2009; Wolfson & Carskadon, 1998).

Previous research has found that a preference for evening hours appears during puberty (Carskadon, Vieira, & Acebo, 1993; Díaz-Morales & Gutiérrez, 2008; Randler, 2011a), consequence of both the maturation processes typical of puberty (Hagenauer, Perryman, Lee, & Carskadon, 2009), and the many changes in the adolescent's relational and social sphere such as school demands, new social opportunities, and diminution of parental supervision (Randler, Bilger, & Díaz-Morales, 2009; Takeuchi et al., 2001). Accumulating evidence indicates that sleep and Morningness/Eveningness (M/E) have effects on school performance. It is well-known that short sleep duration and poor sleep quality are negatively associated with school performance (Gruber et al., 2010; Wolfson & Carskadon, 2003). Adolescents go to bed progressively later and although it may seem that they need less sleep time, they do not get enough sleep, because optimal alertness in adolescents requires on average 9 h of sleep per night (Carskadon & Acebo, 2002). E-types report shorter sleep time than M-types (Megdal & Schernhammer, 2007). On the other hand, M-types tend to be more regular in their lifestyle than E-types (Gaina et al., 2006; Díaz-Morales, Delgado, Escribano, Collado, & Randler, 2011) and higher lifestyle regularity has been associated with better daytime functioning (Wolfson & Carskadon, 1998).

Human cognitive performance changes over the day. Numerous studies have confirmed a synchrony effect with better performance at times that match individuals' preference, in the morning versus in the afternoon (Hasher, Goldstein, & May, 2005; May, 1999). Goldstein, Hahn, Hasher, Wiprzycka, and Zelazo (2007) found that performance was better on Digit Span and Block Design measures when adolescents (11–14 years) were tested at times that were in synchrony with their preferred time of day versus at times that were not.

Taking this line of argument further, one may assume that evening preference increases the risk of poor school performance due to early school schedules. However, few studies have been realized among adolescents aged 12–16 years during the typical (morning) schedule of school environment. Giannotti, Cortesi, Sebastiani, and Ottaviano (2002) found worse performance among evening adolescents aged

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14–18 years, whereas Beşoluk (2011) and Randler and Frech (2006) found that pre-university students with morning preference seemed to be at an advantage in university entrance examinations. Using a wider range of age (11 to 23 years) Borisenkov, Perminova, and Kosova (2010) have recently found that students with low and mean achievement scores had a 55-min phase delay and reported less sleep length.

Considering these aspects, it seems relevant to analyze adolescents' school performance because of their shift to evening preference and earlier school schedules during Compulsory Secondary Education (12–16 years). Using a large sample of adolescents who were tested under their daily educational routine, contribute to further evidence about this topic.

The aim of this study was to assess school performance according to chronotype (Morning, Neither or Evening-type) in a large sample of Spanish adolescents aged 12–16 years. The most high-school in Spain begins between 8.00 and 8.30 am and ends between 2.15 and 3.00 pm with a traditional Spanish school week from Monday to Friday.

One would expect better school performance in M-types who go to school in synchrony with their preferred time of day, in a morning and fixed school schedule whereas E-types would obtain worse school performance because of early morning scholar schedule.

2. Method

2.1. Participants

In this study participated 1133 adolescents aged between 12 and 16 years (M = 14.07, SD = 1.26). 50.5% were girls. All adolescents were studying Compulsory Secondary Education in six schools of Madrid (Spain). The board of directors authorized the study after obtaining the parents' consent. Participation was voluntary and anonymous.

2.2. Instruments

2.2.1. Morningness/eveningness

Participants completed the *Morningness/Eveningness Scale for Children* (*MESC*; Carskadon et al., 1993). This scale is a validated adaptation of the Composite Scale of Morningness (Smith, Reilly, & Midkiff, 1989) that is used to measure *M/E* orientation in adolescents. The scale has 10 items about the preferred timing of such activities as recess, tests, sleep timing, and so forth. It has a response scale with four or five response options for each item. Score ranges from 10 (*eveningness*) to 43 (*morningness*). Spanish version was used (Díaz-Morales & Gutiérrez, 2008). Previous psychometric and cross-cultural studies have reported good internal consistence for *MESC* (Caci, Robert, Dossios, & Boyer, 2005; Díaz-Morales, Dávila, & Gutiérrez, 2007; Gau & Soong, 2003; Kim, Dueker, Hasher, & Goldstein, 2002). The reliability of the scale was .69 (Cronbach's alpha).

2.2.2. School performance

The Spanish grading system is coded from 0 (the worst) to 10 (the best). Two different measures to evaluate school performance were used. *Subjective level of achievement*: adolescents were asked to indicate their subjective level of achievement from last year from 0 to 10. *Self-reported grades*: last year grades in the common subjects for all grades of Compulsory Secondary Education (Spanish language, mathematics, English language and social sciences) were reported and the mean of grades was calculated. Several studies have also used this method (see Wolfson & Carskadon, 2003).

2.2.3. Sleep habits

Because of the association between academic performance and total sleep time, this one was controlled. Adolescents reported their habitual bedtime and rise time during weekdays.

2.3. Procedure

All participants were tested in groups ranging in size from 20 to 30 students in school schedule and in their own classroom.

2.4. Data analysis

Data were analyzed using analysis of variance (*ANOVA*) to contrast the effect of age and gender on *M/E*, *school performance* and *total sleep time*. Association between *M/E* and age was tested using Pearson correlation coefficient. Partial correlations were used to examine the association between total sleep time, school performance, and *M/E* (controlling for age). *ANCOVA* was used to analyze differences in *total sleep time* according to chronotype (age as covariate) and to calculate differences *in school performance* according to gender and circadian typology (age and total sleep time as covariates). *Bonferroni test* was used in multiple post-hoc comparisons.

3. Results

3.1. Preliminary data

In order to detect possible effects of age and gender on *M/E* and *school performance* preliminary analyses were performed. The range for MESC's scores was from 12 to 38. The frequency of distribution was similar to the normal distribution: skewness (value = .01, error = .07) and kurtosis (value = −.27, error = .14). Analysis for *M/E* revealed a significant effect of age, $F(4,1123) = 6.77$, $p < .001$, $\eta^2_p = .024$, but no significant effect of gender, $F(1,1123) = 1.31$, $p = .25$, or interaction age × gender, $F(4,1123) = .84$, $p = .50$. The 12 years-old reported the highest *M/E* score (see Table 1). Next, the association between *M/E* and age was calculated. *M/E* was negatively associated to age ($r = -.11$, $p < .001$).

Given that previous analysis indicated that morningness decreased progressively until the age of 14 years, and then remained on a stable level, the sample was split into two age groups (12–14 and 15–16 years) and the association between *M/E* and age was calculated. In the youngest group (12–14 years), *M/E* was negatively associated to age, $r = -.17$, $p < .001$, but in the oldest group (15–16 years), no significant association was found, $r = .03$, $p = .57$.

Subsequently, we tested the association between *subjective level of achievement* and *self-reported grades*. High positive correlation was

Table 1
Means, standard deviations, and number of adolescents in Morningness/Eveningness (M/E), self-reported grades (SRG), and total sleep time (TST) as a function of age.

Age	*M/E*	Post-hoc $p < .01$	SRG	Post-hoc $p < .05$	TST	Post-hoc $p < .01$	n
12	26.60 (4.63)	>14, 15, 16	6.92 (1.56)	>13, 14, 15, 16	8:45 (0:50)	>13, 14, 15, 16	148
13	25.57 (4.47)		6.15 (1.76)	>15, 16	8:26 (0:47)	>14, 15, 16	248
14	24.55 (4.26)		5.81 (1.81)	>15, 16	8:08 (0:46)	>16	287
15	24.64 (4.32)		5.41 (1.86)	>16	8:01 (0:50)		274
16	24.88 (4.35)		4.67 (1.31)		7:50 (0:57)		176
Total	25.11 (4.43)		5.75 (1.83)		8:12 (0:52)		1133

Note: Standard deviations in parentheses; Post-hoc comparisons, *Bonferroni Test*.