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Children's time of day preference: age, gender and ethnic differences

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Abstract

Comprehensive data for children's time of day preference were collected with school children from 8 through 16 years of age ($n = 989$) using the Children's Morningness–Eveningness Preferences (CMEP) scale. Strong evidence was found that children's optimal time of day preference shifts toward evening at about 13 years of age. Additionally, gender and ethnic differences in time of day preference were also examined. There was no gender difference, but there was a tendency for ethnic differences among older children. An implication of these findings is that a mismatch between older children's time of ~~time~~ day preferences and school start time may have a negative effect on their school performance and this effect could be greater for some ethnic groups than for others. © 2002 Published by Elsevier Science Ltd.

Keywords: Children; Time of day preference; Morningness–eveningness; Circadian phase; Ethnic differences

1. Introduction

A substantial literature now exists confirming observations that young university students (18–25 years old) and older adults (50 and older) have different time of day preferences (e.g. Adan & Almirall, 1990; Intons-Peterson, Rocchi, West, McLellan, & Hackney, 1998; Kerkhof, 1985; May, Hasher, & Stoltzfus, 1993; Tankova, Adan, & Buela-Casal, 1994; Vitiello, Smallwood, Avery, & Pascualy, 1986). That is, few younger adults prefer morning times whereas 75% of older

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adults prefer morning times for both intellectual and physical activities. This literature is based on the use of Horne and Ostberg's (1976) Morningness–Eveningness Questionnaire (MEQ), a task that has been shown to correlate with circadian variations in biological processes such as body temperature. Of potentially great practical importance is the recent report of a synchrony effect: individual adults' cognitive functioning (e.g. memory and attention) is at its peak at their preferred or optimal time of day and falls off substantially at their nonoptimal times (e.g. May, 1999; May & Hasher, 1998; Yoon, May, & Hasher, 1999).

To date, there have been only a small number of studies on children's morningness–eveningness preferences (e.g. Bearpark & Michie, 1987; Carskadon, Vieira, & Acebo, 1993; Ishihara, Honma, & Miyake, 1990). For instance, Carskadon et al. (1993) investigated a phase delay in children's sleep and wake-up time and whether psychosocial (e.g. birth order and peer group) or biological (e.g. puberty) factors are causes of this sleep phase delay. In their study, they found evidence that biological rather than psychosocial factors are related to a phase preference delay by using 6th-grade boys and girls (because they are likely to be in the pubertal development stage). Also, Bearpark and Michie (1987) examined the relation between 350 children's (aged 10–17 years) morning/evening preferences and sleep disturbances using a modified version of the (MEQ). They reported that MEQ scores significantly decreased with age, moving towards an evening preference, and that reported sleep disturbances (e.g. restless sleep) were related to eveningness. Finally, Ishihara et al. (1990) examined changes in morningness–eveningness by Japanese females aged 9–15. They reported a similar finding that with advancing grades, students changed their preference toward eveningness. Additionally, they argued that this circadian phase shift seemed to be established by around 12 years of age.

By our reading of the literature, there is little in the way of normative data available. Here we provide norms on US children ranging from 8 to 16 years of age. Our samples included boys and girls as well as children from five ethnic groups (Asian, African American, Caucasion, Hispanic and Native American). With these diverse samples, we also tried to examine whether there is any gender or ethnic difference in time of day preference.

2. Method

2.1. Participants

Students of elementary (3rd–5th grade), middle (6th–8th grade), and high (9th–11th grade) schools participated in this study. The age range was from 8 to 16. The total number of participants was 989. Of those, 289 students were from public schools in Durham, NC, and the remaining 700 students were academically talented children enrolled in a summer program on the Duke University campus. For the most part, these students come from the southeastern states of the US. In addition, 12 Duke University undergraduates participated for a validity check of the CMEP.

2.2. Materials

The survey consists of two parts: a one-page personal information (e.g. age, gender, and ethnicity) sheet and a two-page Children's Morningness–Eveningness Preferences (CMEP) scale. This questionnaire was adopted from Carskadon et al. (1993), which was revised for use with children from the Horne and Ostberg (1976) Morningness–Eveningness Questionnaire (MEQ). The original Horne and Ostberg questionnaire contains 19 questions while the revised version has only 10 questions, and these are written so as to allow young children to understand the language. The scores on the CMEP range from 10 (~~morning~~ evening preference) to 42 (~~evening~~ morning preference).

2.3. Procedure

~~Constant~~ Consent for children's participation in this study was obtained from parents by mailing out consent forms with return envelopes. The survey was administered in a classroom or in a school library. Before the survey, oral assents were obtained from children for their own participation. For 3rd–5th graders, all the questions in the personal information sheet and the CMEP were read to them whereas older (6th grade and above) students filled out the personal information sheet and the CMEP at their own pace.

3. Results

3.1. Validity check

Since the validity of the MEQ is well established (Adan, 1991; Horne, Brass, & Pettitt, 1980; Horne & Ostberg, 1976; Kerkhof, van der Geest, Korving, & Rietveld, 1981), we sought to assess the validity of the CMEP by comparing preference on the latter with preference on the former. To this end 109 summer students (age range of 12–17) completed both the MEQ and the CMEP. The correlation between their two test scores was significant ($r = 0.83$, $P < 0.05$). Also, 12 Duke undergraduate students completed both the MEQ and the CMEP. The correlation between their two test scores was also significant ($r = 0.95$, $P < 0.05$). These data suggest strongly that the CMEP, like the MEQ, has good validity. Of course, careful and direct checks using physiological measures of arousal would ultimately be useful.

3.2. Reliability check

Eighteen summer students (age range of 13–16) took the CMEP twice approximately two weeks apart. The correlation between their first and second CMEP scores was significant ($r = 0.78$, $P < 0.05$).

3.3. Age difference in morningness–eveningness

CMEP score means (with standard deviations in parentheses) for age 8 through 16 were 28.58 (5.77), 28.85 (4.71), 28 (6.45), 28.67 (5.8), 27.42 (4.32), 25.8 (5.95), 24.39 (6.2), 24.4 (5.73), 23.55 (6.01), respectively. To examine the relation between age and morning/evening preference, both correlation analysis and ANOVA were used. First, when age was regarded as a continuous variable, the correlation between age and CMEP score was -0.3 ($P < 0.05$). Also, a one-factor nine-level ANOVA (age: 8–16 years) showed that CMEP scores significantly decreased with age [$F(8, 969) = 12.9$, $P < 0.05$]. These statistical results indicate that children come to prefer evening to morning as they age. Furthermore, planned comparisons showed that the mean CMEP score of age 13 ($M = 25.8$) was significantly higher than that of age 14 [$M = 24.39$, $F(1, 331) = 4.84$, $P < 0.05$]. Thus, the shift toward evening preference appears to occur at approximately the age of 13.

3.4. Gender difference in morningness-eveningness

There was no significant gender difference in CMEP score [$F(1, 980) < 1$; male: $M = 25.61$, S.D. = 6.17; female: $M = 25.75$, S.D. = 6.03]. Also, a 9 (age: 8–16)×2 (gender: male and female) ANOVA showed no significant interaction between age and gender [$F(8, 966) < 1$].

3.5. Ethnic difference in morningness–eveningness

Mean and standard deviation CMEP scores for ethnic groups are presented in Table 1. Because of the small sample size ($n = 5$), the Native American group was not included in the analysis. Also, since there was a significant negative correlation between age and CMEP score among the four ethnic groups ($r = -0.3$, $P < 0.05$), age was included in the analysis as a covariate. A one-factor four-level ANCOVA (Ethnic group: Asian, African American, Caucasian, Hispanic) showed no significant difference among ethnic groups in the mean CMEP score [$F(3, 863) = 1.2$, $P > 0.05$]. Post hoc multiple comparisons (with the adjusted CMEP means) showed a marginal difference in the CMEP score between the Asian and the African American groups ($P = 0.098$). In addition, a power analysis was performed on the ANCOVA to estimate the probability of rejecting a null hypothesis when there is an effect (Cohen, 1977). Since the effect size was very small ($f = 0.07$), the probability of detecting a main effect of ethnicity, even with our relatively large average sample size ($n = 218.75$), was less than 50% (low power).

3.6. Logistic regression analysis

We also performed a logistic regression analysis to see whether there is any difference in morningness–eveningness (indicated by CMEP scores) among different ethnic groups when younger and older groups are analyzed separately. To this end, we used a logistic regression to establish the break point or the age at which CMEP scores shift significantly.[1] This break point

Table 1
Mean CMEP scores for ethnic groups

Ethnicity	*N*	CMEP			Age	
		Mean adjusted for age	Mean	S.D.	Mean	S.D.
Asian	113	26.25	25.72	6.00	13.67	1.85
African American	86	24.81	26.69	6.00	10.61	2.34
Caucasian	642	25.82	25.63	6.08	13.27	2.36
Hispanic	34	26.59	27.47	5.50	11.88	2.71

[1] We thank Malcolm Binns of the Rotman Research Institute for his advice on this logistic regression analysis.

was found to be 12.91 years (around 13 years)—this suggests that significant circadian phase shift (from morningness to eveningness) occurs approximately at the age of 13. We then divided the sample using this age to establish younger and older age groups (see Table 2). Finally, with these two age groups, differences in CMEP among ethnic groups were examined using ANOVA.

Mean and standard deviation CMEP scores for the ethnic groups in the younger and older groups are presented in Table 3. For the younger group, since the correlation between age and CMEP score among the four ethnic groups was not significant ($r = -0.09$, $P > 0.05$), a one-factor four-level (ethnic group: Asian, African American, Caucasian, and Hispanic) ANOVA was used. No significant difference in the mean CMEP score was found among the ethnic groups [$F(3, 265) < 1$].

For the older group, however, age was significantly correlated with CMEP score among the four ethnic groups ($r = -0.12$, $P < 0.05$). For this reason, a one-factor four-level (Ethnic group: Asian, African American, Caucasian, and Hispanic) ANCOVA was used. The difference among the ethnic groups approached significance [$F(3, 591) = 1.75$, $P = 0.156$]. In addition, a power analysis was performed on the ANCOVA to assess the probability of rejecting a null hypothesis when there is an effect (Cohen, 1977). Since the effect size was small ($f = 0.1$), the probability of detecting a main effect of ethnicity, with our average sample size of 148.75, was about 50% (low power).

Table 2
Mean CMEP scores for younger and older groups

Age	N	CMEP	
		Mean	S.D.
Younger group (below break point)	290	28.38	5.43
Older group (above break point)	687	24.53	6.00

Table 3
Mean CMEP scores for ethnic groups within younger and older groups

Ethnicity	*N*	CMEP			Age	
		Mean adjusted for age	Mean	S.D.	Mean	S.D.
Younger group						
Asian	18		28.33	6.44	10.55	1.19
African American	67		27.70	5.70	9.79	1.20
Caucasian	166		28.73	5.16	10.04	1.39
Hispanic	18		27.72	5.90	10.03	1.27
Older group						
Asian	94	25.16	25.23	5.84	14.79	1.08
African American	19	22.99	23.11	5.78	14.73	1.00
Caucasian	466	24.56	24.54	5.99	14.93	1.06
Hispanic	16	27.17	27.19	5.18	14.88	0.97

Post hoc multiple comparisons on the older students (with adjusted CMEP means) showed a reliable difference between the African American and the Hispanic groups ($P = 0.04$), a marginal difference between the Caucasian and the Hispanic groups ($P = 0.08$) and also between the Asian and the African American groups ($P = 0.14$). The mean CMEP scores suggested that the Hispanic group was significantly or marginally more morning type than were the African American and Caucasian groups. As well, the mean CMEP scores also suggested that the Asian group was marginally more morning type than the African American group. Finally, additional t-tests between the younger and older groups within each ethnic group showed significant differences for the Asian, the African American, and the Caucasian groups, but not for the Hispanic group. These results suggest that Hispanic children may still prefer morning to evening even at a later age.

4. Discussion

The present study reports more comprehensive data on children's time of day preferences with a larger and more diverse sample than has been seen before. Because of the diversity of our sample, we were able to examine both the age effects and the gender and ethnic difference in children's morningness–eveningness preferences.

Our findings on the relation between age and children's time of day preference are consistent with the findings of previous studies (e.g. Bearpark & Michie, 1987; Carskadon et al., 1993; Ishihara et al., 1990) in that younger children's time of day preference was more toward morningness whereas that of older children's was more toward eveningness. In particular, this shift toward eveningness appears to occur around the age of 13. This conclusion was supported both by our planned comparisons and logistic regression analysis. It is important to note that the shift observed here was seen for both summer residential students and public school students, and so cannot be attributed to changes associated with time of year or the social circumstances peculiar to the residential students. This age shift finding age shift is also similar to that of Ishihara et al. who argued on the basis of data collected on Japanese children that circadian phase shift is established by the 1st grade of junior high school (around 12 years).

With respect to gender differences, we observed no reliable differences in CMEP scores between boys and girls. This result is also consistent with the results of previous research (e.g. Bearpark & Michie, 1987; Carskadon et al., 1993). Although some studies with adults (e.g. Moe, Prinz, Vitiello, Marks, & Larsen, 1991) have reported a gender difference in circadian rhythm by measuring body core temperature (i.e. the circadian phase shift occurs a little earlier for women than for men), the shift might be too small to be detected by usual morningness–eveningness questionnaires (see Tankova et al., 1994 for a brief review of gender differences in circadian rhythm).

With respect to ethnic group differences, none were found for the younger age group (less than 13 years). However, there was a suggestion of a marginal difference for older children. This marginal effect appears to result from the low power of the current study (50%)—such a difference might prove reliable were larger samples available. Furthermore, additional analyses suggest that Hispanic children change least with age in their morningness–eveningness preference whereas African American children change most. For both Asian and Caucasian children, the degree of change in their morningness–eveningness preference seems to fall in the middle relative to Hispanic and African American children, and the patterns of change appear to be similar to each other. It would be useful to examine at what age Hispanic children start to show a significant circadian phase shift from morningness toward eveningness.

Our main finding—a circadian phase shift toward eveningness with age—has an important implication for education. Specifically, there are broadly two ways in which eveningness of children might have an effect on their school performance. First, as children age into their teen years, their circadian phase tends to shift from morningness to eveningness. As a result, many of them go to bed later and wake up later (especially during the weekend), compared to when they were younger. Ironically, however, the school starting time moves earlier as children's grade advances (e.g. around 8 am in middle school to around 7:30 am in high school). Although school starts earlier, children cannot adjust their bedtime accordingly and this could result in sleep deprivation. Subsequently, they are sleepy during the morning and become more alert in the afternoon when school is almost over. Thus, the evening preferences of adolescents may create a sleep deprivation situation when school is associated with an early start time (Bearpark & Michie, 1987; Carskadon et al., 1993; Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998; Cofer et al., 1999).

Secondly, the circadian phase shift could also influence children's school performance through asynchrony between their preferred time of day and the time at which classes are taught. According to the synchrony effect (e.g. May & Hasher, 1998; Yoon et al., 1999), younger and older adults perform better on a number of cognitive tasks at their optimal time of day than at their nonoptimal time of day (which happens to be different for the two groups). For example, younger and older adults are less distractible at their optimal times (e.g. May, 1999), their recognition of newly learned information is better at their optimal times (May et al.1993; Yoon, 1997), and their control over strong but inappropriate responses is better at their optimal times (May & Hasher, 1998). As well, and of special relevance to classroom learning, is evidence reviewed by Winocur and Hasher (in press) that shows dramatic differences in memory performance for younger and older adults tested at optimal versus at nonoptimal times. Since children's time of day preference shifts toward eveningness as they get older, their cognitive functioning is likely to be at its peak more toward the afternoon than in the morning. Thus, if important basic classes such as reading and mathematics are taught in the morning, older school children will be learning this critical material at their less-preferred, or nonoptimal time of day, resulting in poorer school performance than might be found were the courses in greater synchrony with circadian arousal rhythms.

In sum, children's preference shift toward eveningness in adolescence may have a negative effect on their school performance because their evening preference conflicts with a traditional early morning school start time. Furthermore, since there is a tendency for ethnic groups to differ in terms of the size of the time of day preference shift, this negative effect may be even more severe for some ethnic groups than for others.

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