

Consequences of adolescent's evening preference on psychological functioning: a review

Juan F. Díaz-Morales* y Cristina Escribano

Complutense University of Madrid (Spain)

Título: Consecuencias de la mayor vespertinidad durante la adolescencia para el funcionamiento psicológico: una revisión.

Resumen: Esta revisión ofrece una visión general sobre los efectos que tiene una mayor vespertinidad durante la adolescencia para el funcionamiento psicológico. Tras una breve introducción sobre la matutinidad/vespertinidad, se presenta una visión general de los cambios que se producen durante la adolescencia en tres grandes áreas: rendimiento escolar, personalidad y salud. Se describen las consecuencias para el rendimiento académico de la mayor vespertinidad durante la adolescencia, considerando los aspectos cognitivos y conativos de la conducta. Aquellos estudiantes que pueden elegir realizar sus tareas en su momento óptimo obtienen un mejor rendimiento. Por otra parte, también se describen los estilos de personalidad y la salud de matutinos y vespertinos como factores relacionados con su adaptación a la escuela y la familia. Por último, se enumeran algunas conclusiones y recomendaciones que pueden mejorar el funcionamiento psicológico de los adolescentes.

Palabras clave: vespertinidad; rendimiento académico; adolescencia; jet-lag social; efecto sincronía; hora del día.

Abstract: This review provides an overview of the role of circadian preference in psychological functioning of adolescents taking into account their shift to eveningness during this stage of life. After a brief explanation about morningness/eveningness and other terms related, an overview of the changes that occur on three of the most important areas in the adolescent's life is presented: school performance, personality styles, and health. Consequences of evening preference on school achievement are considered from the analysis of the relevance of sleep debt and time-of-day in cognition and mood aspects. In general, students who are able to choose activity times coinciding with their preferred times may have a greater opportunity to optimize their performance. The personality styles and health of morning and evening types are also important factors related to school and family adaptation. At last, some recommendations and conclusions in order to promote a healthy psychological functioning are described.

Key words: evening preference; school achievement; adolescence; social jet-lag; synchrony effect; time-of-day.

Introduction

During adolescence, several changes not only physically but also psychologically appear. One of them is the preference for evening hours which has been related to three of the most important areas in this stage of life: school performance, personality styles, and health, which in turn affect psychological functioning. Previous meta-analytic investigation examining the relationship between circadian preference and cognitive abilities has been published (see Preckel, Lipnevich, Scheider, & Roberts, 2011); nevertheless, other aspects such as time of day, sleep, health habits and personality styles are included here. This review has been written taking into account recommendations by Fernández-Ríos and Buela-Casal (2009).

Chronotype, time-of-day and social jet-lag

Research both in chronobiology and chronopsychology provides important findings on the differential nature of the circadian rhythms, most particularly between morning and evening chronotypes (Carrier & Monk, 2000). In general, Morning types (M-types) prefer to get up and go to bed early while Evening types (E-types) prefer later bed times and rise times (Adan et al., 2012; Tankova, Adan, & Buela-Casal, 1994). Neither types (N-types) do not have a clearly preference for earlier or later times.

Because chronotypes differ in their sleep-wake patterns as well as in their performance at different times of the day, the practical implications of these findings have been applied to diverse fields, such as the design of working hours (Costa, Sartori, & Åkerstedt, 2006), athletic performance (Drust, Waterhouse, Atkinson, Edwards, & Reilly, 2005), academic performance (Randler & Frech, 2009), and, in general, health and psychological wellbeing (Willis, O'Connor, & Smith, 2005).

In order to meet societal demands, E-types must try to function during the morning when they are in their non-optimal moment of the day. Wittmann, Dinich, Mellow, and Roenneberg (2006) proposed the notion of *social jetlag* to describe the discrepancy between person's rhythms and those of the environment or, in other words, the misalignment of biological and social (school, work) time. Social jetlag is very common among adolescents who tend to be much later chronotypes than other age groups (Roenneberg et al., 2004). This preference for evening hours has an influence on psychological functioning of adolescents affecting performance, personality styles, and health.

Evening preference during adolescence

One phenomenon of the circadian rhythm is a shift usually twice during each individual's life. First, there is a shift towards eveningness during the age of puberty (Kim, Dueker, Hasher, & Goldstein, 2002), and second, a shift back towards morningness which could be viewed as a biological marker of the end of adolescence (Roenneberg et al., 2003). After reaching adolescence, most people gradually become more and more M-types. However, this might also be trig-

*** Dirección para correspondencia [Correspondence address]:**

Juan F. Díaz-Morales. Individual Differences and Work Department, Facultad de Psicología, Universidad Complutense de Madrid, Campus de Somosaguas, s/n, 28223, Madrid (Spain).

E-mail: juanfcodiaz@psi.ucm.es

gered by social and environmental factors (Wittmann et al., 2006).

While increasing age is associated with a greater tendency towards morningness, younger people are likely to rate themselves as more evening-oriented (Carskadon, Vieira, & Acebo, 1993). This shift occurs around the age of 12–13 and has been widely described all around the world (Andrade & Menna-Barreto, 1996; Caci et al., 2005; Díaz-Morales & Gutiérrez, 2008; Ishihara et al., 1985; Kim et al., 2002; Natale & Bruni, 2000; Randler, 2008b). Therefore, it was suggested that this change is based on biological (hormonal) changes throughout puberty. However, psychosocial factors may also contribute to this change in Morningness-Eveningness (M-E) during adolescence, but evidence is scarce (Randler, Bilger & Díaz-Morales, 2009).

The mechanisms that underlie the adolescent's shift away from morningness orientation may have environmental, social and biological underpinnings (Carskadon et al., 1993; Kim et al., 2002; Roenneberg et al., 2004). Both approaches are summarised here.

Biological factors

Carskadon et al. (1993) showed that M-E was negatively related to puberty stage in girls and, to a lower degree, in boys. The authors reported that psychosocial factors were less influential since the contact to older students at school or having older siblings were not related to M-E. In the same line, Hagenauer, Perryman, Lee and Carskadon (2009) concluded that social factors cannot completely account for that shift for several reasons: (1) a number of researches showed that bedtime delay was observed earlier in girls than in boys coinciding with their earlier pubertal development; (2) the shift towards eveningness is observed in several countries and cultures; (3) adolescents show a delayed circadian phase even in laboratory studies where social influence is limited; (4) evening preference is still observed even though social factors are maintained constant assuming that adolescents attending the same school grade level are exposed to similar social influences; (5) other mammalian species show the similar shift towards later schedules; (6) adolescents develop a resistance to sleep pressure which permits them to stay awake later. At the same time, their circadian timing system becomes delayed and permits them to wake up later (Jenni, Achermann, & Carskadon, 2005); (7) previous researches showed the influence of gonadal hormones on sleep patterns. In conclusion, it seems that maturational changes exert an influence on the shift towards eveningness.

Psychological factors

As adolescents get older, their academic responsibilities increase, they tend to feel independent since parental supervision decreases and their interest in night life or start work begins (Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998).

According to Takeuchi et al. (2001) several factors such as physical (light and temperature), social (family life and school schedules), physiological (meal timing), and psychological (parental discipline about sleep habits) may act as *zeitgebers* (synchronizers) to entrain the sleep-wake rhythm of adolescents to physical day/night cycle. They examined the effect of parental bedtime discipline during childhood on M-E. Students completed the M-E questionnaire and were asked about the discipline by parents in the past (during childhood) and at present (during adolescence) regarding to bedtime. Students living in the suburban district got higher scores on M-E, that is, they were more morning oriented. During both childhood and adolescence bedtimes were decided by parents to a greater extent in the suburban district compared to the urban one. Authors suggested that the family lifestyle characterized by agriculture and/or forestry which requires earlier rise times, could attenuate the shift towards evening in the suburban district. In the same way, Randler et al. (2009) collecting data from German pupils aged 11-20 found that parental monitoring influences on chronotype measured by midpoint of time in bed (a proxy of midpoint of sleep calculated by Roenneberg et al., 2004): higher bedtime discipline was associated to earlier chronotype. Adolescents who decided their own bedtime reported short sleep onset latency. Age was a stronger influential predictor of M-E than pubertal development or parental monitoring, but both of them were significant predictors of timing of sleep. Gau and Soong (2003) examined the relationship between school grade level and M-E in early adolescence, reporting that grade level was the most important predictor of M-E. Therefore environmental factors would be influential factors on M-E coupled to biological factors.

Consequences of evening preference on school achievement

If pupils shift their time-of-day preferences to eveningness and school starts early, there are good reasons to analyze this "*school jetlag*" because it concerns the majority of the adolescent population in industrialized countries. While a large amount of research has been conducted on adjustment to shiftwork, very little research has assessed the consequences of *social jetlag* among adolescents (Wittmann et al., 2006).

In general, during a regular morning schedule, eveningness orientation is associated to poorer academic achievement (Beşoluk, Önder, & Deveci, 2011; Díaz-Morales & Escribano, 2013a; Escribano, Díaz-Morales, Delgado, & Collado, 2012; Gomes, Tavares, & Azevedo, 2011; Preckel et al., 2011). For example, Beşoluk et al. (2011) concluded that university students with a morning preference got higher scores than N- or E-types in a final exam administered in the morning even though some students attended classes in the morning (08:00-14:50) and others in a later schedule (15:00-21:50).

The consequences of changes in M-E preference and sleep patterns during adolescence with early school start times have an important impact on the adolescents' lifestyle habits, which in turn influence on school achievement. Evening preference of adolescents was related to excessive daytime sleepiness (Bearpark & Michie, 1987), behavioral difficulties (Fallone et al., 2001), unhealthy lifestyle (Delgado, Díaz-Morales, Escribano, Collado, & Randler, 2012; Randler, 2011), and depressive tendencies (Chelminski, Ferraro, Petros, & Plaud, 1999). The principal factor related to poorer school achievement has been the permanent sleep debt during adolescence. Nevertheless, other factors have been proposed, such as the putative hypothesis related to the continuous mismatch between morning school schedules and evening preference, which in turn influences on school performance. Four aspects are considered in this section as putative psychological factors related to school achievement: sleep debt, time-of-day, mood, personality styles and health.

Sleep debt

Adolescents usually need more than 8 hours of sleep per night. As young people shift towards eveningness during puberty, they accumulate a considerable sleep debt during school week. They have to compensate on free days and weekends for this sleep loss during the school week (Carskadon et al. 1998). One of the major problems seems to be early school-start times, which force students to start working at a given time that may be too early for them, thereby negatively affecting school functioning (Meijer, Habekothé, & Van Den Wittenboer, 2000). School start times vary around the world. In Germany, for example, most schools start between 07:30 and 07:45 hours and a few between 07:45 and 08:00, whereas in Spain adolescents attend class during a fixed school schedule from 08:30 to 14:20 (Díaz-Morales & Randler, 2008; Randler & French, 2009). The usual rising time of 11-16-year-olds in Germany is about 06:15 during school weeks and between 09:00 and 09:30 on weekends, which is a considerable weekend oversleep (Randler, 2008b). In Spain, for example, average of rise time (07:19) during the school weekdays is consequence of the fixed school start time. However, considering that the mean rising time during the weekend was 10:41, it seems that a significant sleep debt was accumulated during the school days, especially in E-types, who wake up 4:01 later during the weekend (M-types also wake up 2:48 later) than on weekdays (Collado, Díaz-Morales, Escribano, Delgado, & Randler, 2012; Díaz-Morales, Dávila, & Gutiérrez, 2007; Gradisar, Gardner, & Dohnt, 2011).

Much empirical evidence has been found about negative consequences of sleep debt on school performance. For example, Gau et al. (2007) reported emotional and behavioral problems in E-type adolescents. Wolfson and Carskadon (1998) showed that students with later bedtimes or students that reported less sleep usually performed worse. There is al-

so evidence that getting up early for school results in greater complaints about difficulties in attention and concentration in the classroom in fifth grade children (Janvier & Testu, 2007). Also, several studies have detected higher sleepiness and headache in E-types (Bruni et al., 2008; Giannotti et al., 2002; Russo et al., 2007; Tonetti, Fabbri, Martoni, & Natale, 2013). On the basis of these results it is concluded that sleep problems are associated with poor academic performance (Dewald, Meijer, Oort, Kerkhof, & Bögels 2010; Salcedo-Aguilar et al., 2005).

The published literature contains many studies that have demonstrated the importance of total sleep time for full enhancement of academic functioning. These results present some kind of consensus that optimal sleep length is associated with school performance. Since E-types prefer to wake up late while the school start time forces them to wake up early, the discrepancy between biological and social rhythms (i.e., social jetlag) is at a maximum in E-type adolescents (Andrade & Menna-Barreto, 1996; Valdez, Ramírez, & García, 1996).

Time-of-day

Cognition

Research with adolescents and adults suggests that performance on a number of school relevant tasks (such as attention and memory) varies in synchrony with chronotype, with better performance in the morning than later in the day for M-types and better performance later in the day than in the morning for E-types (Intons-Peterson, Rocchi, West, McLellan, & Hackney, 1998). Circadian mismatch (i.e., performance at one's non-preferred time-of-day) negatively affects recall memory, subjective alertness, visual attention, and reaction times (Wright, Hull, & Czeisler 2002).

Table 1. Better performance on cognitive process at optimal and non-optimal time-of-day.

| Optimal time-of-day | Non-optimal time-of-day |
|---|---|
| - Fluid intelligence | - Decision-making |
| - Explicit memory | - Implicit memory |
| - Strategic reasoning during initial task performance | - Problem-solving tasks (i.e. creative tasks) |

However, whereas synchrony effects have been shown in fundamental executive processes among young adults, no differences were found in measures of well established knowledge (i.e. vocabulary test) (Hasher, Zacks, May, Gopher, & Koriat, 1999; Yoon, May, & Hasher, 2000).

It appears that individuals perform better on fluid intelligence tasks during their own optimal time-of-day. In contrast, individuals' performance on crystallized intelligence tasks requiring access to and production of well-learned or familiar responses is unaffected by time-of-day, suggesting that access to semantic knowledge and other forms of crystallized intelligence does not change across the day (Hasher,

Goldstein, & May, 2005; Goldstein, Hahn, Hasher, Wiprzycka, & Zelazo, 2007, May, 1999).

Recent research indicates that during non-optimal time of day (i.e. asynchrony) individuals could perform better on some tasks, such as decision making, implicit memory and creative process (see Table 1). Some evidence suggests that time-of-day modulates cognition in certain aspects of high-level decision-making. Dickinson and McElroy (2012) explored the effects of circadian mismatch in a strategic decision environment. They considered the circadian mismatch between decisions making at an off-peak time-of-day relative to one's circadian preference. Using the repeated Beauty Contest (a video-game used as measure of strategic reasoning) allows them to explore the effects of circadian mismatch on strategic reasoning during initial task performance (controlled thought processes) and on more automatic response processes when the repetition of the task leaves to be novel and mimicry is possible (automatic thought processes). The hypothesis of Dickinson and McElroy (2012) was based on existing research supports that processing of a novel, unfamiliar task in the initial round should lead to more thoughtful reasoning, whereas a learned task, such as subsequent rounds of the Beauty Contest video-game, should lead to more unconscious/automatic responses (Shiffrin & Schneider, 1977). The results seem to indicate that highly practiced responses (i.e., elements of crystallized knowledge) are invariant across the day; however, attention regulation over incoming information and outgoing responses that are not highly practiced (i.e., fluid intelligence) are particularly vulnerable to time-of-day effects.

During non-optimal time-of-day resources are less readily available, and therefore automatic, association-based processing is more likely (Kahneman & Frederick, 2005; May, Hasher, & Foong, 2005). Lower levels of processing resources are associated with reductions in inhibition, influencing the momentary contents of working memory (Hasher et al., 1999). This lower inhibition may clutter or enrich contents in working memory (May, 1999; May & Hasher, 1998; Rowe, Valderama, Hasher, & Lenartowicz, 2006), with implications for performance that depend on task demands. For instance, recent evidence suggests that implicit memory retrieval is likely to be facilitated by more non-conscious, associative processing and hence be better at non-optimal times of day, whereas explicit retrieval is likely to be better at optimal times of day (May et al., 2005). Thus, during non-optimal times of day, inhibition is lower and associative processing is more likely to affect behavior. Performance under non-optimal times of day might actually be better than performance during optimal times or non-emotional conditions. Cavanough, Cutright, Luce and Bettman (2011) showed as emotions, particularly hope, facilitated fluid processing and improved performance on a fluid intelligence task during non-optimal times of day. The interpretation of researchers was that a greater accessibility of and receptivity to affective information at non-optimal times enhanced the influence of incidental emotional associations on subsequent judgments

and behaviors. Thus, during non-optimal times of day lower inhibition and greater reliance on associative processing may make the emotion's associated thoughts and tendencies more influential and accessible. Conversely, during optimal times of day individuals will be more likely to correct for or block out affective information because of heightened inhibitory control, particularly if affective information is incidental, and hence likely to be perceived as irrelevant to the task at hand.

There is more evidence that a non-optimal time-of-day can be beneficial to certain problem-solving tasks (i.e. creative tasks). Wieth and Zacks (2012) showed that for certain problems reduced attentional control at a non-optimal time-of-day benefits performance. Participants who solved insight problems during their non-optimal time-of-day, when arousal is lower, were more successful than participants at their optimal time-of-day.

It is possible that tasks that require a creative approach might benefit from asynchrony since reduced inhibitory effects associated with non-optimal time may lead individuals to consider new approaches to a task that ultimately produce better solutions. This suggests that students designing their class schedules might perform best in classes such as art and creative writing during their non-optimal compared to optimal time-of-day (Wieth & Zacks, 2012). Previous research has shown that students tend to get higher grades when classes are in synch with their circadian arousal (e.g., Guthrie, Ash, & Bendapudi, 1995); however, the interaction between time-of-day and type of tasks performed in class has not been intensely investigated. The results obtained by Dickinson and McElroy (2012), Cavanough et al. (2011) and Wieth and Zacks (2012) suggest that the relationship between time-of-day and grades needs to be investigated and may not simply follow a uniform pattern based on "synchrony and better performance".

Mood

Morningness has been associated with higher positive affect across the day (Hasler, Allen, Sbarra, Bootzin, & Bernert, 2010). M-types also score higher on measures of energy, alertness and lower on tiredness compared with E-types (Clark, Watson, & Leeka, 1989). In contrast, negative affect does not appear to vary according to chronotype (Clark et al., 1989; Hasler et al., 2010).

Existing evidence suggests an association between chronotype and affect, with M-types reporting greater overall experience of emotions associated with positive activation, including excitement, cheerfulness, and alertness, compared with individuals with later time of day preferences. The theoretical position is that positive, but not negative affect should be closely tied to the individual's internal biological clock, as positive affect is known to fluctuate according to a 24-hr cycle (Jankowski, 2013; Murray, Allen & Trinder, 2002). Daytime trends in subjective alertness indicated the maximum score of this self-estimated variable occurred in

the evening in both chronotypes. However, M-type adolescents reach greater score than E-types during the first half of the day, whereas E-type adolescents reach it in the later afternoon (Díaz-Morales et al. 2007; Natale & Cicogna, 1996). Self-reported physical performance shows similar trends as subjective alertness, but sex differences appear. Girls oriented to eveningness are not ready to make physical effort in the morning. This circadian variation in physical performance and sex differences might have important implications for both short- and long-term success of some sport activities. If E-type girls are forced to participate in physical exercise during the regular school timetable (in the morning), may result in negative performance and negative evaluation of sport practice (see Díaz-Morales et al., 2007).

Personality styles and health

Some authors suggested that the relationship between M-E and health may be mediated by personality traits that might contribute to explain to what extent diurnal preferences might be associated with mental and physical healthy behaviors.

This is important because adolescence is a crucial period for identifying young individuals with evening orientation in order to implement preventive health programs (Díaz-Morales, Delgado, Escribano, Collado, & Randler, 2012; Digidon, 2010; Prat & Adan, 2011; Tzischinsky & Shochat, 2011). If eveningness is considered as a risk factor for mental and physical health problems, whereas morningness has been associated with healthy habits, psychological well-being and good quality of life related to health (Delgado et al., 2012; Randler, 2011; Urbán, Magyaródi, & Rigó, 2011), the E-types' lifestyle could affect healthy habits and both school and family adaptation.

Larks (M-types) are considered conscientious, trustworthy and emotionally stable (DeYoung, Hasher, Djikic, Criger, & Peterson, 2007). Owls (E-types) are described as creative, emotionally unstable and have difficulties in social and familial relations (Giamprieto & Cavallera, 2007). Whereas liveliness and good mood decrease along the day among M-types, the opposite pattern occurs among E-types.

Taking into account Millon's (2004) personality styles model, relationships have been identified between circadian preference and thinking styles based on Jung's theory of personality-centered traditional types (Díaz-Morales, 2007). M-types processes incoming information from the outside on the basis of pragmatic data and direct experience, using consolidated schema and considering social norms and rules. On the contrary, E-types tend to act out in an independent and nonconforming manner and resist following traditional standards. Using the Style Of Learning And Thinking questionnaire (SOLAT), Fabbri, Antonietti, Giorgetti, Tonetti and Natale (2007) showed that morningness was associated with the left-thinking style whereas eveningness were associated with the right-thinking style. Recent evidence indicates that M-types and left-thinkers reported the highest subjective

level of achievement whereas E-types and right thinkers, who are more creative and intuitive, reported the lowest (Díaz-Morales & Escribano, 2013b). Given the difficulty in delaying school start times, teachers could use different teaching styles including innovative and creative tasks, which could benefit to evening adolescents.

Positive correlations were found between E-types' personality and rebellious, non-conformist and irresponsible behaviors tending to be unpredictable (McCutcheon, 1998). Cimbalo and Hughey (1986) discovered that E-types have some characteristics associated with Zuckerman's "sensation seekers" being these attracted by novelty and risk (Giamprieto & Cavallera, 2007). Muro, Gomà-i-Freixanet & Adan (2012) found that E-type adolescents of both sexes scored significantly higher than N-types and M-types on seeking sensations, indicating that E-type adolescents show a greater desire for varied, new, complex, and intense sensations, and are ready for experiencing more risks than M-types.

The two different types of personality emphasize different approaches concerning social relations. People who define themselves as basically nocturnal may clash with social demands and convention that they do not accept. A few studies have reported that E-types have much more relational difficulty in family relationships and in a social context what is bound up with the way in which they plan their time. Both family and social context and their time planning have consequences for their lifestyle and psychological functioning (Cofer et al., 1999).

Results of different studies suggest that E-type adolescents have greater behavioral problems at home and school. E-types show greater behavioral troubles, lower academic performance, higher stress rates in their family lives, and more difficulties in social adaptation (Andershed, 2005). Goldstein et al. (2007) found that M-type adolescents obtained higher scores on competence indicators (home and school areas), reported lower attention problems and aggressive behaviour scores.

Eveningness has been identified in adolescents as a risk factor. Research has shown that eveningness was associated with emotional disturbances (anxiety and depressed mood) and attention problems (Giannotti et al., 2002), melancholic mood (Takeuchi, Oishi, & Harada, 2005), bad morning feeling (Gaina et al., 2006), eating disorders (Schmidt & Randler, 2010) or hyperactivity (Lange & Randler, 2011). Gau et al. (2007) showed that E-types were more likely to have depressed or anxious mood, attention problems, aggressive behaviour, delinquent behaviour, social problems, somatic complaints, thought problems, are more withdrawn, have more internalizing and externalizing problems and suicidal tendency than M-types. Randler (2011) found links between eveningness and poor physical and mental health, low self-esteem and negative familial relationship and school functioning. Tzischinsky and Shochat (2011) indicated that E-type adolescents obtained lower scores on physical, emotional, social, school, and psychosocial functioning and, in general, poor quality of life. Delgado et al. (2012) found that,

considering Health-Related Quality of Life (HRQL), E-type adolescents scored lower on vitality, physical well-being, psychological well-being, body image, relations with parents and teachers, school work, and global health compared to M-types.

Several studies support the existing evidence that individuals with circadian preference for evening hours have unfavourable dietary habits. One evident fact is that as most teenagers are oriented towards eveningness, they have difficulty in getting up in the morning, and probably leave home without breakfast. This breakfast skipping must become an increasing problem associated with health and school functioning, because, without breakfast, school achievement and cognitive functioning may also decrease. Evening people therefore may face two problems: they have to work at school at a non-optimal time of day and with sub-optimal nutrition (Randler & French, 2009; Schmidt & Randler, 2010).

Other intake habits of E- and M-types have been analyzed. The best known finding was related to positive association between alcohol use, smoking, drug consumption, and evening orientation (Adan, 1994; Prat & Adan, 2011; Wittmann et al., 2006, Wittmann, Paulus, & Roenneberg, 2010). Differences in the time or frequency of meals, in alcohol and caffeine consumption and in smoking habits were analyzed by Ishihara et al. (1985). E-types had frequent night meals, consumed more caffeine and alcohol, and smoked more cigarettes than M-types. Other studies have shown associations between short sleep duration and unhealthy dietary intake habits, such as snacking, in various age groups (Baron, Reid, Kern, & Zee, 2011; Fleig & Randler, 2009; Heath et al., 2012; Weiss et al., 2010; Westerlund, Ray, & Roos, 2009).

Kanerva et al. (2012) examined the association between food and nutrient intakes and chronotype in a large representative sample of the Finnish population (participants from 25 to 74 years old). They found unhealthier habits in E-types. Those who had a tendency toward eveningness consumed more alcoholic drinks, such as beer and wine, and obtained more energy from ethanol compared with those who had a tendency toward morningness. Furthermore, E-types consumed less wholegrain products (especially rye), vegetables and roots, fruits, and fish, and more chocolate. These food habits are reflected in lower nutrient intakes of carbohydrates, dietary fiber, folic acid, and sodium. Because of their less healthy dietary habits, people who prefer evening hours in their daily activities might be at higher risk for several chronic diseases. Similar results have been obtained in other epidemiological studies. E-types consumed fewer vegetables and more noodles, and also showed a significant association between evening preference and lower intake of protein, calcium, magnesium, zinc, vitamins D and B₆, and riboflavin (Sato-Mito, Shibata, Sasaki, & Sato, 2011).

Apart from metabolic mechanisms implicated in this food diet (see Kanerva et al. 2012), other possible explanations behind the association between chronotype and dietary intakes are psychological features and lifestyle related to

chronotype, described previously as personality styles. One higher proportion of E-types is, for example, physically inactive. In some experimental studies, short-term sleep deprivation (sleep debt) has been shown to decrease physical activity (Schmid et al., 2009). Decrease in physical activity might be replaced with watching television or using other electronic devices that is usually combined with snacking and other unhealthy dietary habits, which could explain some of the associations observed between M-E score and dietary intakes (Kasof, 2001). E-types also tend to have an irregular schedule and to stay awake late, which might influence on food consumption (Baron et al., 2011; Waterhouse et al., 2005). Furthermore, depressive symptoms, which have been linked to eveningness, have also been associated with unhealthy dietary habits, especially among women (Hidalgo et al., 2009; Konttinen, Männistö, Sarlio-Lähteenkorva, Silventoinen, & Haukkala, 2010; Sarlio-Lähteenkorva, Lahelma, & Roos, 2004).

The unfavorable dietary habits and physical inactivity of those who have this tendency could lead to substantial health problems. E-types are more likely to report poor general health, more variable personality (DeYoung et al., 2007), feel lower well-being (Díaz-Morales et al., 2013; Jankowski, 2012; Rander, 2008a), and probably an increased susceptibility to psychiatric illness such as depression (Drennan, Klauber, Kripke, & Goyette, 1991; Kitamura et al., 2010).

Conclusions

Why morningness might be beneficial to positive affect, health and performance? One possibility is that M-type people benefit from the close correspondence between societal expectations and their preferred times for activity. In contrast, normal school and work schedule, which begins early in the day, force E-type adolescents to wake up earlier than their preferred time, called *social jetlag*, which can result in sleep loss and emotional distress (Wittmann et al., 2006).

Temporal variations in cognition may arise for numerous reasons. Perhaps, the circadian timing alters available cognitive resources, though other non-cognitive factors have an influence on performance at non-optimal time of day, such as positive emotions (Cavanaugh et al., 2011). Conventional approaches to education assume that learners are uniform in processing and organizing information. The fact that education system appreciates a certain thinking type (i.e. more analytic than creative) may result in the non-use of the creative and innovative thinking style that might exist among evening adolescents (Díaz-Morales, 2007; Díaz-Morales & Escribano, 2013b; Fabbri et al., 2007).

The evidence summarized in this review shows that E-type adolescents would be more likely to manifest behavioral and school related problems compared to their M-type peers. Tonetti et al. (2013) suggested that future interventions could try to help E-type adolescents to adjust their biological rhythm to the social-school timetable, for example delaying the school start time or alternatively through the

appropriate administration of bright light in the morning, aiming to advance the circadian phase of the biological clock.

The implications of this review suggest the need of being aware of individual differences in the M-E dimensions, as well as taking into account the wide variety of behaviors associated with the evening style in order to design preventive health and academic programs (Clarisse et al., 2010). It is suggested that these programs should promote more flexible timetables, respecting the daily rhythms of central arousal and including activities which involve seeking out a great variability in the level of stimulation and more creative and exploratory experiences.

Adolescents shift from morning to evening orientation. The negative effects are determinant, and this change during puberty is associated with some problems described in this review. E-types often have greater difficulties at school, higher school failure rate, they are less open and interactive within the family, and smoke and drink more coffee than M-types (Giamprieto & Cavallera, 2007). Although optimal ad-

aptation is the result of a balance between different biological pacemakers and the environmental/social zeitgebers, it remains poorly understood how biological, cultural, and environmental zeitgebers act together to determine individual differences on M-E (Schmidt & Randler, 2010). Such negative effects on school achievement and on adolescents' health deserve further attention (Wolfson & Carskadon, 2003). Puberty and adolescence are the most likely stage of life when people adopt healthy habits, and this age group is also the most challenged by social jetlag (Mercer et al., 1998). Educators and parents should be aware of these differences: adolescents are not (necessarily) lazy in the early hours; rather, it seems that this is not the best time of their day.

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