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Chronotype, sleep quality and sleep duration in adult distance education: Not related to study progress

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ABSTRACT

Research in traditional education shows chronotype, sleep duration and sleep quality to be related to learning performance. Research in adult students participating in distance education (DE) is scarce. This study aims to provide knowledge on these relationships in this educational setting. In an observational longitudinal study, chronotype, sleep duration (i.e., for work and free days separately) and sleep quality of 894 students were analyzed in a multiple regression analyses. Students provided information on sleep-related measures and important covariates at the start of their study and study progress was evaluated after 14 months (i.e., the number of successfully completed modules). In line with previous research, chronotype did not predict study progress. Further, sleep duration did not predict study progress, neither as a linear nor as a polynomial term. Third, sleep quality did not predict study progress. Concluding, these results are in line with previous research that DE provides a solution to the asynchrony problem. Findings regarding sleep duration and sleep quality are new and unexpected, asking for attention and further research. Despite the study's observational nature, findings suggest that students participating in DE may benefit from this type of education as the asynchrony problem appears not to apply here, as students can choose their own study schedule.

1. Introduction

Sleep is essential for maintaining proper brain functioning (Cirelli & Tononi, 2008). Insufficient sleep duration and/or quality have been shown to impair school performance in children and adolescents participating in traditional education (Carskadon, 1990; Dewald, Meijer, Oort, Kerkhof, & Bögels, 2010). In addition, the idiosyncratic characteristic chronotype – whether you are a morning or an evening person – has been shown to be influencing school performance in adolescents in traditional education (Escribano, Díaz-Morales, Delgado, & Collado, 2012). However, little research deals with the relation between chronotype, sleep duration, sleep quality and study progress in adult distance education (DE) students.

This population is important as life expectancy is increasing and the fastest growing group is that of older adults (The Netherlands: Centraal Bureau voor de Statistiek, 2014; Worldwide: United Nations, 2012). Retirement age policies are being upwardly revised and our knowledge-based economy is developing quickly; as a result people have to work and learn longer. To compensate for the increasing need to continue to develop professional knowledge and experience far into adult age (Eurydice, 2011), people often participate in formal continuing education. This adult population generally has to combine family and work responsibilities with their study, which is why they often choose for DE. DE increasingly uses Information and Communication Technologies allowing these students to study when and where they choose, often at a self-determined pace. This study was executed among students of this type of DE.

1.1. Mechanisms

There is no generally accepted scientific explanation of why we sleep (Cirelli & Tononi, 2008). As research regarding learning progresses, processes become apparent that provide possible explanations. Recent scientific research shows that sleep promotes the consolidation of information acquired during the day (e.g., Diekelmann & Born, 2010; Payne et al., 2012). Slow-wave sleep is especially important as this plays a role in the consolidation of hippocampus-dependent declarative

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memories. During slow-wave sleep these memories are reactivated and redistributed over networks in the neocortex (Born, 2010), which is important for learning (Ribeiro & Stickgold, 2014). Deprivation of sleep leads to the activation of certain genes which indirectly negatively influence health and cognition. Chronic sleep deprivation adds to this and intensifies the negative effects of acute sleep deprivation on cognition (Möller-Levet et al., 2013), an indicator of performance on the complex measure of academic performance (Diamond, 2013; Furnham, Monsen, & Ahmetoglu, 2009). However, research into the biological mechanisms of sleep – especially regarding sleep deprivation – is in the early stages and full understanding of the exact mechanisms is not possible at this point.

1.2. Chronotype

Chronotype is the behavioral reflection of one's underlying circadian rhythm, meaning, whether one is more a morning person or an evening person. Not only physiological factors such as hormone secretion and body core temperature fluctuate with chronotype. Chronotype also influences a broad range of cognitive capacities such as attention, executive functioning and memory (Schmidt, Collette, Cajochen, & Peigneux, 2007). As cognitive performance is a reliable predictor for learning (Diamond, 2013) it is important to account for chronotype.

Chronotype can be measured using self-assessment (i.e., subjective) and sleep times (i.e., more objective, but still via reported sleep times). The first is considered a qualitative assessment, the latter a quantitative assessment (Roenneberg, Wirz-Justice, & Merrow, 2003). These authors show that both of these measurements are in accordance with each other. Despite the congruency of these measures, it is important to recognize that these measures are different, despite that they aim to measure the same construct.

Chronotype changes over age. Children typically have a more early chronotype (Randler & Truc, 2014), but in adolescence this shifts towards the evening as a result of reasons among which could be pubertal development (i.e., a delay in the secretion of melatonin in adolescence, Crowley, Acebo, & Carskadon, 2007) and the need for functional autonomy (Díaz-Morales, Escribano, Jankowski, Vollmer, & Randler, 2014). In adulthood, chronotype tends to shift back towards the morning type (Díaz Morales & Sánchez-López, 2004).

In traditional education, chronotype has a profound influence on learning results. Such face-to-face programs start early in the morning giving early chronotypes an advantage. Evening types tend to get less sleep, awake later and skip breakfast compared to morning types. This leads to lower motivation, which affects school performance as an indirect effect (Boschloo et al., 2012). In addition, early chronotypes tend to achieve higher grades than late chronotypes (Randler & Frech, 2009). In DE, however, no relationship between chronotype and performance has been found (Jovanovski & Bassili, 2007). This could be because these students can choose a learning time better fitting their chronotype. A study in which morning and evening classes were implemented evaluated which chronotypes performed better in which class. The researchers found that morning types performed better in morning classes, compared to evening types and evening types better in evening classes, compared to morning types (Önder, Horzum, & Beşoluk, 2011). The fact that no differences are observed between chronotype and performance in DE is due to the principles of DE. It allows students to study anytime and anywhere, at their preferred biological time schedule, when their performance is high (Horzum, Önder, & Beşoluk, 2014). However, despite that the education itself does not force an asynchrony on learning time in DE, asynchrony can still occur. Students can lack the ability to choose the proper learning time fitting their chronotype or their freedom to choose the preferred learning time is limited due to other life responsibilities (e.g., work and family responsibilities), which is often the case in adult DE students.

Lastly, it is important to recognize that chronotype influences sleep duration, depending on one's social clock. Evening types, for example, may get too little sleep on weekdays because their social clock dictates they awaken early, though they go to bed late, because of their evening preference. On the other hand, morning types may get too little sleep on weekends when their social clock dictates a nice, but late, get-together Friday evening, resulting in less sleep as morning types wake up early, while evening types can easily sleep longer. Thus, chronotype has an impact on sleep duration, making it important to account for.

1.3. Sleep duration and sleep quality

The ideal sleep duration for adults is around 7–8 h per night, with an inverse U-shaped relation between sleep duration and cognitive performance (Ferrie et al., 2011; Sternberg et al., 2013). Still, many adults get too little sleep as their social clock dictates them to get up early due to, for instance, work responsibilities or children; typical characteristics of DE students.

In traditional education, findings from both cross-sectional and experimental studies show that sleep deprivation (i.e., in the form of duration or quality) leads to poorer learning and lower academic performance (Curcio, Ferrara, & De Gennaro, 2006; Gruber et al., 2014; Short, Gradisar, Lack, & Wright, 2013). In DE, no research regarding the relation between sleep duration and learning performance is available. Though chronotype has been shown to influence sleep duration (Traditional education: Escribano et al., 2012; DE: Önder et al., 2011), it is still important to include sleep duration in the analyses, next to chronotype. This is especially true because DE students are not dictated by their social clock for their study; their study is self-regulated. This means that the shared variance of sleep duration and chronotype in relation to learning performance could be less, which makes sleep duration even more important for the analyses.

Sleep deprivation or impaired sleep quality negatively influences cognitive performance on a wide range of functions including executive attention, working memory, and higher order functions (Durmer & Dinges, 2005). In traditional education, negative effects of sleep deprivation or poor sleep quality on learning performance have repeatedly been shown in children and adolescents (cf. review of Dewald et al., 2010). It has been found in 'emerging adults' (i.e., adults between 18 and 25 years old) that sleep quality is related to academic performance; specifically, lower sleep quality is related to lower academic performance (Radek & Kaprelian, 2013). This is of interest, as the current study also includes these so-called 'emerging adults'. Only one study is available on the relationship between sleep quality and learning performance in adults participating in DE (Miles, 2014). There, a relation between sleep quality and test grade was found; the lower the sleep quality, the lower the test grade. Clarity is lacking in this study, as it appears that students could have been enrolled in different courses, however, this is unclear. If so, measuring learning performance with a grade would not be correct, as courses differ in terms of difficulty and content. These findings therefore ask for clarification and replication. Further, no research is available on the relationship between sleep quality and cognition in adults, to deduce possible hypotheses from. In contrast, much research is available on older adults (i.e., >65 years). However, there is only a small group of students in this age group in the current study. Because of this void in knowledge, it is highly interesting to investigate the combination of sleep duration and sleep quality in the adults in this study.