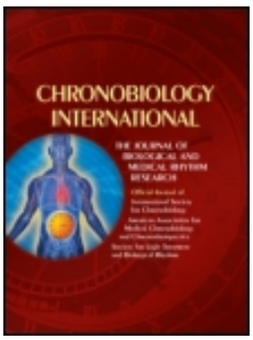

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ORIGINAL ARTICLE

Are all evening-types doomed? Latent class analyses of perceived morningness–eveningness, sleep and psychosocial functioning among emerging adults

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An overwhelming amount of research has indicated that evening-types report more negative psychosocial functioning as well as more negative sleep characteristics (e.g. more sleep problems) relative to morning-types. Researchers also find a strong, consistent link between poor sleep characteristics and negative psychosocial functioning. These studies, however, have been based on a variable-centred approach, and thus were not able to assess possible individual differences *within* morning-types and evening-types with respect to their sleep characteristics prior to assessing differences in psychosocial functioning. Thus, it is not clear whether it is morningness–eveningness *per se* or sleep characteristics that explain the differences in psychosocial functioning found between morning-types and evening-types. The purpose of the present two-year longitudinal study was to employ a person-centred approach to determine whether there are subgroups within morning-types and evening-types based on 10-sleep characteristics (e.g. sleep problems and sleep duration). Then subgroups were compared on three indices of psychosocial functioning (i.e. academics, intrapersonal adjustment and alcohol consumption), both concurrently, as well as one year later. Participants were 780 (72.2% female; $M = 19.0$ years, $SD = 0.90$) emerging adults at a mid-sized university in Southern Ontario, who were either morning-types or evening-types. A latent class analysis (LCA) conducted for morning-types yielded two subgroups, classified as having good sleep characteristics (i.e. morning-good) and poor sleep characteristics (i.e. morning-poor). Results of a second LCA conducted for evening-types yielded three subgroups, classified as having good (i.e. evening-good), moderate (i.e. evening-moderate) and poor (i.e. evening-poor) sleep characteristics. Results comparing subgroups across the 10-sleep characteristics indicated that morning-good and evening-good individuals reported very similar scores, and both were characterized by the least sleep problems and longest sleep duration relative to the other subgroups. In terms of the three psychosocial functioning indices we found that academic achievement generally did not differ across the five subgroups (i.e. morning-good, morning-poor, evening-good, evening-moderate and evening-poor). With respect to intrapersonal adjustment, morning-good and evening-good subgroups reported significantly better intrapersonal adjustment relative to the other subgroups across time. Interestingly, evening-type subgroups generally reported higher alcohol consumption than morning-type subgroups. Overall, these results suggest that intrapersonal adjustment in particular appears to be associated more with differences in sleep characteristics (i.e. sleep problems and duration), than with morningness–eveningness *per se*, while the opposite is generally true for alcohol consumption. Lifestyle and personality factors likely also play a critical role. Importantly, our study is the first to identify a subgroup of evening-types who report good sleep characteristics and similar levels of intrapersonal adjustment and academic achievement to that of the majority of morning-types.

Keywords: Academics, alcohol consumption, intrapersonal adjustment, person-centred, sleep problems

INTRODUCTION

Emerging adulthood is conceptualized as a sensitive transitional period, with unique opportunities and challenges for psychosocial functioning (Arnett, 2000). For example, emerging adults at university aim to balance increased autonomy (Arnett, 2007) with the accomplishment of important developmental life tasks, such as academics (Havighurst, 1972). Successful completion of these tasks is believed to set the foundation for positive psychosocial functioning in subsequent life stages (Erikson, 1968). Understanding the factors associated with psychosocial functioning among university students, therefore, is a crucial task for researchers (Pancer et al., 2004). One factor that has been shown to be associated with psychosocial functioning among this age group is

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morningness–eveningness preference (Taylor et al., 2011).

Emerging adults at university represent a particularly intriguing context for the study of morningness–eveningness because of a greater preference for eveningness during this developmental phase (Kim et al., 2002), coupled with increased flexibility in setting timing for class schedules and sleep-wake patterns (Zimmermann, 2011). The morningness–eveningness construct categorizes individuals based on preferences for ideal sleep-wake timing as well as preferred timing for peak performance on physical and mental tasks (Horne & Östberg, 1976). Individuals may be classified as either morning-types, intermediate types or evening-types (Adan, 1994), but special attention has been placed on exploring differences between the two extreme groups: morning-types and evening-types (Horne et al., 1980; Jankowski & Ciarkowska, 2008). Of concern, evening-types, on average, have been found to report poorer sleep characteristics (Giannotti et al., 2002; Taillard et al., 1999) as well as more negative psychosocial functioning relative to morning-types (Gau et al., 2007; Taylor et al., 2011).

In fact, morningness–eveningness preference has been associated with various indices of psychosocial functioning, including academic achievement (Preckel et al., 2011), intrapersonal adjustment (Lázár et al., 2012) and alcohol consumption (Wittmann et al., 2010). For example, researchers consistently have found that across both high school and university samples, evening-types generally report lower grades relative to morning-types (Beşoluk et al., 2011; Giannotti et al., 2002; Preckel et al., 2011; Taylor et al., 2011). Morning-types and evening-types have also been found to differ on how they experience and regulate their emotions (Drennan et al., 1991). Biss and Hasher (2012), for example, found that a greater preference for eveningness was associated with lower positive affect in both younger (17–38 years) and older (59–79 years) adults. Eveningness has also been shown to be significantly correlated with less positive attitudes towards life (Randler, 2011), lower life satisfaction (Randler, 2008) and lower psychological well-being (Howell et al., 2008; but see Fernández-Mendoza et al., 2010). With regards to alcohol consumption, a number of studies have found that evening-types report consuming more alcohol relative to morning-types (Adan, 1994; Fernández et al., 2010; Taillard et al., 1999; Taylor et al., 2011).

Social jetlag, defined as the asynchrony between an individual's morningness–eveningness preference and the individual's timing of social tasks, may account for the differences in psychosocial functioning between morning-types and evening-types (Wittmann et al., 2006). Evening-types (who prefer a late sleep-wake pattern) may experience social jetlag when they wake up earlier than their preferred wake time in order to attend classes (Adan et al., 2012). Because our society generally caters more to morning-types (e.g. early school start times from a young age), evening-types are generally believed to experience social jetlag to a greater degree than morning-types (Wittmann et al., 2006). Given that social jetlag may negatively affect sleep (e.g. shorter sleep duration), and that poor sleep characteristics have been associated with negative psychosocial functioning (Adan et al., 2012; Galambos et al., 2010), it is necessary to account for the role of these sleep characteristics when examining the link between morningness–eveningness and psychosocial functioning.

In fact, the link between poor sleep characteristics and negative psychosocial functioning is well-established within the literature. For example, less sleep problems have been significantly associated with lower levels of stress (Galambos et al., 2009), lower negative affect (Fortunato & Harsh, 2006), and less depressive symptoms (Pilcher et al., 1997). Shorter sleep duration also has been found to be associated with higher levels of stress (Galambos et al., 2012) as well as depression (Hamilton et al., 2007). Furthermore, individuals who report higher academic achievement also report less sleep problems (Gaultney, 2010; Orzech et al., 2011) and longer sleep duration (Gilbert & Weaver, 2010).

A consistent finding within the literature also is that evening-types suffer from more negative sleep characteristics relative to morning-types. Indeed, past studies have found that evening-types report more sleep problems (Gau et al., 2007; Merikanto et al., 2012; Tzischinsky & Shochat, 2011), shorter sleep duration (Fernández-Mendoza et al., 2010; Giannotti et al., 2002), and longer weekend delay and oversleep (Monk et al., 1994; Randler, 2008; Soehner et al., 2011) relative to morning-types. Although these studies, based on variable-centred analyses, provide important information at the average level regarding differences in sleep characteristics *between* morning-types and evening-types, they do not allow for the modelling of significant individual differences in sleep characteristics *within* morning-types and evening-types. Whereas a variable-centred approach focuses on understanding individuals through patterns observed across variables, a person-centred approach focuses on modelling subgroups of individuals, who may differ across different variables (Bergman & Magnusson, 1997; Bergman & Trost, 2006). For example, although evening-types have been found to report more sleep problems relative to morning-types (Merikanto et al., 2012), it is possible that some evening-types may report less sleep problems than other evening-types. It is also possible that some evening-types may report levels of sleep problems that are comparable with that of some morning-types. This possibility, however, has not been tested in past research.

Moreover, it remains to be determined whether all evening-types are generally ''doomed'' to experience more negative psychosocial functioning than morning-types because of the nature of their morningness–eveningness preference, or alternatively, whether

accounting for individual differences in sleep characteristics might reveal differences in psychosocial functioning among evening-types. In order to address this gap, it will be necessary to first identify whether there are significant individual differences in sleep characteristics among evening-types, and subsequently determine whether these differences map on to differences in psychosocial functioning. Similarly, it will be necessary to determine the degree to which morning-types differ from each other on their sleep characteristics, and whether these individual differences are associated with psychosocial functioning within morning-types. Although researchers have recently started to model poor sleep characteristics as the mechanism linking morningness–eveningness preference to negative psychosocial functioning (Roeser et al., 2012), no studies have specifically modelled individual differences in sleep characteristics within morning-types and evening-types when examining the link between morningness–eveningness and psychosocial functioning.

The present study

The purpose of the present two-year longitudinal study was to employ a person-centred approach in order to: (a) explore significant individual differences (i.e. subgroups) within both morning-types and evening-types based on 10-sleep characteristics (i.e. problems falling asleep, staying asleep, waking up too early and staying awake; subjective dissatisfaction with sleep patterns; perceived daytime interference due to sleep patterns; sleep duration (week and weekend); weekend delay and weekend oversleep) and (b) compare subgroups on three important indices of psychosocial functioning (i.e. academic achievement, intrapersonal adjustment and alcohol consumption), both concurrently as well as one year later. As the present study was the first to examine heterogeneity within morning-types and evening-types based on sleep characteristics, and thus was exploratory, we did not project any specific hypotheses regarding the different types of subgroups that would emerge. Based on past research (Galambos et al., 2009; Roeser et al., 2012), however, we hypothesized that subgroups characterized by good sleep characteristics would report better psychosocial functioning, relative to subgroups characterized by poor sleep characteristics.

MATERIALS AND METHODS

Participants

Participants were 942 emerging adults enrolled at a mid-sized university in Southern Ontario, Canada, who were registered at the university at both Times 1 and 2. At Time 1, all participants, aged 17–25 years, were in their first year of university. Our sample comprised predominantly of domestic-Canadian students (87.1%), and the common ethnic backgrounds of these students other than Canadian were British (19%), Italian (16.8%), French (9.5%) and German (9%), consistent with the broader demographics for the region (Statistics Canada, 2006). Of the international students, the majority were from Asia (36.7%), European Union (15.3%) and the Caribbean (10%). Our final sample comprised a subgroup of students ($n = 780$, 72.2% female) who self-identified as being either morning-types or evening-types at Time 1. We excluded, therefore, participants who indicated that they were both morning- and evening-types ($n = 86$) as well as participants who indicated that they were neither morning- nor evening-types ($n = 40$). Participants in the final subsample were, on average, 19 years of age (SD = 0.90).

Procedure

First-year university students from various academic disciplines were invited to complete a survey examining factors related to stress, coping and adjustment to university, by way of posters, classroom announcements, website posting and visits to on-campus student residences. Participants were given course credit or monetary compensation ($10) for their participation at Time 1, and monetary compensation for their participation at Time 2 ($20). At Time 2, only the students who participated in the first assessment were invited to participate again, by way of emails, posters and classroom announcements. The study was approved by the University Ethics board prior to survey administration at both assessments, and all participants provided informed active consent prior to participation. The survey was administered by trained research assistants. The method and procedure of data collection employed in the present study conforms to international ethical standards (Portaluppi et al., 2010).

Missing data analysis

Missing data occurred within each assessment time point because some students did not finish the entire questionnaire (average missing data = 1.5%), and because some students did not complete both waves of the survey (19.2%). Missing data analysis revealed that these missing data were missing at random (Schafer & Graham, 2002). Thus, missing values were imputed using the expectation-maximum (EM) algorithm. EM is an iterative maximum-likelihood (ML) procedure in which a cycle of calculating means and covariances followed by data imputation is repeated until a stable set of estimated missing values is reached. Methodological research has demonstrated that ML estimation is preferable to pair-wise deletion, list-wise deletion or means substitution (Schafer & Graham, 2002).

Measures

We assessed the 10-sleep characteristics, perceived morningness–eveningness preference and demographics only at Time 1 when participants were in their first year of university. The three indices of psychosocial adjustment were assessed twice: at Time 1 and one year later (Time 2).

Demographics: Age and gender (1 = male, 2 = female) were assessed at Time 1.

Perception of morningness–eveningness: Participants responded *Yes* or *No* to two items: (i) ''Would you describe yourself as a *morning* person (do your best thinking and work in the morning)?'' and (ii) ''Would you describe yourself as an *evening* person (do your best thinking and work in the evening)?'' Participants were classified as morning-types if they responded ''yes'' to the first item and ''no'' to the second item. Likewise, participants were classified as evening-types if they responded ''no'' to the first item and ''yes'' to the second item. Participants who responded ''yes'' or ''no'' to both items were excluded from the analyses.

Sleep characteristics: We assessed 10-sleep characteristics, which reflected sleep problems (six items), sleep duration (week and weekend) and sleep-wake inconsistency (weekend delay and weekend oversleep): **(i)** *Sleep problems*: we assessed sleep problems based on an adapted version of the Insomnia Severity Index (Morin, 1993), which comprised six items. Problems falling asleep, staying asleep, waking up too early and staying awake were rated with responses ranging from *1 = no problem* to *5 = very severe*. One-item assessed the degree to which participants were satisfied with their sleep patterns with responses ranging from *1 = very satisfied* to *5 = very dissatisfied*. The extent of participants' perceived daytime impairment as a result of their sleep patterns was also assessed, with responses ranging from *1 = rarely interferes* to *4 = very often interferes*; **(ii)** *Sleep duration*: participants were asked to indicate what time they ''normally fall asleep'' and ''normally wake up''. Sleep duration was calculated from participants' sleep-wake times, separately for the week and weekend. Higher scores indicate longer sleep duration; **(iii)** *Sleep-wake inconsistency*: We calculated *Weekend delay* (difference between average bed times during the week versus the weekends) as well as *Weekend oversleep* (difference between average wake times during the week versus the weekends) based on participants sleep-wake times for the week and weekend.

Academic achievement: Overall year-end averages across all courses were accessed from the university's Registrar's Office with permission granted from the participants (only two students did not consent to having their grades accessed).

Intrapersonal adjustment: Intrapersonal adjustment was assessed as a composite variable, which comprised three scales: depressive symptoms, daily hassles and self-esteem. **(i)** *Depressive symptoms*: the Centre for Epidemiological Depression Scale (Radloff, 1977) assessed the degree of depressive symptoms individuals had experienced over the past two weeks (e.g. ''I thought my life had been a failure''). Responses ranged from *1 = none of the time (less than 1 day)* to *5 = most of the time (10–14 days)*. Cronbach's alphas at Times 1 and 2 were 0.91, and 0.93, respectively. **(ii)** *Daily hassles*: As a measure of perceived stress, participants indicated the extent to which they felt bothered by 25 hassles relating to peers, family, school and money (e.g. ''Not having enough time''). Responses ranged from *1 = Almost never bothers me* to *3 = Often bothers me*. Cronbach's alphas at Times 1 and 2 were 0.84 and 0.84, respectively. **(iii)** *Self-esteem*: the 10-item Rosenberg Self-Esteem Scale (Rosenberg, 1965) was used to assess participants' self-esteem (e.g. ''I take a positive attitude towards myself''). Responses ranged from *1 = Strongly agree* to *5 = Strongly disagree*. Cronbach's alphas at Times 1 and 2 were 0.90 and 0.92, respectively. Results of a principal components factor analysis indicated that the three scales hung together as one factor (with factor loadings ranging from 0.78 to 0.89 at Time 1 and 0.77 to 0.89 at Time 2. All three scales were standardized and averaged to form the intrapersonal adjustment composite variable. Scores on the individual scales were coded such that higher scores indicate better intrapersonal adjustment (i.e. less depressive symptoms, less daily hassles and higher self-esteem).

Alcohol consumption: Alcohol consumption was a composite variable, which comprised both frequency and amount of alcohol consumption: **(i)** *Frequency*: ''How often do you go drinking or have a drink''? Responses ranged from 1 = *Never* to 8 = *Every day*. **(ii)** *Amount*: ''On average, when you are drinking alcohol, about how many drinks do you have''? Responses ranged from 1 = *less than 1 drink* to 6 = *over 10 drinks*. Scores were standardized and averaged such that higher scores indicated higher alcohol consumption.

Plan of analyses

We conducted LCAs using Mplus Version 7 (Muthen & Muthen, 2012) to assess subgroup heterogeneity. Analyses were conducted separately for morning-types and evening-types. Latent class indicators included 10-sleep characteristics (i.e. problems falling asleep, staying asleep, waking up too early and staying awake; subjective dissatisfaction with sleep patterns; perceived daytime interference due to sleep patterns; sleep duration (week and weekend); weekend delay and weekend oversleep. To determine the number of classes that provided the best fit for the data, we considered three criteria: (1) Bayesian information criterion (BIC), where smaller values indicate a better model fit for the data; (2) significance level of the Lo-Mendell-Rubin-Adjusted Likelihood Ratio Test (LMR-LRT) and the bootstrap likelihood ratio test (BLRT), where once one of these tests reach non-significance (i.e. $p > 0.05$) the number of classes prior to non-significance is deemed a better model fit for the data; (3) no class contains less than 5% of the total sample (Jung & Wickrama, 2008). We also assessed entropy, which refers to the degree of confidence that individuals belong to the correct class and that adequate class distinctions exist.

Following the two LCAs, we conducted a multivariate analysis of variance (MANOVA) test to assess differences in sleep characteristics across subgroups of

morning-types and evening-types. Next, we conducted a repeated measure of MANOVA test to assess differences in psychosocial functioning both at Times 1 and 2 across all subgroups. Follow-up comparisons were based on either Hochberg *post hoc* tests (due to unequal *n*'s across subgroups) when the assumption of homogeneity was met, or Games-Howell *post hoc* test when the assumption of homogeneity of variance was violated.

RESULTS

Overall, the majority of participants perceived themselves to be evening-types (77.2%, $n = 602$) relative to morning-types (22.8%, $n = 178$). Results of *z*-proportion tests indicated that the proportion of males versus females was similar among morning-types (22.4% males and 77.6% females) and evening-types (29.4% males and 70.6% females). Morning-types, on average, reported significantly earlier bed times during the week (11:54 pm) and weekend (1:30 am) relative to evening-types' bed times during the week (1:12 am) and weekend (2:42 am), $p = 0.000$. Morning-types also reported significantly earlier wake times during the week (8:12 am) and weekend (10:12 am) relative to evening-types' wake times during the week (9:30 am) and weekend (11:42 am).

Latent class analysis for morning-types: Within morning-types, LCA indicated a two-class solution as the better fitting model (Table 1). The BIC value was lower for the three-class model (relative to the two-class model), but the LMR-LRT for the three-class model was non-significant, while the LMR-LRT for the two-class model was significant. The two-class model had also no classes less than 5% of morning-types. Class 1 comprises 70.2% of morning-types and was labelled ''morning-good'' because these individuals were characterized by better sleep characteristics (e.g. less sleep problems and longer sleep duration) than Class 2 individuals (Figure 1). The remaining 29.8% of morning-types (Class 2) were classified as ''morning-poor'' because of poorer sleep characteristics (e.g. more sleep problems and shorter sleep duration) relative to morning-good individuals.

TABLE 1. Fit indices and classification precision for latent class models for morning-types and evening-types.

Latent classes	Morning-types		Evening-types		
	2	3	2	3	4
BIC	4739.893	4723.811	16 750.213	16 546.890	16 500.209
Entropy	0.87	0.80	0.88	0.78	0.77
Class >5%	Yes	Yes	Yes	Yes	Yes
LMR-LRT[a]	Sig	NS	Sig	Sig	NS
BLRT	Sig	Sig	Sig	Sig	Sig

BIC, Bayesian information criterion; Class >5% (all classes contain more than 5% of the total sample), LMR-LRT, Lo-Mendell-Rubin-adjusted likelihood ratio test; BLRT, bootstrap likelihood ratio test (tests of fit between the model of interest (e.g. three-class model) and the model with one less class (e.g. two-class model)), Sig, significant; NS, non-significant.

[a]Nylund et al. (2007) recommend stopping the first time the LMR-LRT is non-significant, even if it becomes significant again later.

Latent class analysis for evening-types: Within evening-types, LCA indicated a three-class solution (Table 1). The BIC value was lower for the three-class model relative to the two-class model. The LMR-LRT for the four-class model was non-significant, while the LMR-LRT for the three-class model was significant. The three-class model had also no classes less than 5% of evening-types. Class 1 comprises 38.4% of all evening-types and was labelled ''evening-good'' because these individuals reported the best sleep characteristics relative to the other two classes of evening-types (e.g. least sleep problems and longest sleep duration). Class 2 comprises 48.2% of all evening-types and was labelled ''evening-moderate'' because these individuals generally reported moderate scores across the sleep characteristics relative to individuals in the other two classes. Finally, Class 3, the smallest subgroup, comprises 13.5% of all evening-types and was labelled ''evening-poor'' because these individuals reported the worst sleep characteristics (e.g. most sleep problems and shortest sleep duration) relative to the other two classes of evening-types (Figure 1).

Comparisons of subgroups of morning-types and evening-types on sleep characteristics

In order to test whether there were differences across subgroups in sleep characteristics, a MANOVA was conducted with subgroups (i.e. the five subgroups) as the between-subjects factor. Results indicated a significant effect of subgroups on all sleep characteristics, $\Lambda = 0.162$, F (40, 2906.438) $= 44.77$, $p = 0.000$, $\eta^2 = 0.366$. Table 2 outlines the significant differences. Individuals classified as morning-good and evening-good reported significantly less sleep problems (i.e. falling asleep, staying asleep, staying awake, dissatisfaction with sleep patterns and less perceived daytime interference from sleep patterns) in comparison with the morning-poor, evening-moderate and evening-poor groups. Evening-good individuals, however, did not differ from evening-moderate individuals on problems waking up too early. Additionally, both morning-good and evening-good individuals reported similar sleep duration during the weekend relative to evening-moderate individuals, but evening-good individuals also reported longer sleep duration during the week relative to evening-moderate individuals. Importantly, morning-good and evening-good individuals did not differ from each other on most of the sleep characteristics, with the exception that morning-good individuals reported more problems staying asleep, less problems waking up too early, and shorter sleep duration during the week relative to evening-good individuals (Table 2).

Interestingly, evening-poor individuals reported significantly higher scores on all sleep problems, except

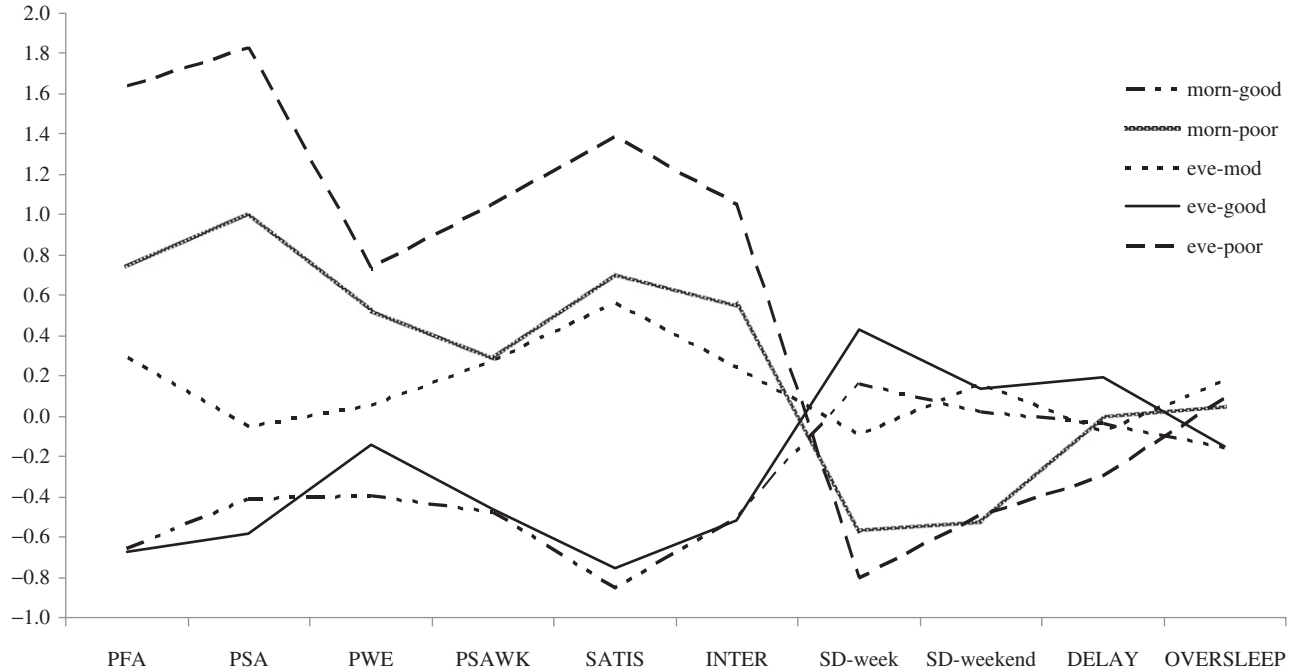

FIGURE 1. Standardized mean values for five subgroups on all sleep characteristics at Time 1. PFA, problems falling asleep; PSA, problems staying asleep; PWE, problem waking up too early; PSAWK, problem staying awake; SATIS, dissatisfaction with sleep patterns; INTER, perceived daytime interference due to sleep patterns; SD-week, sleep duration during the week, SD-weekend, sleep duration on the weekend, DELAY, weekend delay, OVERSLEEP, weekend oversleep. Higher values indicate higher scores on each of the sleep characteristics.

TABLE 2. Significant mean differences on sleep characteristics among five subgroups of morning- and evening-types.

	Morning-good ($n=125$)	Morning-poor ($n=53$)	Evening-moderate ($n=290$)	Evening-good ($n=231$)	Evening-poor ($n=81$)	F	df	p	η^2
Sleep characteristics									
PFA	1.78 (0.78)[a]	3.38 (0.84)[c]	2.86 (0.86)[b]	1.77 (0.73)[a]	4.40 (0.66)[d]	220.62	4, 775	0.000	0.532
PSA	1.43 (0.61)[a]	2.92 (1.00)[d]	1.81 (0.83)[c]	1.25 (0.52)[b]	3.80 (0.89)[e]	218.95	4, 775	0.000	0.531
PWE	1.64 (0.87)[a]	2.74 (1.27)[c]	2.18 (1.30)[b]	1.94 (1.12)[b]	3.00 (1.32)[c]	21.11	4, 775	0.000	0.098
PSAWK	1.53 (0.76)[a]	2.28 (1.04)[b]	2.27 (0.93)[b]	1.55 (0.73)[a]	3.05 (1.24)[c]	59.25	4, 775	0.000	0.234
SATIS	2.20 (0.72)[a]	3.78 (0.81)[b]	3.64 (0.63)[b]	2.29 (0.65)[a]	4.49 (0.58)[c]	299.99	4, 775	0.000	0.608
INTER	1.86 (0.74)[a]	2.70 (0.80)[b]	2.46 (0.69)[b]	1.85 (0.66)[a]	3.10 (0.69)[c]	70.64	4, 775	0.000	0.267
SD-week	8.52 (1.24)[b]	7.46 (1.53)[a]	8.14 (1.44)[b]	8.92 (1.29)[c]	7.11 (1.49)[a]	33.88	4, 775	0.000	0.149
SD-weekend	8.92 (1.04)[b]	8.14 (1.92)[a]	9.11 (1.33)[b]	9.07 (1.37)[b]	8.19 (1.66)[a]	11.94	4, 775	0.000	0.058
Delay	1.52 (1.04)[a,b]	1.56 (1.13)[a,b]	1.48 (1.07)[a,b]	1.78 (1.05)[b]	1.23 (1.20)[a]	4.73	4, 775	0.001	0.024
Oversleep	1.91 (1.14)[a]	2.24 (1.39)[a]	2.42 (1.68)[a]	1.91 (1.51)[a]	2.31 (2.05)[a]	4.61	4, 775	0.001	0.023

PFA, Problem falling asleep; PSA, problem staying asleep; PWE, problem waking up too early; PSAWK, problem staying awake; SATIS, satisfaction with sleep patterns; INTER, perceived daytime interference due to sleep patterns; SD-week, sleep duration during the week; SD-weekend, sleep duration during the weekend; Delay, weekend delay, Oversleep, weekend oversleep. Values with different superscripts in the same row are significantly different from each other. Standard deviations are presented in parentheses.

waking up too early, relative to morning-poor individuals, but the two subgroups did not differ on sleep duration during the week and weekend. Furthermore, in comparison with morning-poor and evening-poor subgroups, individuals classified as evening-moderate reported significantly less problems falling asleep, staying asleep, waking up too early, staying awake (only relative to evening-poor), dissatisfaction with sleep patterns (only relative to evening-poor), interference with daily functioning based on sleep patterns (only relative to evening-poor) and higher sleep duration during the week and weekend. Finally, in terms of both weekend delay and oversleep, there were no significant differences among any of the subgroups, with the exception that evening-good individuals reported higher scores on weekend delay relative to evening-poor individuals.

Comparisons of subgroups on psychosocial functioning

In order to test whether there were differences across subgroups in psychosocial functioning across time, a

TABLE 3. Significant mean differences on psychosocial functioning indices among subgroups of morning-types and evening-types.

	Morn-good ($n=125$)	Morn-poor ($n=53$)	Eve-mod ($n=290$)	Eve-good ($n=231$)	Eve-poor ($n=81$)	F	df1, df2	p	Partial η^2
Academic achievement	0.26 (0.88)^{a}	−0.12 (1.16)^{b}	−0.07 (1.05)^{a,b}	−0.05 (1.00)^{a,b}	0.07 (0.82)^{a,b}	3.46	4, 775	0.008	0.011
Intrapersonal adjustment	0.39 (0.70)^{a}	−0.41 (0.81)^{b,c}	−0.12 (0.80)^{b}	0.34 (0.70)^{a}	−0.56 (0.77)^{c}	45.01	4, 775	0.000	0.188
Alcohol consumption	−0.36 (0.95)^{a}	−0.27 (0.96)^{a,b}	0.12 (0.93)^{c}	0.11 (0.93)^{c}	0.04 (0.84)^{b,c}	9.13	4, 775	0.000	0.045

Scores on academic achievement, intrapersonal adjustment and alcohol consumption are averaged across Times 1 and 2. Values with different superscripts in the same row are significantly different from each other.

repeated measure MANOVA was conducted on the psychosocial functioning indices, with subgroups as the between-subjects factor, and time (Times 1 and 2) and type of psychosocial functioning (academic achievement, intrapersonal function and alcohol use) as the within-subjects factors. Results indicated that there were significant main effects for subgroups, $F(4, 775) = 3.645$, $p = 0.006$, partial $\eta^2 = 0.018$, and time, $\Lambda = 0.994$, $F(1, 775) = 5.055$, $p = 0.025$, partial $\eta^2 = 0.006$, as well as a significant subgroups X-type of psychosocial functioning interaction, $\Lambda = 0.859$, $F(8, 1548) = 15.286$, $p = 0.000$, partial $\eta^2 = 0.073$. Results also indicated that both the subgroup *X* time interaction, and the subgroup *X* time X-type of psychosocial functioning interaction, were not significant, $\Lambda = 0.999$, $F(4, 775) = 0.252$, $p = 0.909$, partial $\eta^2 = 0.001$ and $\Lambda = 0.982$, $F(8, 1548) = 1.726$, $p = 0.088$, partial $\eta^2 = 0.009$, respectively. The significant main effect for time was indicated by higher scores on psychosocial functioning at Time 2 than at Time 1. Results for the *post hoc* analyses assessing the subgroups X-type of psychosocial functioning interaction are shown in Table 3. In terms of academic achievement, there were no significant differences across all subgroups except that morning-poor individuals reported lower grades relative to morning-good individuals. In terms of intrapersonal adjustment, morning-good and evening-good did not differ from each other and both groups reported significantly better intrapersonal adjustment relative to morning-poor, evening-moderate and evening-poor individuals. Evening-moderate reported significantly better intrapersonal functioning relative to evening-poor individuals but did not differ from morning-poor individuals. Morning-poor and evening-poor individuals did not differ from each other on intrapersonal adjustment. Finally, all subgroups of evening-types (i.e. evening-good, evening-moderate and evening-poor) reported significantly higher alcohol consumption than both subgroups of morning-types, except that evening-poor and morning-poor did not differ.

DISCUSSION

An overwhelming amount of research has indicated that evening-types tend to report more negative psychosocial functioning relative to morning-types. Past studies, however, have relied exclusively on variable-centred analyses, which while providing important information regarding average scores on psychosocial functioning *between* morning-types and evening-types, do not account for any significant homogeneity *within* morning-types and evening-types. Given that sleep characteristics has been proposed as one possible mechanism linking morningness–eveningness and psychosocial functioning (Wittmann et al., 2006), we based our analysis of individual differences within morning-types and evening-types on 10-important sleep characteristics. We addressed, therefore, an important gap within the literature regarding whether it is morningness–eveningness *per se* or whether it is sleep characteristics that explain the differences in psychosocial functioning found between morning-types and evening-types. Although more recent studies have attempted to address this gap using variable-centred analyses (Roeser et al., 2012), the present study is the first to specifically identify subgroups within evening-types and morning-types who differ on sleep characteristics.

One of the most intriguing findings of the present study was that up to 40% of evening-types were classified as having good sleep characteristics (i.e. evening-good subgroup) and importantly, did not generally differ on these sleep characteristics relative to the majority of morning-types who reported good sleep. One reason for significant individual differences in sleep characteristics within evening-types might be that some evening-types may have been able to select later class times, which would allow them to maintain their preference for later sleep-wake schedules and not compromise on sleep duration because of having to wake up early for school. Indeed, Onyper et al. (2012) found that later class start times predicted later bed times and wake times, which in turn predicted longer sleep duration and lower scores on daytime sleepiness among a sample of university students. Just as intriguing was the finding that within morning-types, up to one-third of individuals were classified as having poor sleep characteristics. One reason for this finding may be that some morning-types might be constrained by later class start times, which interfere with their preference for earlier sleep-wake timing (e.g. lectures at the university from which this sample was drawn run as late as 10:00 pm). Taken together, our results indicate significant individual differences in sleep characteristics within both morning-types and evening-types – a finding that has not been explored in past research.

Interestingly, across all five subgroups, individuals generally did not differ on either weekend oversleep or weekend delay, which suggests that morning-types and evening-types, regardless of individual differences in sleep problems and sleep duration, tend to maintain similar sleep-wake patterns across the week and weekend. Although past studies have found higher weekend delay and oversleep among evening-types relative to morning-types, the majority of these studies were based on high school samples (Crowley et al., 2007; Giannotti et al., 2002; Kauderer & Randler, 2012; Tzischinsky & Shocat, 2011). As high school class times are usually early and consistent across school days, the impact on sleep-wake times may be more pronounced, particularly among evening-types who have a greater preference for later bed times but are constrained by early daytime class schedules (Crowley et al., 2007; Wittman et al., 2006). Among university students, however, increased flexibility in selecting class schedules (Jovanovski & Bassili, 2007; Zimmerman, 2011) may explain why participants reported similar levels of weekend delay and weekend oversleep.

An important objective of the present study was to determine whether subgroups of morning-types and evening-types, which were generated based on individual differences in sleep characteristics, would differ on three important psychosocial indices. We found that subgroups of evening-types performed just as well academically, compared with subgroups of morning-types. Past research based on variable-centred analyses has found that evening-types generally report poorer academic achievement relative to morning-types (Beşoluk et al., 2011; Preckel et al., 2011). Importantly, some researchers have found that individuals report better academic performance when the timing of their classes/tests is synchronized with their morningness–eveningness preference (Goldstein et al., 2007; Guthrie et al., 1995; Kirby & Kirby, 2006). Thus, one reason why evening-type subgroups did not differ from morning-type subgroups on academic achievement could be that some students were able to synchronize their class schedules with their morningness–eveningness preference (Zimmermann, 2011). Indeed, Jovanovski and Bassili (2007) found that among a sample of university students who had the option of enrolling in an online versus an in-class version of the same course, morningness–eveningness was not significantly associated with course grade, and evening-types demonstrated a greater preference for the online version of the course.

Additionally, as participants were drawn from a university population, factors such as motivation (Deci et al., 1991; Taylor et al., 2011) and conscientiousness (DeYoung et al., 2007) could also explain why subgroups of morning-types and evening-types did not differ from each other on academic achievement, as these factors may play a bigger role in determining academic achievement than morningness–eveningness preference. Indeed, findings from a recent study of adolescents (Roeser et al., 2013) indicated no significant direct association between morningness–eveningness preference and academic performance, but the authors found that daytime sleepiness was negatively correlated with motivation to learn, which in turn was positively associated with academic performance. In that same study, evening-types were found to report higher levels of sleepiness relative to morning-types, and thus Roeser et al. proposed that daytime fatigue, which results in reduced motivation, may be one mechanism that indirectly links morningness–eveningness to poor academic performance among adolescents (i.e. the chronotype-academic performance model). Still, another reason why subgroups of morning-types and evening-types did not differ academically could be due to the fact that participants were a select sample (i.e. university students), given that one criterion for admission to university is based on adequate academic achievement.

In terms of intrapersonal adjustment, we found that subgroups classified by good sleep characteristics reported significantly better intrapersonal adjustment relative to subgroups characterized by poor sleep characteristics, among both morning-types and evening-types. Although past research based on variable-centred analyses have found evening-types to report significantly poorer intrapersonal adjustment relative to morning-types (Gau et al., 2007; Howell et al., 2008; Hess et al., 2000), our findings highlight the importance of accounting for significant individual differences in sleep characteristics when examining the link between morningness–eveningness preference and intrapersonal adjustment. Evening-good individuals not only reported significantly better intrapersonal adjustment relative to the other two evening-type subgroups (i.e. evening-moderate and evening-poor), but also reported levels of intrapersonal adjustment that were comparable with that of morning-good individuals. Importantly, Wittmann et al. (2006) emphasize that it is not eveningness *per se*, but rather consequences of social jetlag (e.g. daytime sleepiness and shortened sleep duration), which may account for the behavioural differences in psychosocial functioning between morning-types and evening-types. For example, it is possible that individuals with poor sleep characteristics may have less cognitive resources during the day to employ effective coping skills, relative to individuals with good sleep characteristics (Schneider et al., 2011). Indeed, more recently, studies have found that poor sleep characteristics significantly mediate the association between morningness–eveningness and intrapersonal adjustment (Roeser et al., 2012). The present study, however, is the first to specifically model individual differences in sleep characteristics within morning-types and evening-types prior to assessing differences on intrapersonal adjustment. Given the consistent link found between sleep and intrapersonal adjustment (Galambos et al., 2010), it is not surprising that subgroups with good sleep characteristics would report

better intrapersonal adjustment relative to subgroups with poorer sleep characteristics. Our findings, however, make a significant contribution to the literature by showing that the association between good sleep and more positive intrapersonal adjustment holds irrespective of one's perceived morningness–eveningness preference.

With respect to alcohol use, we found similar levels of alcohol consumption among all three evening-type subgroups, regardless of differences in sleep characteristics. Interestingly, these subgroups (i.e. evening-good, evening-moderate and evening-poor) all reported consuming significantly more alcohol than morning-good individuals. This finding may be due to differences in personality factors between morning-types and evening-types, regardless of sleep characteristics. Vollmer and Randler (2012), for example, found that morning-types were more likely to endorse social values (e.g. behaving modestly and abiding by rules) whereas evening-types were more likely to endorse individual values (e.g. seeking excitement and fun). There is also some evidence to support greater sensation-seeking (e.g. thrill and adventure seeking, disinhibition and boredom susceptibility) among evening-types relative to morning-types (Tonetti et al., 2010). In a recent review paper on morningness–eveningness, brain function and alcohol use among adolescents, Hasler and Clark (2013) concluded that circadian misalignment (i.e. the mismatch between one's circadian preference and sleep-wake timing), which tends to be more prevalent among evening-types, may be associated with increased risk of alcohol use through altered activation of reward-related systems in the brain. Another reason for this finding may be due to the fact that alcohol consumption is socially defined as a night-time activity within North American culture; thus, evening-types, whose preference is for later bed times, perhaps have more opportunities to consume alcohol than morning-types (Hasler & Clark, 2013; Negriff et al., 2011).

Interestingly, morning-poor individuals did not differ from evening-poor individuals in alcohol use. Some researchers have proposed that higher levels of alcohol consumption traditionally reported among evening-types may be a coping mechanism used to adapt to a morning-oriented world (Mecacci & Rocchetti, 1998; Tankova et al., 1994; Tonetti et al., 2010). Thus, the finding that morning-types with poor sleep characteristics would report consuming just as much alcohol as evening-types with poor sleep characteristics suggests that morning-types may also be susceptible to social jetlag. In line with the social jetlag theory, differences in alcohol consumption may actually be a function of compromised sleep and not merely morningness–eveningness preference *per se* (Wittmann et al., 2006). This line of reasoning seems plausible given the finding that sleep problems have been significantly correlated with the ''coping'' subscale of the drinking motives questionnaire (Digdon & Landry, 2013).

Limitations and directions for future research

The present study makes a significant contribution to the literature by employing a person-centred approach in examining the link between morningness–eveningness preference and psychosocial functioning, specifically by accounting for significant individual differences in sleep characteristics within morning-types and evening-types. Findings, however, should be interpreted in light of the study's limitations. First, our measure of morningness–eveningness assessed individuals' subjective perceptions of themselves as morning-types or evening-types, and was not based on a measure such as the morningness–eveningness questionnaire (MEQ; Horne & Ostberg, 1976), which accounts for perceived optimal timing for peak performance across a variety of different tasks. Furthermore, although university students tend to be, on average, more evening-oriented than morning-oriented (Digdon & Howell, 2008; Taylor et al., 2011), the proportion of individuals who subjectively categorized themselves as evening-types in the current study was higher than what has been reported in past studies (Adan, 1994; Beşoluk et al., 2011; Digdon, 2008; Fernández-Mendoza et al., 2010). This finding presents an intriguing direction for future research to determine whether individuals' subjective perceptions of themselves as morning-types or evening-types are in line with classifications based on the MEQ.

Second, although our sample of university students comprised students across a wide range of academic disciplines and comprised both Canadian-born as well as international students, findings may not be generalizable to students at a different university. Our findings also may not be generalizable to emerging adults who are non-students, employed full-time. Differences in lifestyles between working versus non-working emerging adults may yield different findings and remains a worthwhile research question for future studies to address. A third limitation concerns the fact that our examination of mean differences in our outcome variables as a function of subgroups did not address any bidirectional associations. Thus, our results do not speak to whether more negative psychosocial functioning may be driving differences in sleep characteristics among morning-types and evening-types or alternatively, whether differences in sleep characteristics among morning-types and evening-types precede psychosocial functioning.

Future research should continue to employ a person-centred approach to determine what factors account for the significant heterogeneity in sleep found within both morning-types and evening-types. For example, do evening-types with good sleep characteristics have more flexible schedules that allow them maintain their preferred sleep-wake patterns? In further efforts to account for significant heterogeneity among morning-types and evening-types, an important venture for future research would be to determine individuals' degree of morningness–eveningness in relation to their sleep characteristics and psychosocial functioning.

As we only assessed individuals' perceived classification as morning-types or evening-types, we were not able to determine whether individuals perceived themselves as extreme, moderate or slight morning-types and evening-types. Additionally, future research is needed to determine which factors account for the finding that up to one-third of morning-types was characterized by poor sleep characteristics. Moreover, factors relating to physical (e.g. diet and exercise) and mental health (e.g. mental illness diagnoses) should be accounted for when examining associations among morningness–eveningness, sleep and psychosocial functioning. Finally, as the focus of the study was on examining individual differences in sleep characteristics particularly within morning-types and evening-types, future studies should examine homogeneity in sleep characteristics among neutral types, and determine whether variability in sleep characteristics within neutral types is associated with psychosocial functioning.

CONCLUSIONS

The present study makes a significant contribution to the literature by being the first to use a person-centred approach in order to model significant individual differences within morning-types and evening-types based on sleep characteristics. One of the most important findings was that a significant proportion of evening-types were characterized by good sleep characteristics (i.e. evening-good) that were comparable with that of the majority of morning-types with good sleep characteristics (i.e. morning-good). Furthermore, evening-good individuals reported similar levels of intrapersonal adjustment in comparison with morning-good individuals, and better intrapersonal adjustment than evening-moderate and evening poor individuals. We hope that our finding of significant individual differences within morning-types and evening-types will stimulate a range of future studies that account for and specifically model this heterogeneity in sleep characteristics among morning-types and evening-types when examining the link between morningness–eveningness and psychosocial functioning. Our findings show that accounting for significant heterogeneity within evening-types indicates that all evening-types may not be doomed, both with respect to their sleep as well as their psychosocial functioning.

DECLARATION OF INTEREST

The authors report no conflicts of interest.

REFERENCES

Adan A. (1994). Chronotype and personality factors in the daily consumption of alcohol and psychostimulants. Addiction. 89: 455–62.

Adan A, Archer SN, Hidalgo MP, et al. (2012). Circadian typology: A comprehensive review. Chronobiol Int. 29:1153–75.

Arnett, JJ. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. Am Psychol. 55:469–80.

Arnett, JJ. (2007). Emerging adulthood: What is it, and what is it good for? Child Develop Perspect. 1:68–73.

Bergman LR, Magnusson D. (1997). A person-oriented approach in research on developmental psychopathology. Develop Psychopathol. 9:291–319.

Bergman LR, Trost K. (2006). The person-oriented versus the variable-oriented approach: Are they complementary, opposites, or exploring different worlds? Merrill-Palmer Quart. 52: 601–32.

Beşoluk S, Önder İ, Deveci İ. (2011). Morningness–eveningness preferences and academic achievement of university students. Chronobiol Int. 28:118–25.

Biss RK, Hasher L. (2012). Happy as a lark: Morning-type younger and older adults are higher in positive affect. Emotion. 12: 437–41.

Crowley SJ, Acebo C, Carskadon MA. (2007). Sleep, circadian rhythms, and delayed phase in adolescence. Sleep Med. 8: 602–12.

Deci EL, Vallerand RJ, Pelletier LG, et al. (1991). Motivation and education: The self-determination perspective. Educ Psychol. 26:325–46.

DeYoung CG, Hasher L, Djikic M, et al. (2007). Morning people are stable people: Circadian rhythm and the higher-order factors of the big five. Pers Indiv Differ. 43:267–76.

Digdon, NL. (2008). Circadian preference and college student beliefs about how to cope with sleepiness. Biol Rhythm Res. 39: 417–26.

Digdon NL, Howell AJ. (2008). College students who have an eveningness preference report lower self-control and greater procrastination. Chronobiol Int. 25:1029–46.

Digdon N, Landry K. (2013). University students' motives for drinking alcohol are related to evening preference, poor sleep, and ways of coping with stress. Biol Rhythm Res. 44:1–11.

Drennan MD, Klauber MR, Kripke DF, et al. (1991). The effects of depression and age on the Horne-Ostberg morningness–eveningness score. J Affect Dis. 23:93–8.

Erikson EH. (1968). Identity: Youth and crisis. New York: Norton.

Fernández-Mendoza J, Ilioudi C, Montes MI, et al. (2010). Circadian preference, nighttime sleep and daytime functioning in young adulthood. Sleep Biol Rhythms. 8:52–62.

Fortunato VJ, Harsh J. (2006). Stress and sleep quality: The moderating role of negative affectivity. Pers Indiv Differ. 41: 825–36.

Galambos NL, Dalton AL, Maggs JL. (2009). Losing sleep over it: Daily variation in sleep quantity and quality in Canadian students' first semester of university. J Res Adolescence. 19: 741–61.

Galambos NL, Howard AL, Maggs, JL. (2010). Rise and fall of sleep quantity and quality with student experiences across the first year of university. J Res Adolescence. 21:342–9.

Galambos NL, Lascano DIV, Howard AL, et al. (2012). Who sleeps best? Longitudinal patterns and covariates of change in sleep quantity, quality, and timing across four university years. Behav Sleep Med. 10:1–15.

Gaultney JF. (2010). The prevalence of sleep disorders in college students: Impact on academic performance. J Am Coll Health. 59:91–7.

Gau SS, Shang C, Merikangas KR, et al. (2007). Association between morningness–eveningness and behavioral/emotional problems among adolescents. J Biol Rhythms. 22:268–74.

Giannotti F, Cortesi F, Sebastiani T, et al. (2002). Circadian preference, sleep and daytime behaviour in adolescence. J Sleep Res. 11:191–9.

Gilbert SP, Weaver CC. (2010). Sleep quality and academic performance in university students: A wake-up call for college psychologists. J Coll Student Psychotherapy. 24:295–306.

Goldstein D, Hahn CS, Hasher L, et al. (2007). Time of day, intellectual performance, and behavioral problems in morning versus evening type adolescents: Is there a synchrony effect? Pers Indiv Differ. 42:431–40.

Guthrie JP, Ash RA, Bendapudi V. (1995). Additional validity evidence for a measure of morningness. J Appl Psychol. 80:186–90.

Hamilton NA, Nelson CA, Stevens N, et al. (2007). Sleep and psychological well-being. Soc Indicators Res. 82:147–63.

Hasler BP, Clark DB. (2013). Circadian misalignment, reward-related brain function, and adolescent alcohol involvement. Alcohol: Clin Exp Res. 37:558–65.

Havighurst RJ. (1972). Developmental tasks and education. New York: David McKay.

Hess B, Sherman MF, Goodman M. (2000). Eveningness predicts academic procrastination: The mediating role of neuroticism. J Soc Behav Personality. 15:61–74.

Horne JA, Ostberg O. (1976). A self-assessment questionnaire to determine morningness–eveningness in human circadian rhythms. Int J Chronobiol. 4:97–110.

Horne JA, Brass CG, Petitt AN. (1980). Circadian performance differences between morning and evening 'types'. Ergonomics. 23:29–36.

Howell AJ, Digdon NL, Buro K, et al. (2008). Relations among mindfulness, well-being, and sleep. Pers Indiv Differ. 45:773–7.

Jankowski KS, Ciarkowska W. (2008). Diurnal variation in energetic arousal, tense arousal, and hedonic tone in extreme morning and evening types. Chronobiol Int. 25:577–95.

Jovanovski D, Bassili JN. (2007). The relationship between morningness–eveningness preference and online learning. Biol Rhythm Res. 38:355–65.

Jung T, Wickrama KAS. (2008). An introduction to latent class growth analysis and growth mixture modeling. Soc Personality Psychol Compass. 2:302–17.

Kauderer S, Randler C. (2012). Differences in time use among chronotypes in adolescents. Biol Rhythm Res. 44:601–8.

Kim S, Dueker GL, Hasher L, et al. (2002). Children's time of day preference: Age, gender and ethnic differences. Pers Indiv Differ. 33:1083–90.

Kirby EG, Kirby SL. (2006). Improving task performance: The relationship between morningness and proactive thinking. J Appl Soc Psychol. 36:2715–29.

Lázár AS, Slak A, Lo JC, et al. (2012). Sleep, diurnal preference, health, and psychological well-being: A prospective single-allelic-variation study. Chronobiol Int. 29:131–46.

Mecacci L, Rocchetti G. (1998). Morning and evening types: Stress-related personality aspects. Pers Indiv Differ. 25:537–42.

Merikanto I, Kronholm E, Peltonen M, et al. (2012). Relation of chronotype to sleep complaints in the general Finnish population. Chronobiol Int. 29:311–17.

Monk TH, Petrie SR, Hayes AJ, et al. (1994). Regularity of daily life in relation to personality, age, gender, sleep quality and circadian rhythms. J Sleep Res. 3:196–205.

Morin CM. (1993). Insomnia: Psychological assessment and management. New York: Guilford Press.

Muthen LK, Muthen BO. (1998–2012). Mplus User's Guide. 7th ed. Los Angeles, CA.

Negriff S, Dorn LD, Pabst SR, et al. (2011). Morningness/eveningness, pubertal timing, and substance use in adolescent girls. Psychiatr Res. 185:408–13.

Nylund KL, Asparouhov T, Muthén BO. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. Struct Equ Modeling. 14:535–69.

Onyper SV, Thacher PV, Gilbert JW, et al. (2012). Class start times, sleep, and academic performance in college: A path analysis. Chronobiol Int. 29:318–35.

Orzech KM, Salafsky DB, Hamilton LA. (2011). The state of sleep among college students at a large public university. J Am Coll Health. 59:612–19.

Pancer MS, Pratt M, Hunsberger B, et al. (2004). Bridging troubled waters: Helping students make the transition from high school to university. Guidance Couns. 19:184–90.

Pilcher JJ, Ginter DR, Sadowsky B. (1997). Sleep quality versus sleep quantity: Relationships between sleep and measures of health, well-being and sleepiness in college students. J Psychosomatic Res. 42:583–96.

Portaluppi F, Smolensky MH, Touitou Y. (2010). Ethics and methods for biological rhythm research on animals and human beings. Chronobiol Int. 27:1911–29.

Preckel F, Lipnevich AA, Schneider S, et al. (2011). Chronotype, cognitive abilities, and academic achievement: A meta-analytic investigation. Learn Indiv Differ. 21:483–92.

Radloff L. (1977). The CES-D scale: A self-report depression scale for research in the general population. Appl Psychol Meas. 1: 385–401.

Randler C. (2008). Morningness–eveningness and satisfaction with life. Soc Indicators Res. 86:297–302.

Randler C. (2011). Association between morningness–eveningness and mental and physical health in adolescents. Psychol Health Med. 16:29–38.

Roeser K, Meule A, Schwerdtle B, et al. (2012). Subjective sleep quality exclusively mediates the relationship between morningness–eveningness preference and self-perceived stress response. Chronobiol Int. 29:955–60.

Roeser K, Schlarb, AA, Kübler A. (2013). The chronotype-academic performance model (CAM): Daytime sleepiness and learning motivation link chronotype and school performance in adolescents. Pers Indiv Differ. 54:836–40.

Rosenberg M. (1965). Society and the adolescent self image. Princeton, NJ: Princeton University Press.

Schafer JL, Graham JW. (2002). Missing data: Our view of the state of the art. Psychol Methods. 7:147–77.

Schneider MLD, Vasconcellos DC, Dantas G, et al. (2011). Morningness-eveningness, use of stimulants, and minor psychiatric disorders among undergraduate students. Int J Psychol. 46:18–23.

Soehner AM, Kennedy KS, Monk TH. (2011). Circadian preference and sleep-wake regularity: Associations with self-report sleep parameters in daytime-working adults. Chronobiol Int. 28: 802–9.

Statistics Canada. (2006). Population by ethnic origin. Retrieved from http://www.41.statcan.gc.ca/2009/30000/tbl/cybac30000_2009_000_t05-eng.htm

Taillard JJ, Philip PP, Bioulac BB. (1999). Morningness/eveningness and the need for sleep. J Sleep Res. 8:291–5.

Tankova I, Adan A, Buela-Casal G. (1994). Circadian typology and individual differences: A review. Pers Indiv Differ. 16: 671–84.

Taylor DJ, Clay KC, Bramoweth AD, et al. (2011). Circadian phase preference in college students: Relationships with psychological functioning and academics. Chronobiol Int. 28:541–7.

Tonetti L, Adan A, Caci H, et al. (2010). Morningness–eveningness preference and sensation seeking. Eur Psychiatr. 25:111–15.

Tzischinsky O, Shochat T. (2011). Eveningness, sleep patterns, daytime functioning, and quality of life in Israeli adolescents. Chronobiol Int. 28:338–43.

Vollmer C, Randler C. (2012). Circadian preferences and personality values: Morning types prefer social values, evening types prefer individual values. Pers Indiv Differ. 52:738–43.

Wittmann M, Paulus M, Roenneberg T. (2010). Decreased psychological well-being in late 'chronotypes' is mediated by smoking and alcohol consumption. Subst Use Misuse. 45:15–30.

Wittmann M, Dinich J, Merrow M, et al. (2006). Social jetlag: Misalignment of biological and social time. Chronobiol Int. 23: 497–509.

Zimmermann LK. (2011). Chronotype and the transition to college life. Chronobiol Int. 28:904–10.