Morning affect, eveningness, and amplitude distinctness: associations with behavioural indicators of conscientiousness

Morning affect, eveningness, and amplitude distinctness: Associations with behavioural indicators of conscientiousness

Richard Carciofo

View supplementary material

Published online: 24 Oct 2022.

Submit your article to this journal

View related articles

View Crossmark data

ORIGINAL ARTICLE

Morning affect, eveningness, and amplitude distinctness: Associations with behavioural indicators of conscientiousness

Richard Carciofo

School of Psychology and Clinical Language Sciences, University of Reading, Reading, UK

ABSTRACT

Morningness is associated with well-being, better sleep quality, and more conscientiousness, while eveningness is associated with negative emotionality, poorer sleep quality, and less conscientiousness. The current study aimed to further understanding of associations with conscientiousness by assessing specific behavioural indicators of conscientiousness, morningness-eveningness, and also the Morning Affect and Distinctness (amplitude of diurnal variation) aspects of circadian functioning. A survey of Chinese university students (N = 369, aged 18–30, mean = 19.48, SD = 1.922; 108 males, 261 females), included the Morningness-Eveningness-Stability-Scale, measures of conscientiousness, mindfulness, life satisfaction, aspects of sleep, and the Behavioural Indicators of Conscientiousness (BIC) scale. Morningness and Morning Affect were positively correlated with life satisfaction, mindfulness, better sleep quality, more conscientiousness, and with BIC including Hardworking, Self-control, and Punctuality. Distinctness showed negative correlations with these variables. Negative correlations between Eveningness and conscientiousness, and the BIC subscales of Hardworking and Cleanliness were no longer significant after controlling for Morning Affect. Mediation analysis showed that the associations between Eveningness and conscientiousness/BIC were mediated by Morning Affect. These results extend previous research by showing associations between circadian functioning and specific behavioural indicators of conscientiousness, and suggest that low Morning Affect may provide a mechanism for the relationship between Eveningness and conscientiousness.

Introduction

People vary in their sleep/wake timing, with morning-types having relatively earlier rising and bedtimes, and evening-types relatively later, with corresponding preferences for being more active in the morning or evening (Adan et al. 2012). Research on correlates of morningness-eveningness has shown that morningness is associated with many indicators of well-being, including better subjective health and more positive affect (Biss and Hasher 2012), mindfulness and better sleep quality (Carciofo et al. 2014a/b), and more life satisfaction (Randler 2008), while eveningness is associated with more use of alcohol, nicotine, and other drugs (e.g., Bakotic et al. 2017; Suh et al. 2017), poor sleep quality (Bakotic et al. 2017; Carciofo et al. 2014a), and more psychological distress and disorder (Au and Reece 2017; Taylor and Hasler 2018).

Much research has also investigated personality correlates of morningness-eveningness. A meta-analysis (Tsaousis 2010) showed that of the big five personality dimensions, the strongest correlate was conscientiousness, which had a positive correlation with morningness (r = .29); agreeableness had a small correlation with morningness (r = .13), while openness, neuroticism, and extraversion all correlated negatively but weakly with morningness (rs = −.09, −.07, and −.06, respectively). Also, Lipnevich et al.'s (2017) meta-analysis included assessment of distinct Morningness and Eveningness dimensions, finding that conscientiousness correlated positively with morningness and negatively with eveningness. Conscientiousness also negatively correlates with poor sleep quality, and with negative emotionality, including depression, anxiety, and stress (Carciofo 2020; Duggan et al. 2014), but positively correlates with mindfulness (Giluk 2009). Also, the relationship between morningness and life satisfaction may be mediated by conscientiousness and emotional stability/neuroticism (Drezno et al. 2019).

Conscientiousness is a positive predictor for well-being, including more positive affect and life satisfaction (Anglim et al. 2020), better physical and mental health, and better academic and occupational achievement

(Borgio and Louzada 2021; Roberts et al. 2014). A range of facets of conscientiousness have been identified across studies, including order/orderliness, industriousness, self-control, responsibility, conventionality, formalness, decisiveness, and punctuality (Roberts et al., 2014; Soto and John 2009). Morningness has been positively correlated with the facets of self-discipline and order (Carciofo et al. 2016), and punctuality (Werner et al. 2015), and also with more future time perspective (Stolarski et al., 2013), and more self-control and less procrastination (Digdon and Howell 2008). In contrast, eveningness has been associated with indicators of less conscientiousness, including having less persistence and more impulsivity (Caci et al. 2005, 2004).

Personality is broadly defined, encompassing " … enduring emotional, interpersonal, experiential, attitudinal, and motivational styles … " (McCrae and John 1992, 175), and trait measures of personality typically include items for all these aspects (cognitive, emotional, and behavioural). In response to this, Jackson et al. (2010) specifically investigated behaviours associated with conscientiousness, and developed the 185-item Behavioural Indicators of Conscientiousness (BIC) scale. The structure of the BIC is hierarchically organised, with the lowest level identifying 11 interpretable factors: Avoid work (e.g., *Play sick to avoid doing something*), Organization (e.g., *Label drawers in my office*), Impulsivity/impulse control (e.g., *Spend more money than I should*), Antisocial (e.g., *Shout at a stranger in public*), Cleanliness (e.g., *Clean the windows in my house*), Industriousness (e.g., *Work or study long hours*), Laziness (e.g., *Sit and do nothing*), Appearance (e.g, *Clean up immediately after a meal*), Punctuality (e.g., *Get to appointments on time*), Formality (e.g., *Make use of someone's formal title*), and Responsibility (e.g., *Keep my promises*).

A more comprehensive understanding of the relationship between morningness-eveningness and conscientiousness may be obtained by examining associations with specific Behavioural Indicators of Conscientiousness, as identified by Jackson et al. (2010). In addition, much of the extant literature is based on research utilising self-report measures (such as the Morningness-Eveningness Questionnaire; Horne and Östberg 1976) in which a unidimensional assessment of morningness-eveningness is obtained, but recent research (e.g., Ogińska et al. 2017) has also emphasised the separate component of Distinctness (amplitude of diurnal variations in mood, motivation, and cognitive functioning), and the component of Morning Affect, which refers to energy/alertness soon after waking, and how long it takes to fully awaken, without reference to specific times for getting up (Randler et al. 2016). The Morningness-

Eveningness-Stability-Scale improved (MESSi; Randler et al. 2016) includes subscales for Morning Affect, Eveningness, and Distinctness, and research utilising this scale has found that Morning Affect positively correlates with morningness, conscientiousness, and life satisfaction, and negatively correlates with Eveningness, poor sleep quality, and negative emotionality, while Distinctness tends to show the opposite associations, including positive correlations with negative emotionality, and Eveningness negatively correlates with conscientiousness (Carciofo and Song 2019; Carciofo 2020; Demirhan et al. 2019; Díaz-Morales et al. 2017; Díaz-Morales and Randler 2017; Randler et al. 2016; Rodrigues et al., 2018). Using measures for separate components of circadian functioning may extend understanding by revealing relationships which may not be shown when assessed with unidimensional morningness-eveningness measures.

So, the current research aimed to examine associations between components of circadian functioning (Morning Affect, Eveningness, and Distinctness) and behavioural indicators of conscientiousness; previously studied variables were also included to test if consistent patterns of inter-relationships were found, as shown in previous research. Based on the reviewed research, it was expected that Morning Affect would correlate positively with conscientiousness, better sleep quality, more life satisfaction, and more mindfulness, while Eveningness and Distinctness were both expected to negatively correlate with conscientiousness, and Distinctness also to positively correlate with poor sleep quality, and negatively correlate with life satisfaction. Daytime sleepiness has not been reliably associated with morningness-eveningness (see Carciofo et al. 2014b), but was included to explore associations with the components of Morning Affect, Eveningness, and Distinctness, and with the Behavioural Indicators of Conscientiousness (BIC). Also, based on previous findings related to conscientiousness, Morning Affect was expected to show positive associations with the Behavioural Indicators of Conscientiousness (BIC), while Eveningness and Distinctness were expected to show negative associations; also, life satisfaction, mindfulness, and good sleep quality were expected to have positive associations with BIC. However, component/facet-level analysis may show different associations (in strength, and possibly also direction) compared to those with higher-order constructs, so the current study explored any such variations for the BIC. In addition, as previous research (Carciofo 2020) found that the association between Eveningness and conscientiousness was attenuated when controlling for Morning Affect (such that the correlation became near zero), it was also investigated

whether Morning Affect may influence associations with BIC, including whether it may act as a mediator in relationships between Eveningness and conscientiousness/BIC. A Chinese translation of the BIC scale was made for this study, and its psychometric properties were assessed.

Methodology

Sample

An invitation to participate, including the link to the online survey, was emailed to 11,967 students at an English-medium university in Suzhou, China. The survey began with a briefing, including the stated inclusion criteria of being a Chinese student at the university aged at least 18 years. Participation was voluntary, unpaid, anonymous, and could be withdrawn at any time; informed consent was given by clicking an icon which then began the survey. Of the 711 participants who began the survey, 374 provided completed responses, but 5 were excluded for not meeting the inclusion criteria, leaving $N = 369$, aged 18–30 (mean = 19.48, $SD =$ 1.922; skewness = 2.080, kurtosis = 5.472), with 108 males (mean age = 19.33, $SD = 1.623$), and 261 females (mean age = 19.54, $SD = 2.033$), $t = -.923$, $p = .357$. The research protocol was approved by the University Ethics Committee at Xi'an Jiaotong-Liverpool University, Suzhou, China (research proposal number: 19–01-25).

Materials

The Behavioural Indicators of Conscientiousness scale (BIC)

Jackson et al.'s (2010), 45-item version of the BIC was translated into Chinese. Firstly, six items in Jackson et al.'s (2010), 45-item version were changed for other items from the corresponding subscale of the full-length (185-item) BIC scale, so as to increase content coverage, or to be more relevant/suitable for young, adult students; for example, *"Yell at another driver"* was changed for *"Smash something when angry or frustrated,"* and *"Call in sick to work when not sick"* was changed for *"Oversleep for class or work."* Also, changes of wording were made to nine other items to facilitate clear translation (e.g., *"Make lists"* was changed to *"Make lists of things I need to do"*/*"Blow off work"* was changed to *"Avoid doing work"*). The translation was made by a native Chinese-speaker, and this was back-translated by another native Chinese-speaker, and this was then checked against the original by a native English-speaker, and some minor corrections were then made. Response options for items were: *1 = never do the behaviour; 2 =*

seldom do the behaviour; 3 = sometimes do the behaviour; 4 = often do the behaviour; 5 = very often or always do the behaviour; 22 items were reverse-scored, as in Jackson et al.'s (2010) BIC scale.

The Morningness-Eveningness-Stability-Scale improved (MESSi; Randler et al. 2016; Chinese version: Carciofo and Song 2019), with subscales for: Morning Affect (MA; e.g., *How alert do you feel during the first half hour after having awakened in the morning?*); Eveningness (EV; e.g., *I am more an evening than a morning active person*); and Distinctness (DI; e.g., *There are moments during the day when it is harder for me to think*). Each item is scored from 1 to 5, with five items for each subscale; higher scores indicate more MA/EV/DI.

The Students' Life Satisfaction Scale (SLSS; Huebner 1991)

Jiang et al.'s (2017) Chinese version removed two reverse-worded items, leaving five items, each scored from 1 to 6; higher scores indicate more life satisfaction. Reference to "most kids" in one item was changed to "most people."

The Big Five Inventory, 44-item (BFI-44; John and Srivastava 1999; Chinese version:Carciofo et al. 2016; John and Srivastava 2003)

Only the nine conscientiousness items were included in the present study. Each item was scored on a 1–5 Likert scale, with higher scores indicating more conscientiousness. The facet of *Order* can be separately assessed from two of the items, and *Self-discipline* can be assessed from five of the items (Soto and John 2009).

The Epworth Sleepiness Scale (ESS; Johns 1991)

The ESS has eight items, each scored 0 to 3; higher scores indicate more daytime sleep propensity. For clarity, minor changes of wording were made to Peng et al.'s (2011) Chinese version.

The Mindful Attention Awareness Scale-lapses only (MAAS-LO)

Carriere et al.'s (2008), 12-item MAAS-LO (Chinese version: Carciofo et al., 2014b) omits three items from the original scale developed by Brown and Ryan (2003). Each item was scored on a 1 to 6 scale, such that higher scores indicate more mindfulness.

Sleep

One item enquired about sleep quality: *How often do you have sleep problems (here "sleep problems" can refer to problems such as insomnia or waking up frequently at*

night), with options of: *1) never, 2) occasionally, 3) at least once a month, 4) at least once a week, 5) every day.*

One item enquired about sleep duration: *Your average sleep time at night is . . .*, with options of *1) less than or equal to 4 hours, 2) about 5 hours, 3) about 6 hours, 4) about 7 hours, 5) greater than or equal to 8 hours.*

Data analysis

Principal axis factor analysis (compare Jackson et al. 2010), with an oblique rotation (Promax) was used to assess the structure of the Chinese BIC scale. Parallel analysis (O'Connor 2000) was used to identify how many factors to retain, whereby each eigenvalue from the raw data which was larger than its corresponding 95th percentile randomly generated eigenvalue was retained. Analysis was iterative, whereby items with no loadings ≥ .40 on any factor were removed, and the analysis was then repeated. Use of exploratory factor analysis (rather than confirmatory factor analysis) allows for identification of structural differences that may be culturally based, or due to the translation (OrÇan 2018).

Descriptive statistics for each scale include the mean, standard deviation, range, skewness, kurtosis, and Cronbach's alpha measure of internal consistency. Zero-order Pearson correlations between variables were calculated, and also partial correlations controlling for Morning Affect for correlations with Eveningness; partial correlations with age and gender as control variables were also calculated. Correlation coefficients of .10, .30, and .50 may respectively indicate small, medium, and large effect sizes, and for medium effect sizes to be established with 80% power at $p = .05$, a sample size of $N = 85$ is suggested, and for small effect sizes, $N = 783$ (Cohen 1992).

In addition to the components of the MESSi scale, a composite measure of morningness-eveningness ("M-E") was also calculated by reversing the scores for Eveningness and then adding them to scores for Morning Affect (see also Vagos et al. 2019). This allowed for comparisons with research that has used composite/unidimensional measures.

The PROCESS macro (v2.10; Hayes 2013) was used to undertake mediation analysis, in which unstandardised indirect effects were obtained from 10,000 bootstrap samples; 95% bias-corrected confidence intervals which exclude zero indicate significant indirect/mediation effects.

Results

BIC factor structure

The Principal Axis Factor analysis with an oblique rotation (Promax) in conjunction with parallel analysis was repeated five times until a clearly interpretable structure with all items loading ≥ .40 on a single factor (with no cross-loadings ≥ .40) was obtained. At each iteration sampling adequacy was supported with Kaiser–Meyer–Olkin values all > .8, significant ($p < .001$) values for Bartlett's test of sphericity, and anti-image correlations all > .6 (Field 2009). Details of each iteration are given in the Supplementary Materials. The final iteration showed a 10-factor structure with all items loading ≥ .40 on one of the factors (with no cross-loadings ≥ .40), and all factors were clearly interpretable. Eight were factors identified in Jackson et al.'s (2010) study, with near identical item loadings: factor 1 = laziness (items 3, 24, 25, 26, 28); factor 2 = impulsivity (items 9, 10, 11, 12); factor 3 = organisation (items 5, 6, 7); factor 4 = cleanliness (items 17, 18, 19); factor 5 = appearance (items 29, 30, 31, 32); factor 6 = industriousness (items 20, 21, 22, 23); factor 7 = punctuality (items 33, 34, 36); factor 8 = formality (items 37, 38, 39, 40). In addition, factor 9 was identified as "honesty" (items 13, "Lie to authority figures," and 43, "Lie to a significant other"); and factor 10 was identified as "politeness" (item 42, "Say please and thank you," and 45, "Hold the door for people"). The pattern matrix of the factors is shown in the Supplementary Materials, Table S1.

As all factors were scored so that higher scores indicate more conscientiousness, for the purposes of clarity the factor names were changed as follows: "Laziness" changed to "Hardworking," and "Impulsive" changed to "self-control." Correlations between the factors ranged from −.050 (cleanliness and honesty) to .559 (cleanliness and appearance); see Supplementary Materials, Table S2. For all factors, the corrected item-total correlations were all > .4 (for both of the 2-item factors, the 2 items correlated > .4).

Age significantly correlated with Hardworking, $r = -.134$ ($p = .010$); for the other factors, correlations with age ranged −.093 (self-control) to .065 (honesty), all $ps > .05$. Males had significantly higher scores than females for hardworking, self-control, punctuality, and formality; females had significantly higher scores than males for organisation (see Supplementary Materials, Table S3).

Descriptive statistics

Table 1 shows the range, mean, standard deviation, skewness, kurtosis, and internal consistency (Cronbach's alpha) for all scales/subscales. Each scale showed a wide range of scores, and the distributions generally approximated normality with absolute values of skewness and kurtosis <1, except for politeness, which showed some negative skew. Values of alpha were all >

Table 1. Descriptive statistics for scales and subscales.

	Range (possible)	Mean	Standard deviation	Skewness	Kurtosis	Cronbach's Alpha
Behavioural Indicators of Conscientiousness						
Hard-working	5–25 (5–25)	15.64	3.951	−.124	.057	.789
Self-control	4–20 (4–20)	12.13	3.626	−.247	−.488	.792
Organisation	3–15 (3–15)	10.02	3.363	−.308	−.627	.836
Cleanliness	3–15 (3–15)	9.78	2.823	−.159	−.180	.863
Appearance	4–20 (4–20)	13.84	3.413	−.210	−.132	.740
Industriousness	4–20 (4–20)	13.82	3.249	−.300	.283	.780
Punctuality	4–15 (3–15)	12.34	2.355	−.949	.706	.783
Formality	4–20 (4–20)	10.75	3.270	.179	.036	.725
Honesty	2–10 (2–10)	7.31	1.653	−.539	.564	.647
Politeness	2–10 (2–10)	8.52	1.569	−1.393	2.480	.606
Morningness-Eveningness	15–46 (10–50)	30.09	6.222	−.002	−.392	.787
Morning Affect	5–25 (5–25)	17.43	3.569	−.437	−.008	.764
Eveningness	5–25 (5–25)	17.34	4.211	−.265	−.261	.803
Distinctness	5–25 (5–25)	18.87	4.200	−.690	.413	.819
Conscientiousness	9–44 (9–45)	29.37	5.710	−.139	.239	.820
Order	2–10 (2–10)	6.16	1.526	−.120	−.165	.381
Self-discipline	5–25 (5–25)	16.23	3.484	.078	.071	.721
Life satisfaction	5–30 (5–30)	20.63	5.588	−.452	−.334	.899
Mindfulness	12–68 (12–72)	44.56	8.645	−.413	.926	.829
Daytime sleepiness	2–24 (0–24)	10.73	3.762	.261	.312	.662
Sleep problems	1–5 (1–5)	2.58	1.151	.689	−.554	-
Sleep duration	1–5 (1–5)	3.89	.864	−.802	.822	-

For all variables, $N = 369$; standard error of skewness = .127; standard error of kurtosis = .253.

.7, except for Honesty, Politeness, and Order (all 2-item scales), and for daytime sleepiness.

Correlations

Inter-correlations between components of circadian functioning, conscientiousness, life satisfaction, mindfulness, and sleep-related factors are shown in Table 2. Morningness-eveningness and Morning Affect had mostly small to medium positive correlations (mostly significant) with conscientiousness (including self-discipline and order), life satisfaction, mindfulness, and sleep duration (more morningness, and higher levels of morning affect/alertness associated with more conscientiousness, life satisfaction, mindfulness, and sleep duration), and negative correlations with Distinctness, daytime sleepiness, and sleep problems. Eveningness had small, significant negative correlations with conscientiousness, self-discipline, and sleep duration (more eveningness associated with less conscientiousness, self-discipline, and sleep duration); after controlling for Morning Affect, only that with sleep duration retained significance, and the positive correlation with life satisfaction became stronger and significant. Conscientiousness, life satisfaction, and mindfulness had positive inter-correlations, and negatively correlated with Distinctness, daytime sleepiness, and sleep problems. When controlling for age and gender, absolute changes in the coefficients were all < .025.

Correlations with the BIC factors are shown in Table 3. The composite measure of morningness-eveningness (M-E) had mostly small to medium positive correlations with BIC factors, indicating associations with more morningness, although the correlations with

Table 2. Correlations between components of circadian functioning, conscientiousness, life satisfaction, mindfulness, and sleep-related factors.

	MA	EV	DI	C.	Order	Self-discipline	LS	Mindful	ESS	Sleep problems	Sleep duration
Morningness-Eveningness	.759***	−.834***	−.209***	.319***	.227***	.326***	.091	.247***	−.026	−.231***	.154**
Morning Affect (MA)		−.274***	−.311***	.430***	.315***	.418***	.265***	.311***	−.121*	−.341***	.096
Eveningness (EV)			.045	−.107*	−.069	−.127*	.089	−.102	−.064	.052	−.147**
Eveningness, controlling for Morning Affect			*−.044*	*.013*	*.019*	*−.014*	*.175****	*−.018*	*−.102*	*−.046*	*−.126**
Distinctness (DI)				−.244***	−.208***	−.221***	−.286***	−.265***	.260***	.172***	−.074
Conscientious (C.)					.700***	.945***	.358***	.324***	−.177***	−.200***	.100
Order						.500***	.219***	.280***	−.205***	−.085	.044
Self-discipline							.338***	.275***	−.122*	−.222***	.082
Life satisfaction (LS)								.306***	−.106*	−.268***	.149**
Mindfulness									−.218***	−.162**	.200***
Daytime sleepiness (ESS)										−.041	−.020
Sleep problems											−.189***

N = 369. *p ≤ .05; **p ≤ .01; ***p ≤ .001.

Table 3. Correlations with Behavioural Indicators of Conscientiousness.

	Hard-working	Self-control	Organisation	Cleanliness	Appearance	Industrious	Punctuality	Formality	Honesty	Politeness
Morningness-Eveningness	.339***	.136**	.198***	.165**	.149**	.086	.182***	.117*	.059	.071
Morning Affect	.427***	.226***	.262***	.150**	.177***	.204***	.269***	.163**	.112*	.104*
Eveningness	−.139**	−.009	−.070	−.116*	−.070	.046	−.041	−.035	.008	−.016
Eveningness, controlling for Morning Affect	*−.026*	*.056*	*.002*	*−.079*	*−.022*	*.108**	*.036*	*.010*	*.041*	*.013*
Distinctness	−.344***	−.207***	−.130*	−.043	−.094	−.155**	−.109*	−.207***	−.085	.028
Conscientious	.596***	.340***	.400***	.322***	.328***	.535***	.339***	.332***	.188***	.258***
Order	.366***	.309***	.218***	.206***	.209***	.308***	.239***	.192***	.110*	.154**
Self-discipline	.600***	.301***	.414***	.298***	.303***	.531***	.319***	.323***	.185***	.237***
Life satisfaction	.414***	.221***	.196***	.076	.130*	.319***	.184***	.235***	.215***	.127*
Mindfulness	.371***	.302***	.136**	.044	.108*	.167***	.188***	.177***	.213***	.089
Daytime sleepiness	−.217***	−.223***	−.014	−.007	−.034	−.121*	−.165**	−.017	−.065	.040
Sleep problems	−.198***	−.191***	−.140**	−.043	−.112*	−.106*	−.093	−.054	−.135**	.020
Sleep duration	.102	.065	−.026	.010	.047	.000	.104*	−.020	.072	−.002

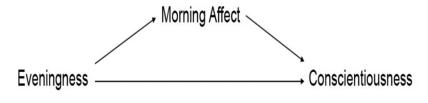N = 369. *p ≤ .05; **p ≤ .01; ***p ≤ .001.

Industriousness, Honesty, and Politeness were weak and did not reach statistical significance. However, Morning Affect had significant small to medium positive correlations with all BIC factors, the strongest being with Hardworking. Eveningness had small, significant negative correlations with Hardworking and Cleanliness, but after controlling for Morning Affect these were attenuated and no longer significant. In contrast, the positive correlation with Industriousness became slightly stronger, and statistically significant. Conscientiousness and the two facets of order and self-discipline each had significant, mostly medium to strong, positive correlations with all BIC factors. Mindfulness and life satisfaction had significant, small to medium positive correlations with most BIC factors, while Distinctness and sleep problems had some significant, small to medium negative correlations. Hardworking was typically the strongest correlate of the BIC factors. When controlling for age and gender, absolute changes in the coefficients were all < .035.

Mediation analysis

Eveningness had small (absolute *r* > .1 < .2) significant negative correlations with the big five dimension of conscientiousness, with the facet of self-discipline, and also with two behavioural indicators of conscientiousness: Hardworking and Cleanliness; when controlling for Morning Affect, these correlations with Eveningness were attenuated and no longer significant. These results may suggest an indirect effect from Eveningness to conscientiousness/BIC through Morning Affect (see Figure 1). This was tested for each of the noted significant correlates of Eveningness (conscientiousness, self-discipline, Hardworking, and Cleanliness). As shown in Table 4, in each case there was a significant indirect (mediation) effect, and the direct effect of Eveningness was not significant in any of the final regression models.

Discussion

The current research aimed to achieve a more comprehensive understanding of the relationships between components of circadian functioning and conscientiousness, including specific Behavioural Indicators of Conscientiousness (BIC), as identified by Jackson et al. (2010). A Chinese translation of the BIC scale replicated eight of the 11 factors from Jackson et al.'s (2010) study, with near identical item loadings: laziness (renamed "hardworking"), impulsivity (renamed "self-control"), organisation, cleanliness, appearance, industriousness, punctuality, formality, plus factors identified as "honesty," and "politeness." Inter-correlations between the subscales ranged from −.050 to .559, and they mostly showed good/very good internal consistency, with alpha values ranging .606 to .863, similar to values obtained by Jackson et al. (2010), who found inter-correlations

Figure 1. Mediation model.

Table 4. Mediation analyses.

Regression model summary	Predictor: Eveningness β (t)	Mediator: Morning Affect β (t)	Control variable: Age β (t)	Control variable: Gender β (t)	Unstandardised Indirect effect (95% CI)
Model 1: Criterion = Hardworking $R = .447$, $R^2 = .200$, $F(4, 364) = 22.715***$	−.039 (−.795)	.401 (8.090***)	−.050 (−1.055)	−.119 (−2.502*)	−.1012 (−.1540/−.0616)
Model 2: Criterion = Cleanliness $R = .191$, $R^2 = .037$, $F(4, 364) = 3.452**$	−.071 (−1.316)	.142 (2.604**)	.040 (.769)	.079 (1.523)	−.0255 (−.0522/−.0060)
Model 3: Criterion = Conscientiousness $R = .434$, $R^2 = .189$, $F(4, 364) = 21.178***$	.012 (.243)	.445 (8.909***)	.055 (1.147)	.018 (.379)	−.1622 (−.2453/−.1021)
Model 4: Criterion = Self-discipline $R = .421$, $R^2 = .177$, $F(4, 364) = 19.591***$	−.014 (−.277)	.423 (8.416***)	.046 (.942)	.009 (.180)	−.0941 (−.1432/−.0563)

N = 369. *$p \leq .05$; **$p \leq .01$; ***$p \leq .001$. Gender coded 0 = male, 1 = female.

ranging .00 to .53, and alpha values ranging .65 to .91 (for the full-length scale). In addition, concurrent validity was supported by the mostly medium to strong positive correlations between the BIC subscales and a separate, general measure of conscientiousness.

Consistent with previous research, findings showed that: morningness-eveningness (M-E, the reversed Eveningness scale combined with the Morning Affect scale) was positively correlated with conscientiousness, that is, more morningness associated with more conscientiousness (Carciofo et al. 2016; Lipnevich et al. 2017; Tsaousis 2010), and with more mindfulness and fewer sleep problems (Carciofo et al. 2014a/b). Morning Affect (energy/alertness soon after waking) showed the same pattern of correlations, but in each case the coefficients were stronger, indicating the potential value in distinguishing this component from a composite measure involving items related to morningness-eveningness when seeking to more fully understand relationships with other variables; further clarification of how Morning Affect is related to morningness preference may also be informative. Distinctness (amplitude of diurnal variation in mood, motivation, and cognitive functioning) had a positive correlation with sleep problems (more distinctness associated with more sleep problems), and negative correlations with conscientiousness and life satisfaction (see Carciofo and Song 2019; Carciofo 2020; Demirhan et al. 2019; Díaz-Morales et al. 2017; Díaz-Morales and Randler 2017; Randler et al. 2016; Rodrigues et al., 2018), and also with mindfulness. In addition, Eveningness was negatively correlated with conscientiousness, but after controlling for Morning Affect, this was no longer significant, while the positive correlation with life satisfaction became stronger and statistically significant, replicating findings from Carciofo (2020, 2021). This latter finding (of a positive correlation between eveningness and life satisfaction) may be

related to more social activity among evening-type students, especially for more extraverted evening-types who may have more life satisfaction (partly) due to having a more engaging social life in the evenings (Drezno et al. 2019); further research may test this. Morningness-eveningness (M-E) and Eveningness were not significantly associated with daytime sleepiness, but Morning Affect had a significant negative correlation, and Distinctness showed a positive correlation. Conscientiousness, life satisfaction, and mindfulness had positive inter-correlations (consistent with findings from Anglim et al. 2020; Giluk 2009; Tsaousis 2010), and negatively correlated with daytime sleepiness, and sleep problems.

Consistent with expectations, Behavioural Indicators of Conscientiousness (BIC) were positively correlated, mostly significantly, with small-to-medium coefficients, with morningness-eveningness and Morning Affect; again, the correlations were mostly stronger with Morning Affect than with the composite morningness-eveningness measure. Also, mostly negative, small-to-medium correlations were found with Eveningness and Distinctness. Eveningness had significant negative correlations with Hardworking and Cleanliness, however, controlling for Morning Affect attenuated the coefficients which were no longer significant, although the small positive correlation with Industriousness showed statistical significance. The BIC factors also positively correlated with mindfulness and life satisfaction, and had negative correlations with sleep problems and daytime sleepiness.

Furthermore, mediation analysis showed that Eveningness had an indirect effect through Morning Affect, on conscientiousness, the facet of self-discipline, and the BIC factors of Hardworking and Cleanliness, and in each case the direct effect of Eveningness was not significant. These results indicate that eveningness preference per se may not be strongly associated with being less

conscientious, but has an association through the mechanism of having a lower level of Morning Affect (alertness/energy in the morning). These findings show that investigation of associations between aspects of circadian functioning and aspects of personality may identify mechanisms which may fully, or partly, account for these relationships. Further investigation of the potential mediating role of Morning Affect identified in the current research may identify other factors that may be involved in the relationship with conscientiousness, such as reduced positive affect/increased negative affect, reduced motivation, and cognitive impairments. The current results also highlight the need to more fully understand the relationship between Eveningness and Morning Affect. Sleep-related factors, including social jetlag, are plausible, and in the current study Eveningness had a significant, though small correlation with shorter sleep duration, which has been previously reported in research assessing Eveningness with the MESSi subscale (Carciofo 2020; Carciofo and Song 2019; Demirhan et al. 2019), although coefficients have consistently been small/weak. There may also be long-term influences in which the childhood experience of social jetlag may negatively impact the development of conscientiousness (Drezno et al. 2019). In addition, the negative emotionality associated with low Morning Affect may potentially increase the risk of sleep disturbance (Carciofo 2020), perhaps through maladaptive coping mechanisms; for example, depression has been found to mediate between eveningness and problematic internet use (Przepiorka et al. 2021). Furthermore, the artificial light from electronic screens may adversely impact the functioning of the circadian system (Touitou and Point 2020). Thus, a negative cycle of sleep and circadian functioning disturbances, low Morning Affect, negative emotionality, and maladaptive coping responses, may potentially develop. Such a cycle may be targeted in intervention studies, such as sleep/health education programmes; if improvements to sleep habits/quality promote more conscientious behaviours, then this may have benefits in a range of situations, including education where poor attainment is associated with both eveningness and lower conscientiousness (Borgio and Louzada 2021; Eberspach et al. 2016).

Limitations and further research

The current research involved a sample of university students, and there was a low response rate for the survey, with a mostly female sample. So, the current findings should be replicated with larger, more gender-balanced samples, and also include more equal numbers of participants across different age groups. This would allow for investigation of gender and age differences,

and so show if the gender differences in BIC observed in the current study are reliable (research with Chinese samples has typically not found gender differences for general conscientiousness; see Carciofo et al. 2016 for discussion). Further research with Chinese samples could also establish if the factor structure of the BIC scale found in the current study is stable, and further investigate potential cultural differences. Further evidence for convergent validity could be established by assessing a range of conscientiousness facets for comparison with the BIC, and including other big five dimensions could also establish divergent validity (Jackson et al. 2010). As volunteer participants may be more conscientious, other sampling methods could also be used.

The cross-sectional design of the current study prohibits any conclusions about causality. Further research is needed to investigate the potential causal relationships between Eveningness, sleep-related factors, Morning Affect, and conscientiousness, and also associations with negative emotionality and coping strategies; metacognitive beliefs may also be involved in these relationships (Carciofo 2020). Further research could also test behavioural indicators of conscientiousness related to health (which Jackson et al. 2010, purposefully omitted from the BIC scale); as morningness-eveningness, Morning Affect, Eveningness, Distinctness, and conscientiousness, have all been associated with indices of physical and/or psychological health (e.g., Au and Reece 2017; Díaz-Morales et al. 2017; Ogińska and Ogińska-Bruchal 2014; Partonen 2015; Roberts et al. 2014; Taylor and Hasler 2018) further research on the inter-relationships between these variables may include assessment of relevant mental health issues, such as depression, which may influence the relationships observed in the current study. Further research may also investigate potential interventions to increase conscientiousness/health-related behaviours, such as related to sleep hygiene. The current study only included single-item measures of sleep problems and duration, and the measure of daytime sleepiness showed relatively low internal consistency, so future studies may include more thorough assessment of these variables. In addition, future research may also compare findings from different personality models, such as temperament and character dimensions, and the evolutionary-biological approach (Antúnez et al. 2014; Randler et al. 2015), and also compare results using different measures of chronotype (Randler et al. 2015), and different measures of the components of circadian rhythms.

Also, as noted by Jackson et al. (2010), other examples of conscientious behaviour that could be assessed include behaviours for specific groups such as parents, and other measures may be developed specifically

focussing on cognitive and affective aspects of the conscientiousness dimension. Alternative methodologies that could also be employed include experience sampling, diary studies, observation, and peer assessment (Jackson et al. 2010; Roberts et al. 2014).

Conclusion

The current study found that morningness and Morning Affect are not only positively correlated with a general measure of conscientiousness, but also with behavioural indicators of conscientiousness including Hardworking, Self-control, Organisation, and Punctuality. Eveningness and Distinctness showed some negative correlations with these variables, but for Eveningness the correlations were no longer significant after controlling for Morning Affect, which fully mediated these relationships. These findings support the value of using component-level measures to more fully understand relationships which may not be revealed with more general assessments, and indicate the potential for further conceptual clarification and refinement of measures. Given that both conscientiousness and components of circadian functioning are associated with indices of well-being, further research may inform both theory and health-promoting interventions.

Disclosure statement

Funding

ORCID

Richard Carciofo http://orcid.org/0000-0003-2069-7047

References

Adan A, Archer SN, Hidalgo MP, Di Milia L, Natale V, Randler C. 2012. Circadian typology: a comprehensive review. Chronobiol Int. 29:1153–75. doi:10.3109/07420528.2012.719971

Anglim J, Horwood S, Smillie LD, Marrero RJ, Wood JK. 2020. Predicting psychological and subjective well-being from personality: A meta-analysis. Psychol Bull. 146:279–323. doi:10.1037/bul0000226

Antúnez JM, Navarro JF, Adan A. 2014. Morningness-eveningness and personality characteristics of young healthy adults. Pers Individ Dif. 68:136–42. doi:10.1016/j.paid.2014.04.015

Au J, Reece J. 2017. The relationship between chronotype and depressive symptoms: A meta-analysis. J Affect Disord. 218:93–104. doi:10.1016/j.jad.2017.04.021

Bakotic M, Radosevic-Vidacek B, Koscec Bjelajac AK. 2017. Morningness–eveningness and daytime functioning in university students: The mediating role of sleep characteristics. J Sleep Res. 26:210–18. doi:10.1111/jsr.12467

Biss RK, Hasher L. 2012. Happy as a lark: morning-type younger and older adults are higher in positive affect. Emotion. 12:437–41. doi:10.1037/a0027071

Borgio JG, Louzada FM. 2021. The mediating effect of conscientiousness on the academic consequences of social jetlag. Chronobiol Int. 38:624–28. doi:10.1080/07420528.2021.1873800

Brown KW, Ryan RM. 2003. The benefits of being present: mindfulness and its role in psychological well-being. J Pers Soc Psychol. 84:822–48. doi:10.1037/0022-3514.84.4.822

Caci H, Mattei V, Baylé FJ, Nadalet L, Dossios C, Robert P, Boyer P. 2005. Impulsivity but not venturesomeness is related to morningness. Psychiatry Res. 134:259–65. doi:10.1016/j.psychres.2004.02.019

Caci H, Robert P, Boyer P. 2004. Novelty seekers and impulsive subjects are low in morningness. Eur Psychiatry. 19:79–84. doi:10.1016/j.eurpsy.2003.09.007

Carciofo R. 2020. Morning affect, eveningness, and amplitude distinctness: Associations with negative emotionality, including the mediating roles of sleep quality, personality, and metacognitive beliefs. Chronobiol Int. 37:1565–79. doi:10.1080/07420528.2020.1798978

Carciofo R. 2021. Morning affect, eveningness, and amplitude of diurnal variation: Associations with parent adult-child relationships, and adult attachment style. Chronobiol Int. 38:501–08. doi:10.1080/07420528.2020.1866002

Carciofo R, Du F, Song N, Zhang K. 2014a. Mind wandering, sleep quality, affect and chronotype: An exploratory study. PLoS ONE. 9:e91285. doi:10.1371/journal.pone.0091285

Carciofo R, Du F, Song N, Zhang K. 2014b. Chronotype and time-of-day correlates of mind wandering and related phenomena. Biol Rhythm Res. 45:37–49. doi:10.1080/09291016.2013.790651

Carciofo R, Song N. 2019. The Chinese Morningness-Eveningness-Stability-Scale improved (MESSi): Validity, reliability, and associations with sleep quality, personality, affect and life satisfaction. Chronobiol Int. 36:1036–46. doi:10.1080/07420528.2019.1608225

Carciofo R, Yang J, Song N, Du F, Zhang K, Qiu J. 2016. Psychometric evaluation of Chinese-Language 44-item and 10-item big five personality inventories, including correlations with chronotype, mindfulness and mind wandering. PLoS ONE. 11:e0149963. doi:10.1371/journal.pone.0149963

Carriere JSA, Cheyne JA, Smilek D. 2008. Everyday attention lapses and memory failures: The affective consequences of mindlessness. Conscious Cogn. 17:835–47. doi:10.1016/j.concog.2007.04.008

Cohen J. 1992. A Power Primer. Psychol Bull. 112:155–59 doi:10.1037/14805-018.

Demirhan E, Önder I, Horzum MB, Masal E, Ş B. 2019. Adaptation of the Morningness–eveningness Stability Scale improved (MESSi) into Turkish. Chronobiol Int. 36:427–38. doi:10.1080/07420528.2018.1560307

Díaz-Morales JF, Randler C. 2017. Spanish adaptation of the morningness-eveningness-stability-scale improved (MESSi). Span J Psychol. 20:1–8. doi:10.1017/sjp.2017.21

Díaz-Morales JF, Randler C, Arrona-Palacios A, Adan A. 2017. Validation of the MESSi among adult workers and young students: General health and personality correlates. Chronobiol Int. 34:1288–99. doi:10.1080/07420528.2017.1361437

Digdon NL, Howell AJ. 2008. College students who have an eveningness preference report lower self-control and greater procrastination. Chronobiol Int. 25:1029–46. doi:10.1080/07420520802553671

Drezno M, Stolarski M, Matthews G. 2019. An in-depth look into the association between morningness–eveningness and well-being: Evidence for mediating and moderating effects of personality. Chronobiol Int. 36:96–109. doi:10.1080/07420528.2018.1523184

Duggan KA, Friedman HS, McDevitt EA, Mednick SC. 2014. Personality and healthy sleep: The importance of conscientiousness and neuroticism. PloS ONE. 9:e90628. doi:10.1371/journal.pone.0090628

Eberspach L, Fenske G, Groten SC, Neufeldt LE, Scherrer V, Preckel F. 2016. Why do Larks perform better at school than Owls? The mediating effect of conscientiousness. Int Online J Educ Sci. 8:4–16. doi:10.15345/iojes.2016.05.002

Field A. 2009. Discovering statistics using SPSS. 3rd ed. London: Sage Publication.

Giluk TL. 2009. Mindfulness, big five personality, and affect: A meta-analysis. Personality Individual Differ. 47:805–11. doi:10.1016/j.paid.2009.06.026

Hayes AF. 2013. Introduction to mediation, moderation, and conditional process analysis. New York: Guilford Press. PROCESS macro available from: [accessed 17 August 2018]. http://processmacro.org/faq.html

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

Huebner ES. 1991. Initial development of the student's life satisfaction scale. Sch Psychol Int. 12:231–40. doi:10.1177/0143034391123010

Jackson JJ, Wood D, Bogg T, Walton KE, Harms PD, Roberts BW. 2010. What do conscientious people do? Development and validation of the Behavioral Indicators of Conscientiousness (BIC). J Res Pers. 44:501–11. doi:10.1016/j.jrp.2010.06.005

Jiang X, Fang L, Stith BR, Liu R-D, Huebner ES. 2017. A psychometric evaluation of the Chinese version of the students' life satisfaction scale. Appl Res Qual Life. doi:10.1007/s11482-017-9576-x

Johns MW. 1991. A new method for measuring daytime sleepiness: The Epworth sleepiness scale. Sleep. 14:540–45. doi:10.1093/sleep/14.6.540

John OP, Srivastava S. 1999. The big five trait taxonomy: history, measurement, and theoretical perspectives. In: Pervin LA, John OP, editors. Handbook of personality: theory and research. 2nd ed. New York: Guilford Press; p. 102–38.

John OP, Srivastava S. 2003. In: The big five trait taxonomy: history, measurement, and theoretical perspectives. In: Pervin LA, John OP editors. Handbook of personality: theory and research. 2nd. Shanghai: East China Normal University Press. p. 135–84. [Chinese BFI44 printed on p.176]. [Chinese BFI44 printed on p.176]

Lipnevich AA, Credè M, Hahn E, Spinath FM, Roberts RD, Preckel F. 2017. How distinctive are morningness and eveningness from the big five factors of personality? A meta-analytic investigation. J Pers Soc Psychol. 112:491–509. doi:10.1037/pspp0000099

McCrae RR, John OP. 1992. An introduction to the five-factor model and its applications. J Pers. 60:175–215. doi:10.1111/j.1467-6494.1992.tb00970.x

O'Connor BP. 2000. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. Behav Res Methods Instrum Comput. 32:396–402. doi:10.3758/BF03200807

Ogińska H, Mojsa-Kaja J, Mairesse O. 2017. Chronotype description: In search of a solid subjective amplitude scale. Chronobiol Int. 34:1388–400. doi:10.1080/07420528.2017.1372469

Ogińska H, Ogińska-Bruchal K. 2014. Chronotype and personality factors of predisposition to seasonal affective disorder. Chronobiol Int. 31:523–31. doi:10.3109/07420528.2013.874355

OrÇan F. 2018. Exploratory and confirmatory factor analysis: which one to use first? J Meas Eval Educ Psychol. 9:414–21. doi:10.21031/epod.394323

Partonen T. 2015. Chronotype and health outcomes. Curr Sleep Med Rep. 1:205–11. doi:10.1007/s40675-015-0022-z

Peng LL, Li JR, Sun JJ, Li WY, Sun YM, Zhang R, Yu LL. (2011). Reliability and validity of the simplified Chinese version of Epworth sleepiness scale. Chin J Otorhinolaryngology Head Neck Surg. 46:44–49. [Chinese language].

Przepiorka A, Blachnio A, Cudo A. 2021. Relationships between morningness, big five personality traits, and problematic Internet use in young adult university students: Mediating role of depression. Chronobiol Int. 38:248–59. doi:10.1080/07420528.2020.1851703

Randler C. 2008. Morningness-eveningness and satisfaction with life. Soc Indic Res. 86:297–302. doi:10.1007/s11205-007-9139-x

Randler R, Díaz-Morales JF, Rahafar A, Vollmer C. 2016. Morningness–eveningness and amplitude – Development and validation of an improved composite scale to measure circadian preference and stability (MESSi). Chronobiol Int. 33:832–48. doi:10.3109/07420528.2016.1171233

Randler C, Gomà-i-Freixanet M, Muro A, Knauber C, Adan A. 2015. Do different circadian typology measures modulate their relationship with personality? A test using the alternative five factor model. Chronobiol Int. 32:281–88. doi:10.3109/07420528.2014.968282

Roberts BW, Lejuez C, Krueger RF, Richards JM, Hill PL. 2014. What is conscientiousness and how can it be assessed? Dev Psychol. 50:1315–30. doi:10.1037/a0031109

Rodrigues PF, Vagos P, Pandeirada JN, Marinho PI, Randler C, Silva CF. 2018. Initial psychometric characterization for the Portuguese version of the Morningness-Eveningness-Stability-Scale improved (MESSi). Chronobiol Int. 35 (11):1608–1618. doi:10.1080/07420528.2018.1495646

Soto CJ, John OP. 2009. Ten facet scales for the big five inventory: convergence with NEO PI-R facets, self-peer agreement, and discriminant validity. J Res Pers. 43:84–90. doi:10.1016/j.jrp.2008.10.002

Stolarski M, Ledzińska M, Matthews, G. 2013. Morning is tomorrow, evening is today: relationships between chronotype and

time perspective. Biol Rhythm Res. 44:181–196. doi:10.1080/09291016.2012.656248

Suh S, Yang H-C, Kim N, Yu JH, Choi S, Yun C-H, Shin C. 2017. Chronotype differences in health behaviors and health-related quality of life: A population-based study among aged and older adults. Behav Sleep Med. 15:361–76. doi:10.1080/15402002.2016.1141768

Taylor BJ, Hasler BP. 2018. Chronotype and mental health: Recent advances. Curr Psychiatry Rep. 20:59. doi:10.1007/s11920-018-0925-8

Touitou Y, Point S. 2020. Effects and mechanisms of action of light-emitting diodes on the human retina and internal clock. Environ Res. 190:109942. doi:10.1016/j.envres.2020.109942

Tsaousis I. 2010. Circadian preferences and personality traits: a meta-analysis. Eur J Pers. 24:356–73. doi:10.1002/per.754

Vagos P, Rodrigues PF, Pandeirada JN, Kasaeian A, Weidenauer C, Silva CF, Randler C. 2019. Factorial structure of the Morningness-Eveningness-Stability-Scale (MESSi) and sex and age invariance. Front Psychol. 10:3. doi:10.3389/fpsyg.2019.00003

Werner L, Geisler J, Randler C. 2015. Morningness as a personality predictor of punctuality. Curr Psychol. 34:130–39. doi:10.1007/s12144-014-9246-1