BRIEF REPORT

Skipping breakfast: Morningness-eveningness preference is differentially related to state and trait food cravings

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ABSTRACT. *Eveningness preference is associated with unhealthy eating behaviors. We measured state and trait food cravings in chronotypes in the morning and in the evening. Less Evening (E)- than Morning (M)-types reported to have had breakfast. Accordingly, hours that had elapsed since the last meal were higher in E- than M-types in the morning, but did not differ between groups in the evening. E-types reported higher anticipation of positive reinforcement that may result from eating than M-types in the morning, but both had the same hunger levels. On a trait level, M-types reported more feelings of guilt for giving into cravings compared to E-types. Results suggest that E-types skip breakfast more often than M-types, but this eating pattern does not inevitably lead to more food cravings in the evening or more pronounced habitual cravings. Furthermore, E-types did not experience more hunger in the morning although they had not been eating for a longer time period. Results support findings about a different lifestyle in E-types compared to M-types.*

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INTRODUCTION

Circadian rhythms are important determinants of daily living in humans (1). Various psychological, behavioral, and biological variables show a 24-hour oscillation, even in the absence of environmental zeitgebers such as sunlight (2). Most humans remain to eat three meals per day when no zeitgebers are available, albeit intervals between meals are adjusted to the duration of wakefulness (3).

However, interindividual differences exist in the length and the position of circadian phases (4). The variability of the settings of the circadian clock is reflected in the concept of morningness/eveningness (M/E). Depending on the diurnal preference, people may either be morning- or evening-orientated (M- or E-type) or, like the majority, be a neutral chronotype (5).

M-types are more stable and regular in their lifestyle with respect to event timing than are E-types (6, 7). Moreover, M-types have a healthier lifestyle, e.g. they consume less alcohol and nicotine or eat breakfast more regularly and earlier than E-types (8). Eveningness preference is associated with higher consumption of caffeinated drinks and fast food in adolescents (9).

Besides these differences between chronotypes with regards to unhealthy eating behaviors, eveningness preference has also been associated with disordered eating (10-12). Eveningness preference was correlated with higher disinhibited eating, higher perceived hunger, and higher body-mass-index (BMI) (13). Morningness preference was related to cognitive restraint of eating behavior and flexible dietary control strategies (13) which recently have been related to high dieting success (14). It has been argued that the exposure to the dimmer lighting of evening promotes general behavioral disinhibition (10, 15), which affects E-types longer than M-types because of their later bedtimes. However, these findings might be due to more temporal issues than to lighting effects (16). Conversely, it has also been suggested that an altered eating behavior could modulate circadian preference (11). In sum, the relation between disordered eating behavior and eveningness preference seems to be associated with eating at a later time of day.

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Chronotypes, morningness-eveningness, food craving, breakfast, eating behavior.

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Most of those studies used correlational designs between questionnaires for morningness/eveningness preference and eating behavior. Often retrospective reports of eating behavior were investigated disregarding time of day. Therefore, our study investigated M- and E-types in the morning and in the evening. Furthermore, this is the first study that explored differences in food cravings between chronotypes. As such food cravings are associated with disinhibited eating behavior (14, 17-21); we expected food cravings to be elevated in E- compared to M-types.

MATERIALS AND METHODS

Participants

We screened online 471 students of the University of Würzburg with the Morningness-Eveningness Questionnaire (MEQ, see below). Subjects from the upper and lower 20% of the distribution were invited to take part in the study (MEQ-scores ≤44 for E-type and ≥55 for M-type). The current sample consisted of 66 participants (N=18 M-types tested in the morning, N=17 M-types tested in the evening, N=13 E-types tested in the morning, N=18 E-types tested in the evening). Participants' mean age was M=23.08 years (SD±2.68) and mean BMI was M=22.22 kg/m² (SD±4.48). The majority of participants were women (84.85%, N=56).

Questionnaires

Morningness-Eveningness Questionnaire (MEQ). The MEQ (22, 23) identifies morningness-eveningness preference and consists of 19 items (Cronbach's α=0.82) (24). Subjects can be classified in five categories: definite or moderate E-type, neutral type, moderate or definite M-type. MEQ scores and melatonin onset as a physiological measure of the circadian period correlate significantly, supporting the validity of the questionnaire (22). Retest-reliability is very good (r=0.97) (22). Higher values indicate a higher morningness preference.

Food Cravings Questionnaires (FCQs). Habitual food cravings were assessed using the trait version of the Food Cravings Questionnaires (FCQ-T) (18, 19). This 39-item instrument asks participants to indicate on a 6-point Likert scale how frequently they experience food cravings (ranging from *never* to *always*). The FCQ-T consists of nine subscales measuring food cravings in relation to 1) intentions to consume food, 2) anticipation of positive reinforcement, 3) relief from negative states, 4) lack of control over eating, 5) preoccupation with food, 6) hunger, 7) emotions, 8) cues that trigger cravings, and 9) guilt. Subscales are highly intercorrelated and internal consistency of the total FCQ-T is α>0.90 (18, 19).

Current food cravings were assessed with the state version of the Food Cravings Questionnaires (FCQ-S) (18, 19). This 15-item questionnaire requires participants to indicate on a 5-point Likert scale how intensely they experience craving at this moment (ranging from *strongly disagree* to *strongly agree*). The FCQ-S assesses momentary food cravings on the dimensions 1) intense desire to eat, 2) anticipation of positive reinforcement, 3) relief from negative states, 4) lack of control over eating, and 5) hunger. Subscales are highly inter-correlated and internal consistency of the total FCQ-S is α>0.90 (18, 19).

Additional questions. Subjects indicated the amount of hours that had elapsed since their last meal and if they have had breakfast in the morning (yes/no). They also reported their age, height and weight.

Procedure

Participants filled out questionnaires either in the morning (between 8-11 a.m.) or in the evening (16-19 p.m.). Data acquisition was part of a larger study on stress reactivity in M/E types (cf. 25, 26). Questionnaires were completed at rest after stress levels had returned to baseline.

Data analysis

Group differences between chronotypes were tested with univariate ANOVAs (age, BMI, MEQ, trait cravings) or χ^2-tests (gender, breakfast). Group differences between chronotypes as a function of time of day (hours since last meal, state cravings) were tested with univariate ANOVAS using chronotype (M- vs E-type) and time of day (morning vs evening) as between-factors. T-tests served for post-hoc pairwise comparisons. Due to missing data, n varies between parameters.

RESULTS

Group differences between chronotypes

Chronotypes did not differ in age, BMI or gender distribution (Table 1). As expected, M-types had higher MEQ-scores than E-types (Table 1). More M-types than E-types reported to have had breakfast (Table 1). Groups did not differ in total FCQ-T-scores or any FCQ-subscale except for *feelings of guilt* which were more pronounced in M-types as compared to E-types (Table 1).

TABLE 1
Group differences between chronotypes.

	Morning-types M±SD	Evening-types M±SD	Test statistic	p-value
Age	23.40±2.49	22.71±2.88	$F_{(1,64)}$=1.09	NS
Body-mass-index	22.59±5.35	21.79±3.29	$F_{(1,64)}$=0.52	NS
Gender (female)	N=31 (88.57%)	N=25 (80.65%)	$\chi^2_{(1,N=66)}$=0.80	NS
Morningness-Eveningness Questionnaire	59.63±3.80	40.71±4.61	$F_{(1,64)}$=334.28	<0.001
Breakfast	N=31 (91.18%)	N=13 (46.43%)	$\chi^2_{(1,N=62)}$=14.92	<0.001
Food Cravings Questionnaire - Trait	109.72±30.57	108.62±28.02	$F_{(1,42)}$=0.02	NS
Intentions to consume food	9.33±3.22	9.13±2.79	$F_{(1,42)}$=0.05	NS
Anticipation of positive reinforcement	13.38±3.97	14.05±4.05	$F_{(1,42)}$=0.31	NS
Relief from negative states	7.67±2.58	7.48±3.01	$F_{(1,42)}$=0.05	NS
Lack of control over eating	16.91±6.91	17.48±6.10	$F_{(1,42)}$=0.08	NS
Preoccupation with food	16.62±6.17	15.83±6.09	$F_{(1,42)}$=0.18	NS
Hunger	12.52±3.61	12.83±3.39	$F_{(1,42)}$=0.08	NS
Emotions	10.29±4.47	10.00±4.60	$F_{(1,42)}$=0.04	NS
Cues that trigger cravings	13.57±4.08	15.17±3.74	$F_{(1,42)}$=1.85	NS
Guilt	9.43±3.96	6.65±3.94	$F_{(1,42)}$=5.43	<0.05

Group differences between chronotypes as a function of time of day

Last meal. There were main effects for chronotype ($F_{(1,58)}$=18.60, p<0.001) and time of day ($F_{(1,58)}$=10.14, p<0.01) and a significant interaction chronotype × time of day (Table 2). Post-hoc t-tests indicated that food deprivation in E-types was longer compared to M-types in the morning ($t_{(26)}$=-4.14, p<0.001), but did not differ in the evening ($t_{(32)}$=-0.18, ns). Accordingly, food deprivation was longer for E-types in the morning compared to evening ($t_{(26)}$=4.24, p<0.001), but did not differ for M-types between morning and evening ($t_{(32)}$=-0.89, ns).

State cravings. There were no main effects for chronotype or time of day for the FCQ-S-total score or any of the subscales (all F's<1.50, ns). There was a marginally significant interaction between chronotype and time of day for the FCQ-S-total score (Table 2), but none of the post-hoc comparisons reached significance (all t's<1.60, ns). There was also a marginally significant interaction chronotype × time of day for the *positive reinforcement* subscale (Table 2). Post-hoc t-tests indicated that E-types had higher scores in the morning compared to M-types ($t_{(28)}$=-2.11, p<0.05), but did not differ from M-types in the evening ($t_{(30)}$=0.40, ns). Finally, there was a significant interaction chronotype × time of day for the *intense desire to eat* subscale (Table 2). Post-hoc t-tests revealed that there were no differences between chronotypes in the morning ($t_{(28)}$=-1.69, ns) or in the evening ($t_{(30)}$=1.18, ns), but that scores in M-types were lower in the morning than in the evening ($t_{(30)}$=-2.18, p<0.05). E-types did not differ between times of day ($t_{(28)}$=0.75, ns).

TABLE 2
Group differences between chronotypes as a function of time of day.

	Morning-types		Evening-types		Interaction chronotype × time of day	
	Morning M±SD	Evening M±SD	Morning M±SD	Evening M±SD	Test statistic	p-value
Hours since the last meal	2.97±2.79	3.68±1.70	8.96±4.89	3.77±1.13	$F_{(1,58)}$=17.54	<0.001
Food Cravings Questionnaire - State	33.94±12.95	39.80±11.09	39.54±10.55	33.71±11.59	$F_{(1,58)}$=3.85	0.06
Intense desire to eat	7.12±3.44	9.67±3.13	9.23±3.35	8.29±3.42	$F_{(1,58)}$=4.16	<0.05
Anticipation of positive reinforcement	6.47±3.09	7.40±2.59	8.54±2.30	7.00±3.08	$F_{(1,58)}$=2.93	0.09
Relief from negative states	6.88±3.10	7.13±3.00	7.46±2.07	5.82±2.33	$F_{(1,58)}$=1.90	NS
Lack of control over eating	6.12±2.91	6.00±2.73	6.00±2.86	4.59±1.73	$F_{(1,58)}$=0.96	NS
Hunger	7.35±3.57	9.60±2.59	8.31±3.30	8.00±2.98	$F_{(1,58)}$=2.54	NS

DISCUSSION

In the current study, we found that more M- than E-types reported to have had breakfast, replicating prior findings (e.g. 8). Accordingly, E-types were longer food deprived in the morning and reported a higher anticipation of positive reinforcement as a result from eating. However, they did not differ from M-types in self-reported hunger. On a habitual level, M-types reported more feelings of guilt from cravings than E-types.

Results further support findings about a different lifestyle in E-types compared to M-types. However, this did not lead to more habitual experiences of food craving. M-types reported more feelings of guilt in relation to such cravings. Those results may account for M-types being more conscientious (27) and try more to cognitively restrain their eating behavior (13) which may lead to more dissatisfaction when losing control during craving.

E-types were longer food deprived and experienced more food craving in the morning, but did not experience more hunger. This finding may indicate that E-types could have less interoceptive awareness. While this argument remains speculative, future studies may address this question with self-report or physiological tests (28) and connect it to E-types' eating behavior. Moreover, future investigations are needed to determine if skipping breakfast in E-types is driven by biological or social influences. For example, appetite-regulating peptides have been found to demonstrate a diurnal rhythm and to be linked to sleeping behavior (29, 30). Accordingly, later meal times in E-types might be influenced by those biochemical rhythms. On the other hand, social jetlag may also contribute to skipping breakfast when E-types get up late and are short of time for eating before leaving the house.

Our study has several limitations. Firstly, late time of day has been associated with problems to control food intake (10, 15, 16). Our evening testing already ended at 7 p.m. Hence, this could explain why we could not find stronger food cravings in the evening in E-types. Further research should investigate if specifically in the late evening period, evening-types show a disinhibition of eating behavior accompanied by increased food craving and eating. Secondly, our sample size was small and restricted to young students. For instance, differences in BMI could probably not be detected as most of participants were normal-weight. Thirdly, we adopted a between subjects design in order to avoid possible effects of repeated measures. However, a within subjects design may have been beneficial, especially in the light of small sample size.

In sum, our results indicate differential relations between state and trait food cravings with morningness-eveningness preference. Further research could address this issue in greater detail by describing developments of state cravings throughout the day and connect these cravings to personality variables, e.g. interoception or perfectionism, in chronotypes.

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REFERENCES

1. Aschoff J. Circadian rhythms in man. Science 1965; 148: 1427-32.
2. Monk TH, Buysse DJ, Reynolds CF, et al. Circadian rhythms in human performance and mood under constant conditions. J Sleep Res 1997; 6: 9-18.
3. Aschoff J, von Goetz C, Wildgruber C, et al. Meal timing in humans during isolation without time cues. J Biol Rhythm 1986; 1: 151-62.
4. Bailey SL, Heitkemper MM. Circadian rhythmicity of cortisol and body temperature: Morningness-eveningness effects. Chronobiol Int 2001; 18: 249-61.
5. Natale V, Cicogna P. Morningness-eveningness dimension: is it really a continuum? Pers Indiv Differ 2002; 32: 809-16.
6. DeYoung CG, Hasher L, Djikic M, et al. Morning people are stable people: Circadian rhythm and the higher-order factors of the Big Five. Pers Indiv Differ 2007; 43: 267-76.
7. Monk TH, Buysse DJ, Potts JM, et al. Morningness-eveningness and lifestyle regularity. Chronobiol Int 2004; 21: 435-43.
8. Nakade M, Takeuchi H, Kurotani M, et al. Effects of meal habits and alcohol/cigarette consumption on morningness-eveningness preference and sleep habits by Japanese female students aged 18-29. J Physiol Anthropol 2009; 28: 83-90.
9. Fleig D, Randler C. Association between chronotype and diet in adolescents based on food logs. Eat Behav 2009; 10: 115-8.
10. Kasof J. Eveningness and bulimic behavior. Pers Indiv Differ 2001; 31: 361-9.
11. Natale V, Ballardini D, Schumann R, et al. Morningness-eveningness preference and eating disorders. Pers Indiv Differ 2008; 45: 549-53.
12. Schmidt S, Randler C. Morningness-eveningness and eating disorders in a sample of adolescent girls. J Indiv Differ 2010; 31: 38-45.
13. Schubert E, Randler C. Association between chronotype and the constructs of the three-factor-eating questionnaire. Appetite 2008; 51: 501-5.

14. Meule A, Westenhöfer J, Kübler A. Food cravings mediate the relationship between rigid, but not flexible control of eating behavior and dieting success. Appetite 2011; 57: 582-4.
15. Kasof J. Indoor lighting preferences and bulimic behavior: an individual differences approach. Pers Indiv Differ 2002; 32: 383-400.
16. Stroebele N, De Castro JM. Effect of ambience on food intake and food choice. Nutrition 2004; 20: 821-38.
17. Cepeda-Benito A, Fernandez MC, Moreno S. Relationship of gender and eating disorder symptoms to reported cravings for food: construct validation of state and trait craving questionnaires in Spanish. Appetite 2003; 40: 47-54.
18. Cepeda-Benito A, Gleaves DH, Williams TL, et al. The development and validation of the state and trait Food-Cravings Questionnaires. Behav Ther 2000; 31: 151-73.
19. Meule A, Lutz A, Vögele C, et al. Food cravings discriminate differentially between successful and unsuccessful dieters and non-dieters. Validation of the Food Craving Questionnaires in German. Appetite 2012; 58: 88-97.
20. Moreno S, Rodríguez S, Fernandez MC, et al. Clinical validation of the trait and state versions of the food craving questionnaire. Assessment 2008; 15: 375-87.
21. Moreno S, Warren CS, Rodríguez S, et al. Food cravings discriminate between anorexia and bulimia nervosa. Implications for "success" versus "failure" in dietary restriction. Appetite 2009; 52: 588-94.
22. Griefhahn B, Künemund C, Bröde P, et al. [The validity of a German version of the Morningness-Eveningness-Questionnaire developed by Horne and Östberg]. Somnologie 2001; 5: 71-80.
23. Horne JA, Östberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. Int J Chronobiol 1976; 4: 97-110.
24. Smith CS, Reilly C, Midkiff K. Evaluation of three circadian rhythm questionnaires with suggestions for an improved measure of morningness. J Appl Psychol 1989; 74: 728-38.
25. Roeser K, Obergfell F, Meule A, et al. Of larks and hearts - morningness/eveningness, heart rate variability and cardiovascular stress response at different times of day. Physiol Behav 2012; 106: 151-7.
26. Roeser K, Meule A, Schwerdtle B, et al. Subjective sleep quality exclusively mediates the relationship between morningness-eveningness preference and self-perceived stress response. Chronobiol Int 2012; 29: 955-60.
27. Hogben AL, Ellis J, Archer SN, et al. Conscientiousness is a predictor of diurnal preference. Chronobiol Int 2007; 24: 1249-54.
28. Herbert BM, Pollatos O. [Interoceptive sensitivity, feelings, and behavioral control]. Z Neuropsychol 2008; 19: 125-37.
29. Schoeller DA, Cella LK, Sinha MK, et al. Entrainment of the diurnal rhythm of plasma leptin to meal timing. J Clin Invest 1997; 100: 1882-7.
30. Motivala SJ, Tomiyama AJ, Ziegler M, et al. Nocturnal levels of ghrelin and leptin and sleep in chronic insomnia. Psychoneuroendocrinol 2009; 34: 540-5.