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Personality, time-of-day preference, and eating behavior: The mediational role of morning-eveningness ☆

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ABSTRACT

Although prior research has established that eating behaviors are related to both the Big Five personality traits and time-of-day preference, no research has directly examined if time-of-day preference mediates personality differences in eating behavior. We directly tested this model by assessing participants' (N = 279) Big Five personality traits, time-of-day preference, and three-factors of eating (i.e., restrained eating, uncontrolled eating, and emotional eating) using validated questionnaires. Mediation analyses revealed that time-of-day preference partially mediated the relationship between the personality factors (conscientiousness, neuroticism, and extraversion) and eating behavior, primarily uncontrolled eating. These results indicate that time-of-day preference, in part, accounts for personality differences in eating behavior. This emphasizes the need to assess time-of-day preference when examining the relationship between personality and health-related behaviors.

1. Introduction

The wide variety of routine behaviors that individuals exhibit can often be accounted for by individual differences, such as the Big Five personality factors. For this reason, personality is often examined as a predictor of health-related outcomes, such as eating behavior (e.g., Bogg & Roberts, 2004; Provencher et al., 2008). Another individual difference that is also frequently associated with eating behavior is time-of-day preference (e.g., Sato-Mito et al., 2011; Schubert & Randler, 2008). Time-of-day preference is conceptualized as an individual's peak performance time when he or she is at his or her most capable, physically and cognitively. Although both of these individual differences are related to eating behavior, no research has examined if time-of-day preference accounts for personality differences in eating behavior. Thus, the current research extends recent work (Walker, Kribs, Christopher, Shewach, & Wieth, 2014) by examining this mediational model.

1.1. Personality and eating behavior

A number of studies have documented the relationship between the Big Five personality traits and eating behavior. Research consistently shows that conscientiousness is both positively associated with healthy eating behavior, such as restrained eating (Elfhag & Morey, 2008; Provencher et al., 2008), and negatively associated with unhealthy eating behavior, such as emotional eating and external eating (i.e., eating in response to cues, such as sight and smell; Elfhag & Morey, 2008; Heaven, Mulligan, Merrilees, Woods, & Fairooz, 2001). Conversely, the trait of neuroticism tends to positively predict unhealthy eating behavior, such as emotional eating and external eating (Heaven et al., 2001; Provencher et al., 2008), and it negatively predicts restrained eating (Elfhag & Morey, 2008). Research has also demonstrated that extraversion is negatively associated with emotional eating and positively associated with restrained eating (Elfhag & Morey, 2008). Likewise, studies have shown that openness is positively related to restrained eating (Elfhag & Morey, 2008; Heaven et al., 2001) and agreeableness is negatively related to external eating (Provencher et al., 2008).

1.2. Personality and time-of-day preference

Researchers have frequently examined how personality factors relate to time-of-day preference. It is well established that more

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conscientious people tend to have more of a morning preference (Adan et al., 2012; Tsaousis, 2010). Agreeableness also tends to be related to morningness, but to a lesser extent (Tsaousis, 2010). Conversely, neuroticism is often shown to be associated with an evening preference (Adan et al., 2012). Although research on the remaining personality traits (i.e., extraversion and openness) appears to be less consistent, a recent review of the literature suggests that they are generally unrelated to time-of-day preference (Adan et al., 2012). In the current study we focus on how an individuals' personality influences their time-of-day preference, similar to Adan et al. (2012) and Tsaousis (2010). Although the opposite relationship is theoretically plausible, we focus on the impact of personality on time-of-day preference largely because time-of-day preference is substantially heritable. Genetics account for approximately 40% to 50% of the variability in time-of-day preference (e.g., Hur, 2007), while the other 50% to 60% is a function of other individual differences, such as personality (Walker et al., 2014).

1.3. Time-of-day preference and eating behavior

Several studies have established that individuals with a morning preference tend to have healthier eating behaviors. For instance, morningness positively predicts restrained eating and negatively predicts uncontrolled eating, perceived hunger (i.e., high level of perceived hunger), and Body Mass Index (BMI; Schubert & Randler, 2008). Moreover, people with an evening preference tend to eat for longer periods of time, eat larger portions, skip more meals, and watch TV more frequently while eating (Lucassen et al., 2013; Meule, Roeser, Randler, & Kübler, 2012; Sato-Mito et al., 2011).

Not surprisingly, the relationship between time-of-day preference and eating behavior appears to be embedded in human biology (Kanerva et al., 2012). Circadian rhythms can dictate when one feels hungry (Mendoza, 2007), and these rhythms also manifest in time-of-day preference. The hurried pace of modern US society is not set up to accommodate the circadian rhythms of some people, especially those with an evening preference. Evening people often have sleep cycle disruptions due to changes in their sleep schedule during the workweek when they must rise before their preferred time (Roenneberg et al., 2007). Research has shown that these disruptions can negatively impact one's health (e.g., increased appetite and obesity; Knutson, Spiegel, Penev, & Van Cauter, 2007; Patel & Hu, 2008). Thus, this biologically-based connection between time-of-day preference and eating behavior suggests that time-of-day preference may account for personality differences in eating behavior.

1.4. The current study

Existing research has established relationships between personality and eating behavior and time-of-day preference and eating behavior. However, to our knowledge, no research has examined a model that includes time-of-day preference as a potential mediator of the relationship between personality and eating behavior. To test this model, participants completed a 60-item personality questionnaire (Costa & McCrae, 2008), the Morning-Eveningness Questionnaire (Horne & Östberg, 1976), and the Three-Factor Eating Questionnaire (Karlsson, Persson, Sjöström, & Sullivan, 2000).

Consistent with previous research, we hypothesized that conscientiousness, extraversion, agreeableness, and openness would positively predict healthy eating behavior (restrained eating) and negatively predict unhealthy eating behavior (uncontrolled eating and emotional eating). Conversely, we predicted that neuroticism would positively relate to unhealthy eating behavior and negatively relate to healthy eating behavior. Also consistent with existing research, we predicted that morning people would express healthier eating behavior than evening people. However, unique to the present research, we hypothesized that time-of-day preference would mediate the relationship between personality and eating behavior. Specifically, we expected that conscientiousness and agreeableness would negatively predict uncontrolled eating and emotional eating (and positively predict restrained eating), but that these relationships would be mediated by time-of-day preference. Because extraversion and openness are not typically related to time-of-day preference, we anticipated these models would be nonsignificant. We also believed that the positive relationship between neuroticism and both uncontrolled eating and emotional eating (and negative relationship with restrained eating) would be mediated by time-of-day preference (see Fig. 1 for the general mediation model). We believed that these combined findings would demonstrate the mediational role of time-of-day preference in the relationship between personality and eating behavior.

2. Method

2.1. Participants

We recruited a sample of 279 (151 men and 128 women) participants through Amazon's Mechanical Turk worker pool (https://www.mturk.com/), and they received $1.50 for participation in this study. Because of institutional regulations, participation was limited to U.S. workers only. Utilizing this population for psychological research has yielded a more demographically diverse sample than the typical undergraduate population, while still maintaining the reliability of data collected via traditional methods (Buhrmester, Kwang, & Gosling, 2011). Prospective participants learned that they would be completing a series of individual difference measures. They completed all measures in one 30-min period. Participants ranged in age from 18 to 82 years (M = 34.08, SD = 11.45) and had an average BMI of 26.23 (SD = 6.92).

2.2. Materials and procedure

2.2.1. NEO-FFI-3

Participants first completed Costa and McCrae's (2008) 60-item NEO-FFI-3 measure of the Big Five personality factors, conscientiousness (e.g., "I work hard to accomplish my goals"; α = .90), agreeableness (e.g., "I generally try to be thoughtful and considerate"; α = .83), extraversion (e.g., "I like to have a lot of people around me"; α = .88), openness (e.g., "I have a lot of intellectual curiosity"; α = .83), and neuroticism (e.g., "I often feel tense and jittery"; α = .92). All responses were made on a 1 (*strongly disagree*) to 5 (*strongly agree*) scale. We averaged the 12 items for each factor to form a score for that factor.

2.2.2. Morning-eveningness questionnaire

Participants then completed Horne and Östberg's (1976) Morning-Eveningness Questionnaire (MEQ) to measure time-of-day preference. The MEQ is a 19-item measure that is the most

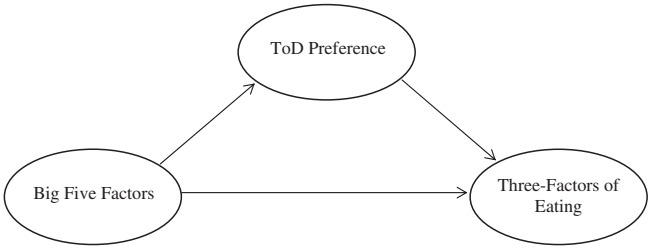

Fig. 1. Time-of-day (ToD) preference mediating the relationship between the Big Five personality factors and the three-factors of eating.

Table 1
Descriptive statistics and correlations between study variables.

	M	*SD*	1	2	3	4	5	6	7	8	9
1. Time-of-day preference[a]	49.23	9.33	–								
2. Conscientiousness[b]	45.15	7.82	.23**	–							
3. Agreeableness[b]	43.82	7.48	.15*	.34**	–						
4. Extraversion[b]	36.14	8.33	.23**	.36**	.11	–					
5. Openness[b]	45.24	7.03	−.04	.10	.14*	.09	–				
6. Neuroticism[b]	32.77	10.42	−.28**	−.61**	−.28**	−.51**	−.01	–			
7. Uncontrolled eating[c]	19.37	5.43	−.21**	−.33**	−.20**	−.15*	−.05	.36**	–		
8. Restrained eating[d]	14.20	3.91	.18**	.06	−.02	.21**	−.06	−.06	−.05	–	
9. Emotional eating[e]	6.14	2.60	−.07	−.32**	−.06	−.16**	−.00	.40**	.67**	.13*	–
10. BMI[f]	26.23	6.92	−.06	−.11	.00	−.09	.01	.05	.22**	.05	.28**

[a] Higher scores indicate a morning preference; lower scores indicate an evening preference.
[b] Scores on conscientiousness, agreeableness, extraversion, openness, and neuroticism range from 12 (*low*) to 60 (*high*).
[c] Scores on uncontrolled eating range from 9 (*low*) to 36 (*high*).
[d] Scores on restrained eating range from 6 (*low*) to 24 (*high*).
[e] Scores on emotional eating range from 3 (*low*) to 12 (*high*).
[f] Categories on BMI: below 18.5 (underweight); 18.5–24.9 (normal); 25–29.9 (overweight); 30 or higher (obese).
* $p < .05$.
** $p < .01$.

common measure of time-of-day preference (Adan et al., 2012). An example item is, "During the first half hour after having awakened in the morning, how tired do you feel?" Responses were multiple choice (e.g., *very tired, fairly tired, fairly refreshed, very refreshed*) or made on a response continuum (e.g., a 24-h continuum ranging from *12am* to *11pm*). Scores on the MEQ could range from 16 (*strong evening preference*) to 86 (*strong morning preference*). In the current data, scores ranged from 26 to 76 ($M = 49.23$, $SD = 9.33$, $\alpha = .82$).

2.2.3. Three-Factor Eating Questionnaire

Participants then completed the 18-item Three-Factor Eating Questionnaire (Karlsson et al., 2000), which was shortened and revised from the 51-item questionnaire (Stunkard & Messick, 1985). This dietary practice questionnaire assesses three different aspects of eating behavior. The first subscale assesses *restrained eating* (i.e., "conscious restriction of food intake to control body weight or to promote weight loss"; de Lauzon et al., 2004, p. 2373). An example item on the restrained eating subscale is, "I deliberately take small helpings as a means of controlling my weight" ($\alpha = .81$). The second subscale measures *uncontrolled eating* (i.e., "tendency to eat more than usual due to a loss of control over intake accompanied by subjective feelings of hunger"; de Lauzon et al., 2004, p. 2373). An example item on the uncontrolled eating subscale is, "Sometimes when I start eating, I just can't seem to stop" ($\alpha = .89$). The final subscale assesses *emotional eating* (i.e., "inability to resist emotional cues"; de Lauzon et al., 2004, p. 2373). An example item on the emotional eating subscale is, "When I feel anxious, I find myself eating" ($\alpha = .92$). All responses were measured on a scale from 1 (*definitely false*) to 4 (*definitely true*).

Finally, participants completed a demographic questionnaire. Participants answered typical demographic questions (e.g., age), and also self-reported other factors (e.g., height, weight) for the purposes of calculating BMI.

3. Results

3.1. Overview of analyses

Table 1 contains descriptive statistics and zero-order correlations for the Big Five personality traits, the three-factors of eating, and BMI. Following the recommendations of Baron and Kenny (1986), for each mediational model we examined the relation between the predictor and the mediator, the predictor and the outcome, and the mediator and the outcome with the predictor in the model. When the relationship between the predictor and the mediator and the relationship between the mediator and the outcome with the predictor in the model were significant, we examined the indirect effect via bootstrapping using PROCESS, an SPSS macro (Hayes, 2008). When these relationships were nonsignificant the indirect effect was not tested. The indirect effects were considered significant if zero was not contained in the 95% confidence interval. We included age and gender as covariates[1] in all of the following mediation analyses.

3.2. Mediational analyses

3.2.1. Uncontrolled eating

We first examined models predicting uncontrolled eating. In the first model, conscientiousness significantly predicted both time-of-day (ToD) preference, $\beta = .18$, $t(274) = 3.09$, $p < .01$ ($R^2 = .13$, $F[3, 274] = 13.59$ $p < .001$), and uncontrolled eating, $\beta = -.32$, $t(274) = -5.51$, $p < .001$. When ToD preference was added to the model ($\Delta R^2 = .02$, $F[4, 273] = 10.18$, $p < .001$), ToD preference predicted uncontrolled eating above and beyond conscientiousness, $\beta = -.14$, $t(273) = -2.28$, $p < .05$. However, the relationship between conscientiousness and uncontrolled eating remained significant, $\beta = -.30$, $t(273) = -5.04$, $p < .001$. Examination of the indirect effect revealed a confidence interval around the indirect effect ($-.02$, $SE = .01$) that did not contain zero (95% CI [$-.043$, $-.003$]), indicating that ToD preference partially mediated the relation between conscientiousness and uncontrolled eating.

In the next model, neuroticism significantly predicted both ToD preference, $\beta = -.22$, $t(274) = -3.60$, $p < .001$ ($R^2 = .14$, $F[3, 274] = 14.85$ $p < .001$), and uncontrolled eating, $\beta = .37$, $t(274) = 6.13$, $p < .001$. When ToD preference was added to the model ($\Delta R^2 = .01$, $F[4, 273] = 11.73$, $p < .001$), ToD preference predicted uncontrolled eating above and beyond neuroticism, $\beta = -.12$, $t(273) = -2.03$, $p < .05$. However, the relationship between neuroticism and uncontrolled eating remained significant, $\beta = .34$, $t(273) = 5.59$, $p < .001$. Nonetheless, the confidence interval around the indirect effect (.01, $SE = .01$) did not contain zero (95% CI [.001, .037]), showing that ToD preference partially mediated the relation between neuroticism and uncontrolled eating.

We then tested if ToD preference mediated the relation between agreeableness and uncontrolled eating. Since agreeableness did not predict ToD preference, $\beta = .06$, $t(274) = .98$, $p = .33$ ($R^2 = .10$, $F[3, 274] = 10.41$, $p < .001$), no further analyses were con-

[1] BMI was not significantly related to the predictors or the mediator and was therefore not included as a covariate.

ducted on this model. Similarly, the model with openness was not examined, as this trait was unrelated to both uncontrolled eating and ToD preference, $rs < -.05$.

Extraversion significantly predicted ToD preference, $\beta = .22$, $t(274) = 3.94$, $p < .001$ ($R^2 = .15$, $F[3, 274] = 15.79$, $p < .001$), contrary to our hypotheses. However, as expected, extraversion also negatively predicted uncontrolled eating, $\beta = -.14$, $t(274) = -2.32$, $p < .05$. After ToD preference was added to the model ($\Delta R^2 = .03$, $F[4, 273] = 4.24$, $p < .01$), it related to uncontrolled eating above and beyond extraversion, $\beta = -.17$, $t(273) = -2.67$, $p < .01$, and the relationship between extraversion and uncontrolled eating dropped to nonsignificance, $\beta = -.10$, $t(273) = -1.67$, $p = .10$. The confidence interval around the indirect effect ($-.02$, $SE = .01$) did not contain zero (95% CI [$-.058$, $-.008$]), revealing that ToD preference mediated the relation between extraversion and uncontrolled eating.

3.2.2. Restrained eating

We then examined the models predicting restrained eating. Only the trait of extraversion was related to this outcome, therefore the remaining models are not described in detail. Extraversion predicted both ToD preference (see above) and restrained eating, $\beta = .22$, $t(274) = 3.81$, $p < .001$. When all three were entered into the mediational model ($\Delta R^2 = .02$, $F[4, 273] = 6.46$, $p < .001$), ToD preference related to restrained eating above and beyond extraversion, $\beta = .15$, $t(273) = 2.40$, $p < .05$. Although the relationship between extraversion and restrained eating remained significant, $\beta = .19$, $t(273) = 3.18$, $p < .01$, the confidence interval around the indirect effect (.02, $SE = .01$) did not contain zero (95% CI [.002, .034]), indicating that ToD preference partially mediated the relation between extraversion and restrained eating.

Two additional models are not described because the direct effects were nonsignificant. However, the indirect effects of the following models were tested and shown to be statistically significant: conscientiousness, ToD preference, and restrained eating (.02, $SE = .01$, 95% CI [.004, .038]); neuroticism, ToD preference, and restrained eating ($-.01$, $SE = .01$, 95% CI [$-.031$, $-.004$]).

3.2.3. Emotional eating

Because ToD preference was not related to emotional eating ($r = -.07$) the models with that eating outcome were not tested. In sum, these models indicate that ToD preference partially mediated the relationship between the Big Five factors and eating behavior, primarily uncontrolled eating.

4. Discussion

The current study is the first research to test mediational models of the relationship between personality and eating behavior. Past work has shown that both personality factors and time-of-day preference are associated with eating behaviors (Elfhag & Morey, 2008; Schubert & Randler, 2008). However, the current study indicates that time-of-day preference, in part, accounts for personality differences (conscientiousness, neuroticism, and extraversion) in these eating behaviors, primarily uncontrolled eating. The indirect effects in combination with the mediational models suggest that future work might benefit from including time-of-day preference when examining eating behaviors.

Additionally, our findings were consistent with past research such that conscientiousness, agreeableness, and extraversion were negatively related to unhealthy eating behavior (e.g., uncontrolled eating), and neuroticism was positively related to unhealthy eating behavior. Morningness was also positively related to healthy eating behavior (i.e., restrained eating) and negatively related to unhealthy eating behavior. Finally, participants high in conscientiousness, agreeableness, and extraversion expressed a morning preference, whereas participants high in neuroticism expressed an evening preference. These findings supported most of our preliminary predictions and further substantiate the interrelationships between personality, time-of-day preference, and eating behavior.

As mentioned in the introduction, Kanerva et al. (2012) integrated findings from previous research and proposed an underlying biological mechanism that may explain why time-of-day preference is a mediator in the current research. The workweek is a time when an individual's sleep-wake cycle can be impacted because many jobs require specific time commitments (Roenneberg et al., 2007). When this cycle is disrupted, which has been shown to be common for individuals with an evening preference (Kanerva et al., 2012), it can negatively influence an individual's circadian rhythm and health (Knutson et al., 2007). Based on the results of the current study, we further posit that this underlying biological mechanism, in part, drives the relationship between the personality factors and eating behavior. That is, circadian rhythm disruptions, commonly seen in individuals with an evening preference, might be the force causing time-of-day preference to partially mediate the relation between personality traits and eating behavior. Future research should test this mechanism to examine if changes in one's sleep-wake cycle are driving the current models.

Of course, not all of the personality and eating behavior relationships can be accounted for by time-of-day preference. In fact, time-of-day preference was unrelated to some eating outcomes that were marginally or significantly associated with personality factors (e.g., BMI and emotional eating). There are many other factors that can contribute to an individual's eating behaviors, such as socio-economic status or environmental factors (Taylor, Evers, & McKenna, 2005), and time-of-day preference is only one of the many factors that predicts dietary behavior.

4.1. Limitations and future research

One of the primary limitations of the current research is the fact that we did not examine actual food and nutrient ingestion as was done in Kanerva et al. (2012). While designing this study, we decided to focus solely on the three-factors of eating because they have been associated with specific food consumption. For instance, de Lauzon and colleagues' (2004) comprehensive study focusing on food intake showed that restrained eaters tend to consume more healthy foods (e.g., fish, low-fat foods, green vegetables). Conversely, uncontrolled eaters tend to consume unhealthier, energy-dense foods (e.g., fat, potatoes, salty foods), whereas emotional eaters tend to consume more oleaginous foods (e.g., cakes, pastries, biscuits). Although our conclusions are somewhat limited because we did not directly examine nutrient ingestion, these established connections suggest that actual food consumption will fit into the current mediational models, particularly the consumption of unhealthier, energy-dense foods.

An additional limitation of the current study is that those high in extraversion expressed a morning preference. Although some studies have shown that extraversion and time-of-day preference have a positive correlation (e.g., Hogben, Ellis, Archer, & von Schantz, 2007), these positive correlations are not typically significant. This finding runs counter to Adan and colleagues' (2012) review that concluded extraversion is often correlated with eveningness, but these correlations are not typically significant when using the Big Five Inventory's trait of extraversion. It has been suggested that differences in the relation between personality and time-of-day preference can be attributed to both the different theoretical models used in various personality inventories (Tsaousis, 2010) and the different measures used to assess circadian typology (Randler, Gomà-i-Freixanet, Muro, Knauber, & Adan, in press). For instance, different measures of personality

focus on subcomponents of extraversion (e.g., impulsivity), which most likely contribute to the fluctuating relation between extraversion and time-of-day preference (Adan et al., 2012). To our knowledge we are also the first study using the 60-item NEO-FFI-3 (Costa & McCrae, 2008) in a study with time-of-day preference. This 60-item measure includes the facet of *activity*,[2] not *impulsivity*, which research suggests may drive the relationship between extraversion and morningness (Muro, Gomà-i-Freixanet, & Adan, 2009). Studies should explore the different facets of extraversion and also compare different samples (e.g., student versus non-student samples) to best determine how this trait relates to time-of-day preference.

Finally, this research was necessarily correlational, cross-sectional, and focused on self-report measures. Although these designs are typical in time-of-day preference and personality research, future work should utilize longitudinal designs and incorporate observational methods to assess these constructs. We also must note that our self-report BMI results should be interpreted with caution, as individuals may misreport their height and weight. More importantly, with some research demonstrating a relation between time-of-day preference and BMI (Roenneberg, Allebrandt, Merrow, & Vetter, 2012), future research should further investigate the relation between time-of-day preference and BMI. Future work should also examine other health-related behaviors using the current framework. For example, the Big Five personality factors and time-of-day preference have been shown to be associated with other health-related behavior, such as tobacco use, as well as excessive alcohol and drug use (e.g., Bogg & Roberts, 2004; Prat & Adan, 2011). Future studies should test if time-of-day preference mediates the relationship between personality and these other health-related behaviors.

5. Conclusion

Adding to the previous literature, the current study revealed that time-of-day preference partially mediated the relationship between three of the Big Five personality factors (conscientiousness, neuroticism, and extraversion) and eating behavior, primarily uncontrolled eating. This study in combination with other research (Walker et al., 2014) shows the necessity of exploring models that include both personality traits and time-of-day preference. More importantly, this research indicates that future studies should investigate how time-of-day preference might account for personality differences in health-related behavior.

Conflicts of interest

We declare no conflicts of interest with respect to authorship and/or publication of this article.

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[2] The activity facet of the extraversion subscale (consisting of 3 items) showed the largest correlation with morningness ($r = .27$, $p < .001$), further substantiating this reasoning.