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Age, the Big Five, and time-of-day preference: A mediational model[☆]



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ABSTRACT

This research examined the extent to which the Big Five personality factors mediated the relationship between age and time-of-day preference. A sample of 491 Americans ($M_{\text{age}} = 32$ yrs) completed the 240-item NEO-PI-R, the 19-item Horne and Östberg's (1976) Morningness–Eveningness Questionnaire (MEQ), and provided demographic information. As demonstrated in previous research, correlations revealed that older people expressed a stronger morning preference. More importantly, using bootstrapping procedures, it was found that the Big Five factor of conscientiousness attenuated the relationship between age and time-of-day preference. These findings indicate that conscientiousness plays a significant role in the relationship between age and time-of-day preference.

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1. Introduction

Circadian rhythms are manifested in different ways, such as core body temperature. One of the most marked of these manifestations is morningness–eveningness preference, also known as a person's time-of-day preference. A person's time-of-day preference generally coincides with when they are physically and cognitively at their peak and therefore feel most alert, energetic, and capable (Kim, Dueker, Hasher, & Goldstein, 2002). These differences in time of peak arousal are responsible for the existence of what is known as morning and evening people. Those with a morning preference (often called larks) are more alert and aroused in the morning, whereas those with an evening preference (often called owls) are more alert and aroused in the evening.

Generally, people who have a morning preference tend to be more optimistic (Randler, 2008) and get better grades in school (Randler & Frech, 2006) than people with an evening preference. People who have an evening preference tend to be more creative (Giampietro & Cavallera, 2007) and intelligent (Roberts & Kyllonen, 1999), but are also more likely to abuse alcohol (Prat & Adan, 2011) than people with a morning preference. Indeed, as discussed at length in Cavallera and Giudici (2008), there are many life domains, both personal (e.g., health behaviors, emotional functioning) and interpersonal (e.g., work, family interactions) that are related to one's time-of-day preference. There are a multitude of factors that shape one's time-of-day preference. Previous research

has shown that genes account for approximately 50% of the variability that we observe in our time-of-day preference (Hur, 2007). Therefore, another 50% of the variability in time-of-day preference is a function of other individual difference factors, such as age and personality.

Most research on individual differences in time-of-day preference has necessarily been correlational (e.g., DeYoung, Hasher, Djikic, Criger, & Peterson, 2007; Randler, 2011). However, few, if any studies have examined mediational models to detect potential mechanisms that could elucidate why certain individual differences exist in time-of-day preference. The purpose of the current research is to assess if and how the Big Five personality factors mediate the relationship between age and time-of-day preference.

1.1. Age and time-of-day preference

The relationship between time-of-day preference and age has been relatively well-established. In their comprehensive review, Adan et al. (2012) noted that prior to age 12, people tend to have a morning preference. At the beginning of adolescence (12–15 yrs), morningness preference shifts to an evening preference, and this latter preference continues into the early 20s, at which time that evening preference subsides and a morningness preference gradually returns (e.g., Randler, 2008; Randler, 2011; Roenneberg et al., 2004). These shifts in time-of-day preference have been explained primarily by examining the relationship between age and physiological changes that people experience as they start adolescence, and subsequently, enter adulthood. For instance, there is an increased need for sleep due to the rapid growth during adolescence (Roenneberg et al.). Likewise, the onset of pubertal development ushers in a variety of hormonal and other physical

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changes that push back one's time-of-day preference to a stronger evening preference. For example, the release of melatonin occurs later in the day in adolescents than in adults leading to later onset of sleepiness and a later natural wake time (Carskadon, Acebo, Richardson, Tate, & Seifer, 1997).

There are also social factors that facilitate an evening preference during adolescence. For instance, parents may allow greater freedom to adolescents to set their own daily schedules and perform tasks at their preferred time of day. Furthermore, social demands, such as raising children and career demands, may force people to become more morning oriented. Of course, age is not the only individual difference factor that has been shown to relate to time-of-day preference.

1.2. Personality and time-of-day preference

In addition to age differences, researchers have examined the contribution of personality in time-of-day preference. A number of studies have examined the Big Five personality traits (agreeableness, openness to experience, conscientiousness, neuroticism, and extraversion) as predictors of time-of-day preference. As summarized in Adan et al. (2012), research in this area is somewhat equivocal about how certain traits are related to time-of-day preference. For instance, higher scores on neuroticism have, in some studies, been associated with an evening preference (e.g., Tonetti, Fabbri, & Natale, 2008), whereas in other studies (e.g., Hogben, Ellis, Archer, & von Schantz, 2007), there was no relationship detected between neuroticism and time-of-day preference. Using a meta-analytic approach, Tsaousis (2010) found that conscientiousness had a moderate relationship with a morning preference ($r = .29$), and agreeableness had a small relationship with a morning preference ($r = .13$). Openness, extraversion, and neuroticism each had much smaller relationships with an evening preference ($r_s = -.09, -.06$, and $-.07$, respectively). Therefore, as Adan et al. (2012) stated, "...conscientiousness showed a positive relationship to morningness and is considered the best predictor of morningness" (p. 1164).

1.3. Age and personality

Similar to age differences in time-of-day preferences, there are established age differences in personality. Lucas and Donnellan (2009), using a dataset of 12,618 respondents, found that as people age, they tend to score higher on measures of conscientiousness and agreeableness. Additionally, they found that extraversion, openness, and neuroticism were lower among older respondents. Subsequent research by Soto, John, Gosling, and Potter (2011) replicated these results in a sample of more than 1 million English-speaking people, though the relationship between age and extraversion was slightly weaker than in Lucas and Donnellan's work. Integrating the strengths of exploratory and confirmatory factor analyses with structural equation modeling, Marsh, Nagengast, and Morin (2013) largely replicated these two sets of results. However, they found that conscientiousness, which tended to increase precipitously through middle-adulthood, began to decline at around age 50. Lucas and Donnellan also noted that age differences in conscientiousness were not perfectly linear, with conscientiousness scores leveling-off (but not declining) at about age 50, and remaining constant until about age 70, when they began increasing again.

What may account for at least some of these age differences in personality? As people progress from early adulthood into middle age, they typically attend to at least two major life tasks, specifically, building career experiences and cultivating close relationships (Erikson, 1968). As Hogan and Roberts (2004) described in detail, being conscientious and agreeable would facilitate the

attainment of these two outcomes, partially explaining the positive relationships between age and these two personality traits. As people continue into middle- and late-adulthood, behavioral expressions of these traits would continue to facilitate professional and personal successes.

1.4. The current study

Prior research has established relationships between age and time-of-day preference, personality and time-of-day preference, and age and personality. Despite research establishing these relationships, we know of no research that has tested for mediators of the relationship between age and time-of-day preference. This study was designed to test the mediational role of the Big Five personality factors in the relationship between age and time-of-day preference. To investigate these relationships, participants completed a questionnaire measuring each of the Big Five personality factors (Costa & McCrae, 1992). Additionally, participants completed Horne and Östberg's (1976) Morningness–Eveningness Questionnaire (MEQ) to assess time-of-day preference. Consistent with previous research, we hypothesized that older participants would express a strong morning preference, whereas younger participants would express a stronger evening preference. Furthermore, with previous research suggesting that conscientiousness generally tends to increase with age (e.g., Lucas & Donnellan, 2009) and is strongly associated with a morning preference (e.g., Adan et al., 2012), we hypothesized that conscientiousness would mediate the relationship between age and time-of-day preference.

2. Method

2.1. Participants and procedure

This study had 491 participants (48% female), ranging in age from 17 to 71 yrs ($M = 32.45$ yrs, $SD = 15.29$ yrs). The sample was drawn from two groups of participants. The first group consisted of Introductory Psychology students attending a small liberal arts college in the Midwestern United States. Over the span of two semesters, 223 students completed the measures. These respondents ranged in age from 17 to 27 yrs ($M = 18.7$ yrs, $SD = 1.1$ yrs). One hundred nine students were female. Students received class credit for completing the survey, which was completed during a mass testing session at the start of each semester.

In addition, a sample of 268 people was drawn from an online social science survey service called StudyResponse: <http://www.studyresponse.net/index.htm>. These respondents ranged in age from 21 to 71 yrs ($M = 45.3$ yrs, $SD = 11.2$ yrs), and they completed the same materials as did the students. The online sample had 126 female participants. Online participants were compensated with \$8.00, distributed through Study Response. No data were collected from either sample regarding race or ethnicity.

In sum, 47% of our sample was aged 17–25; 6.2% was aged 26–30; 8.2% was aged 31–35; 8.3% was aged 36–40; 5.4% was aged 41–45; 7.0% was aged 46–50; 5.9% was aged 50–55; 7.7% was aged 56–60; 3.1% was aged 61–65; and 1.2% was aged 66 or older.

2.2. Measures

Participants first completed Costa and McCrae's (1992) 240-item NEO-PI-R measure of the Big Five personality factors. All responses were made using a 1 (*not at all descriptive of me*) to 7 (*very much descriptive of me*) range. There were 48 items that were averaged to form a score for each Big Five Factor. An example item for agreeableness is "I try to be courteous to everyone I meet" ($\alpha = .90$). An example item for openness is "I sometimes lose interest when

people talk about very abstract, theoretical matters (reverse-coded)" ($\alpha = .91$). An example item for conscientiousness is "I'm pretty good about pacing myself so as to get things done on time" ($\alpha = .93$). An example item for extraversion is "I'd rather vacation at a popular beach than an isolated cabin in the woods" ($\alpha = .92$). An example item for neuroticism is "I often get disgusted with people I have to deal with" ($\alpha = .93$).

Participants then completed Horne and Östberg's (1976) Morningness–Eveningness Questionnaire (MEQ) to measure time-of-day preference. The MEQ has been shown to correlate strongly with biological indicators of time-of-day preference, such as core body temperature and sleep patterns (Horne & Östberg, 1976), and is the most common measure of time-of-day preference (Adan et al., 2012). The MEQ contains 19 items, including "When you have no commitments the next day, at what time do you go to bed compared to your usual bedtime?" and "At what time in the evening do you feel tired and, as a result, in need of sleep?" Most questions are multiple-choice, and some questions ask participants to mark their response on a continuum; answers are then coded into numerical scores. Possible scores on the MEQ range from 16 to 86, with higher values representing a stronger morning preference, and lower scores representing a stronger evening preference. In the current data, scores ranged from 22 to 74.5 ($M = 49.4$, $SD = 9.9$, $Mdn = 49.0$, mode = 47.0, skewness = .074, kurtosis = $-.113$). In this study, internal reliability of the MEQ was .83.

2.3. Model

We proposed a model in which personality mediated the relationship between age and time-of-day preference (see Fig. 1 for a visual depiction of the model). For mediation to exist, the predictor variable (i.e., age) must be related to the criterion variable (i.e., time-of-day preference), and the potential mediating variable

(i.e., the Big Five personality factors) must be related to both the predictor variable and the criterion variable. We therefore first analyzed the zero-order correlations between these variables. To test the mediational model, we next ran bootstrapping procedures to discern which, if any, of the Big Five factors mediated the relationship between age and time-of-day preference.

Bootstrapping takes into account multiple variables as mediators and covariates not proposed as mediators during calculation. These considerations give this analysis an advantage over other mediational tests, as it is able to fully ascertain all the potential mediators in one equation, reducing the chance of error, and accounting for the network of relationships between variables (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2008).

3. Results

3.1. Zero-order correlations

Table 1 contains descriptive statistics and zero-order correlations. Consistent with previous research, age was related to time-of-day preference ($r = .41$), indicating that as expected, older participants indicated a stronger morning preference, whereas younger participants indicated a stronger evening preference. In addition, age was significantly correlated with each Big Five factor except for openness. Specifically, age was positively correlated with agreeableness and conscientiousness, and negatively correlated with neuroticism and extraversion. Finally, each personality factor was correlated with time-of-day preference. Specifically, people scoring high on agreeableness and conscientiousness expressed a morning preference, whereas people scoring high on openness, neuroticism, and extraversion expressed an evening preference.²

3.2. Mediational analyses

The strategy of using the Big Five personality traits as mediating factors allows us to see how each trait may influence the relationship between age and time-of-day preference. This model leaves open the possibility that the personality factors are themselves intercorrelated, as Table 1 reveals. Bootstrapping accounts for the interrelationship between potential mediating variables. To conduct our bootstrapping analyses, we used Preacher and Hayes' (2008) SPSS macro to test for multiple mediators. Using this bootstrapping analysis allowed us to test the influence of each individual mediating factor, as well as the effect that each mediating factor has in combination with the others (simultaneously testing multiple mediators). Participants' age was entered as the predictor variable, time-of-day preference (MEQ) was entered as the criterion variable, and agreeableness, openness, conscientiousness, neuroticism, and extraversion were entered as the proposed mediating variables.

Fig. 1 contains the results of our bootstrapping analysis. We used 5000 boot iterations and a 99% percentile confidence interval (CI). Results of the bootstrapping analyses showed that the total effect of age on time-of-day preference (.2651, $p < .001$) remained significant when the Big Five mediators were added (direct effect of age on time-of-day preference = .2095, $p < .001$). Therefore, age continued to be related to time-of-day preference when controlling for the Big Five. When the mediating factors were added into the model, the coefficient decreased, though it remained significant. The total indirect effect (total effect – direct effect = indirect effect)

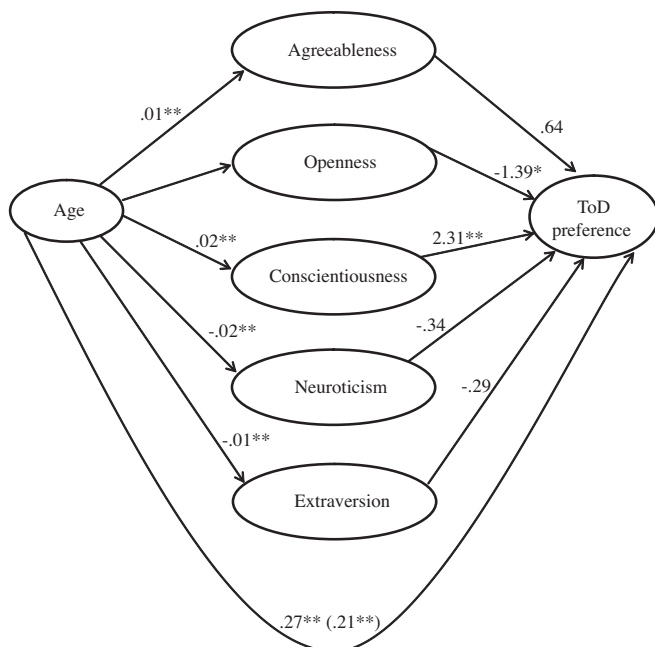


Fig. 1. Big Five personality trait mediators between age and time-of-day preference (ToD preference). Note: Path values represent regression coefficients from the bootstrapping analysis. The value outside of the parenthesis represents the total effect of age on MEQ before the mediating factors are taken into account. The value in parentheses represents the direct effect of age on MEQ after the mediating factors are added to the model, using Hayes and Preacher (2008) bootstrapping SPSS macro for multiple mediation. * $p < .05$. ** $p < .01$.

² We did not find sex differences in time-of-day preference; for women, $M = 49.41$, $SD = 9.99$; for men, $M = 49.46$, $SD = 9.81$; $t(488) = .058$, $p = .93$.

Table 1

Descriptive statistics and correlations between study variables.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6
1. Age	32.5 yrs	15.3 yrs	–					
2. Time-of-day preference ^a	49.4	9.9	.41**	–				
3. Agreeableness	4.83	0.67	.22**	.14**	–			
4. Openness to experience	4.61	0.73	–.03	–.11*	.26**	–		
5. Conscientiousness	4.84	0.77	.31**	.31**	.32**	–.05	–	
6. Neuroticism	3.55	0.80	–.33**	–.22**	–.33**	–.11*	–.51**	–
7. Extraversion	4.50	0.78	–.25**	–.10*	.22**	.35**	.07	–.30**

Scores on agreeableness, openness, conscientiousness, neuroticism, and extraversion could range from 1 (*low*) to 7 (*high*).^a Higher scores indicate a morning preference; lower scores indicate an evening preference.* $p < 0.05$.** $p < .01$.

of age on MEQ through the five mediating variables was not significant, with a point estimate of .0555 and a 99% bootstrap percentile CI of $-.0002$ to $.1075$.

We next examined the individual mediators. The indirect effects of the individual proposed mediating factors showed that agreeableness, with a point estimate of .0064 and a 99% percentile CI of $-.0122$ to $.0267$; openness, with a point estimate of .0019 and a 99% percentile CI of $-.0077$ to $.0147$; neuroticism, with a point estimate of .006 and a 99% percentile CI of $-.0275$ to $.0375$; and extraversion, with a point estimate of .0038 and a 99% percentile CI of $-.0245$ to $.0303$ were not unique mediators in this model. However, conscientiousness, with a point estimate of .0373 and a 99% percentile CI of .0087 to .0695 was a unique mediator.

In sum, our bootstrapping analysis indicated that the Big Five factor of conscientiousness attenuated the relationship between age and time-of-day preference.^{3, 4, 5}

4. Discussion

This study was designed to assess whether any of the Big Five personality factors mediated the relationship between age and time-of-day preference. As expected, it was found that older participants were more conscientious and agreeable, and expressed a morning preference. Younger participants were more neurotic and extraverted, and expressed an evening preference. In addition, we found that conscientious and agreeable people were both more likely to express a morning preference, whereas open, neurotic, and extraverted people were each more likely to express an evening preference. These results, with respect to age differences in time-of-day preference and age differences in personality, largely replicated prior research (e.g., Adan et al., 2012; Lucas & Donnellan, 2009). However, adding to the literature, we found that conscientiousness was a significant mediator between age and time-of-day preference. It is important to note that the relationship between

age and time-of-day preference was still significant after controlling for the Big Five personality factors. Using bootstrapping procedures, we showed that conscientiousness attenuated, but did not completely mediate, the relationship between age and time-of-day preference.

Consistent with previous research (see Adan et al., 2012; Cavallera & Giudici, 2008), the current study showed that age is a significant predictor of time-of-day preference. Why does time-of-day preference change with age? Previous research has shown that need for sleep influences the relationship between time of day preference and age (Randler, 2008). Additionally, the current study shows that the personality factor of conscientiousness also plays a role in this relationship. These findings are consistent with the life course perspective of personality that holds that there is an interaction between biological developments with changes to life circumstances as one ages (see Roberts, Wood, & Smith, 2005). As noted previously, conscientiousness may change as people begin their careers; certain behaviors, such as coming to work on time and completing tasks in a timely fashion, are expected (see Hogan & Roberts, 2004). It therefore follows that as one enters and builds a career, conscientious behaviors have to be displayed, which in turn can be seen in the relationship between conscientiousness, age, and time of day preference.

In addition, future work can explore how conscientiousness might play a role in other previously established relationships with time-of-day preference. Several studies have examined the relationship between time-of-day preference and health-related behaviors. Kanerva et al. (2012) examined the relationship between time-of-day preference and dietary habits. They found that people with an evening preference tended to eat less healthily in a number of ways than people with a morning preference. For instance, as compared with a morning preference, an evening preference was associated with greater alcohol and sugar consumption, and less consumption of whole grains, fruits, vegetables, and fish. Likewise, people with an evening preference ingested less protein, zinc, calcium, vitamin D, and riboflavin than did people with a morning preference (Sato-Mito, Shibata, Sasaki, & Sato, 2011). People with an evening preference also appear to be less physically active than people with a morning preference (e.g., Cavallera, Boari, Labbrozzi, & Del Bello, 2011). Additionally, a number of studies have documented that conscientiousness is associated with engaging in healthy behaviors. For instance, in a meta-analytic investigation of 194 studies, Bogg and Roberts (2004) found that conscientiousness was inversely related with excessive alcohol use, illegal drug use, unhealthy eating, risky driving, risky sex, tobacco use, and engaging in violent behavior. In addition to refraining from health-threatening behaviors, conscientious people tend to engage in health-enhancing behaviors, such as eating a nutritious breakfast (Reeves, Halsey, McMeel, & Huber, 2013) and engaging in physical exercise (Rhodes & Smith, 2006). One possible

³ Given we sampled from two groups of participants, we reran our bootstrapping analyses separately on each group. These separate analyses revealed conceptually identical results to those of the composite analysis presented. In the StudyResponse sample, conscientiousness emerged as a more powerful mediator than it did in the student sample. Specifically, in the student sample, conscientiousness had a point estimate of .0298 and a 99% confidence interval of .0038 to .0595. In the StudyResponse sample, conscientiousness had a point estimate of .0401 and a 99% confidence interval of .0102 to .0756.

⁴ Given Marsh et al.'s (2013) finding that conscientiousness may decline after about age 45 or 50, we tested for nonlinear relationships between age and conscientiousness. We were unable to detect any such relationships.

⁵ We examined age differences in MEQ by comparing those age groups noted in the Method section. A one-way ANOVA, with Bonferroni-corrected pairwise comparisons, revealed that participants aged 25 and younger expressed a stronger morning preference than all other age groups, all $ps < .01$, with the exception of the 26–30 year old age group, $p = .073$. This latter age group did not differ from any of the other age groups on MEQ scores.

extension of the current study is to examine a model in which conscientiousness predicts time-of-day preference, which in turn acts as a mediator between conscientiousness and healthy behaviors.

Indeed, Adan et al. (2012) established conscientiousness as the Big Five factor most strongly predictive of time-of-day preference. As Cavallera and Giudici (2008) reviewed in detail, time-of-day preference is a factor in adjusting to work shift schedules. For instance, on night shifts, a morning preference was associated with greater drowsiness than was an evening preference (Smith et al., 2005). However, given that conscientiousness is positively related to work values (Christopher, Zabel, & Jones, 2008), another extension of the current work might be to examine conscientiousness as a moderator of the relationship between time-of-day preference and work shift adjustment. Perhaps those high in conscientiousness are more easily able to adapt to working at their nonpreferred time of day.

The importance of respondent age in this study was inherently a limitation. We did not include participants younger than 17 yrs old. Some studies have focused on adolescent time-of-day preferences. These studies have typically found that starting at about age 12 or 13, people tend to shift from a morning preference to more of an evening preference (Adan et al., 2012; Cavallera & Giudici, 2008). However, if indeed conscientiousness levels tend to be lower among this age group than among the age ranges sampled in our research, as Marsh et al.'s (2013) work suggests, we would likely find the same pattern of results as we have presented herein. Similar to most other studies in the time-of-day preference literature, our data were cross-sectional and self-report. Certainly, a longitudinal design would provide a better foundation off of which to base causal inferences.

In summary, this research found that the Big Five factor of conscientiousness significantly attenuated older people's morning preference and younger people's evening preference. The remaining Big Five traits correlated with either morning preference (agreeableness) or evening preference (openness, neuroticism, and extraversion) but did not attenuate the relationship between age and time-of-day preference. Adding to previous research, conscientiousness' position as a mediator between age and time-of-day preference paves the way for future research to explore models in which conscientiousness plays a role in previously established behaviors associated with time-of-day preference.

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