Unearthing the "green" personality: Core traits predict environmentally friendly behavior

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Abstract

Pro-environmental attitudes and behaviors show substantial individual differences, and exploring their predictors can help reveal the origins of pro-environmental behavior. Basic personality traits may provide a partial explanation, but it is unclear which personality traits are reliably associated with pro-environmental behaviors. The current paper uses a specific type of environmental behavior, reducing greenhouse gas emissions, to clarify which personality correlates are most robustly associated with behavior, and to test mediation of those effects through attitudes. A large ($N = 345$) sample of United States adults representative in age, gender, and ethnicity completed the 100-item HEXACO personality inventory, a novel self-report measure of behaviors that reduce greenhouse gas emissions, and scales of environmental and political attitudes. Accounting for demographics, emissions-reducing behaviors were most strongly predicted by Openness, Conscientiousness, and Extraversion, and these effects of personality were mediated by attitudes towards the natural environment. These observations broaden the understanding of the etiology of environmental attitudes and behavior.

Keywords: personality, carbon footprint, environmental behavior, environmental attitudes, climate change

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Individual behaviors that negatively affect the environment, including driving cars, energy use, and diet, account for major ecological damage and are a threat to human society (IPCC, 2013). Many psychological factors predict individual environmental behaviors, including attitudes, values, and norms (e.g., Kaiser, Wölfing, & Fuhrer, 1999; Stern, 2000). Despite the established relationship between personality and behavior across diverse domains (e.g., Paunonen, 2003), basic personality traits (e.g., the Big Five; John & Srivastava, 1999) have been infrequently used as predictors of individual environmental behaviors, and in particular use of the HEXACO model (Lee & Ashton, 2004) is rare. Moreover, in addressing personality predictors of environmental behavior, none of the studies have focused on a critical component of environmentalism: individual actions that reduce greenhouse gas emissions (IPCC, 2013). The current paper advances our understanding of the personality bases of environmentalism by examining links between the widely used and psychometrically sound HEXACO personality framework and self-reported emissions-reducing behaviors, and tests whether environmental attitudes mediate the predicted effects.

Personality: A brief overview

Individuals differ on stable psychological features (Eysenck & Eysenck, 1985). These differences have been conceptualized at many levels, from broad temperaments of approach and avoidance motivation (Elliot & Thrash, 2002; Gray, 1981) to various taxonomies of personality traits. A vast literature on personality structure and assessment supports a descriptive theory of five broad and replicable personality traits, often labeled: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, and referred to as the 'Big Five' (John & Srivastava, 1999). Openness reflects rich, abstract thinking and an appreciation for variety and unusual experiences. Conscientiousness is indicated by high levels of self-discipline, respect for

duty, and desire for achievement. Extraversion is characterized by an energetic engagement with the world, sociability, and breadth of activities. Agreeableness is the tendency to value social harmony and getting along with others. Finally, Neuroticism is the tendency to experience negative emotions, such as anger, anxiety, and depression (McCrae & Costa, 1997). A six-factor model (HEXACO; Ashton & Lee, 2007; Ashton, Lee, & de Vries, 2014; Lee & Ashton, 2004) also demonstrates discriminant validity. The HEXACO model re-labels Neuroticism 'Emotionality' – although Emotionality and Neuroticism are not interchangeable (Lee & Ashton, 2004) – and identifies a sixth core trait, Honesty-Humility, which taps sincerity, fairness, greed avoidance, and modesty. Honesty-Humility shares variance with Agreeableness and Conscientiousness as conceptualized in Big Five models, and its inclusion as a separate factor contributes useful and unique personality variance when predicting attitudes and behavior (Lee & Ashton, 2005; Lee, Ashton, Ogunfowora, Bourdage, & Shin, 2010). Honesty-Humility (but not Agreeableness) predicts active cooperation and Agreeableness (but not Honesty-Humility) predicts non-retaliation (Hilbig, Zettler, Leist, & Heydasch, 2013). Each of the six HEXACO traits has demonstrated predictive validity through associations with life outcomes and behaviors (e.g., Caspi, Roberts, & Shiner, 2005). Personality can also be measured within traits, by fractionating each trait into facets (e.g., DeYoung, Quilty, & Peterson, 2007). This level of analysis can reveal the underlying components responsible for the main effect of traits. Below, we review the literature on core personality and environmental behavior.

Personality and environmental behavior

Core personality traits, such as the Big Five and HEXACO dimensions, are promising candidates for individual differences predictors of environmental behavior because they are cross-culturally reliable (McCrae & Costa, 1997), have excellent internal validity, and may partially determine factors such as attitudes. Broad models of environmental behavior (Kaiser et

al., 1999; Stern, 2000) situate basic personality earlier in the chain of causation than values, ideology, and attitudes. This causal hierarchy is supported by longitudinal evidence showing the enduring effects of early personality on outcomes later in life (e.g., Block & Block, 2006), and in particular by evidence that early temperament (e.g., in 3-year-olds) predicts later values, attitudes, and behaviors before those constructs could have existed for the individual (e.g., Caspi & Silva, 1995; Slutske, Moffitt, Poulton, & Caspi, 2012). This path structure is also consistent with common theorizing within the personality literature (e.g., McCrae & Costa, 1999). Therefore, empirical papers can seek to test path models between core personality, intermediate levels of attitudes, values, and beliefs, and then behavior. Next we summarize findings on which personality traits predict environmental behavior. Each association is zero-order and $p < .05$ unless otherwise stated.

There is a strong argument for how Openness relates to environmentalism. Openness is characterized by flexible, abstract thinking, exactly what is necessary to imagine long-term and long-distance environmental consequences such as those associated with climate change. Openness also has a component of counterculture. Since the status quo is damaging the environment, becoming concerned about the environment means rejecting the is-ought fallacy that the way things currently are reflects the way they should be. This step requires intellect and alternative thinking. In line with this logic, Openness has shown the most robust links to environmentalism. In three studies and five samples (Hilbig, Zettler, Moshagen, & Heydasch, 2012; Hirsh & Dolderman, 2007; Markowitz, Goldberg, Ashton, & Lee, 2012), Openness showed moderate associations (rs = .23-.46) with environmental intentions, goals, or self-reported behavior. The first hypothesis is based on these findings. H1: *Of the core personality traits, Openness will show the strongest unique prediction of emissions-reducing behavior.*

The other core personality traits have shown mixed results. One study reported a significant effect for Conscientiousness, $r = .14$ (predicting electricity conservation; Milfont & Sibley, 2012, Study 2). This report is atypical because it contains the only study in which Openness was non-significant as a predictor of behavior. Two studies reported small or inconsistent effects of Conscientiousness on environmental concern (Hirsh, 2010) and self-reported environmental behavior (Markowitz et al., 2012); another report contained one study with no effect on behavior and a second with a moderate relationship, $r = .22$ (Hilbig et al., 2012). Despite expectations that duty and self-discipline would relate to conservation behaviors, previous work has fallen short of delivering strong evidence for Conscientiousness. For Extraversion, two samples using structural equation modeling and accounting for the other traits showed that Extraversion predicted environmental behavior at $r = .20$ and in a second sample $r = .31$ (correlation coefficients between latent factors; Hilbig et al., 2012). In a study using multiple measures of Extraversion across two samples, Extraversion correlated with environmental behavior at the zero-order level at rs $= .04-.19$ (Markowitz et al., 2012; several correlations *n.s.*). In another study, there was no significant relationship between Extraversion and environmental goals, $r = .09$, *n.s.* (Hirsh & Dolderman, 2007). Overall, there is moderate evidence for a unique contribution for Extraversion.

Agreeableness is also linked with environmental behavior. The personality framework in each study is noted below since Agreeableness in the Big Five and HEXACO are not equivalent. Unlike Big Five Agreeableness, which broadly taps motivation for social harmony, concern for others, and cooperation, HEXACO Agreeableness does not contain elements of empathic concern or humility/modesty (the latter is tapped by HEXACO Honesty-Humility), and so the HEXACO arguably provides a more focal measure of pure Agreeableness than the Big Five. Within the HEXACO framework, HEXACO Agreeableness can be viewed as capturing common

variance among characteristics including forgivingness, gentleness, flexibility, and patience, whereas HEXACO Honesty-Humility can be viewed as capturing common variance among characteristics including sincerity, fairness, greed-avoidance, and modesty. One paper found a strong effect of Big Five Agreeableness on environmental goals, $r = .31$ (Hirsh & Dolderman, 2007), and another set of three studies using an abbreviated Big Five personality scale observed that Agreeableness modestly predicted electricity conservation, $r = .15$ (Milfont & Sibley, 2012, Study 2). Using the HEXACO, one paper reported $r = .30$ for Agreeableness (Hilbig et al., 2012, Study 1). However, that same paper reported a sample with no effect for HEXACO Agreeableness (Hilbig et al., 2012, Study 2), and another paper using both HEXACO and Big Five measures found no relationship with Agreeableness across two samples (Markowitz et al., 2012). This pattern of results may indicate that Big Five Agreeableness is more robustly associated with environmentalism, although this account does not fully explain the mixed results to date (e.g. Markowitz et al., 2012 report a null association for Big Five Agreeableness).

The role of Honesty-Humility is unclear. In one report, it correlated with environmental behavior $r = .41$ and $r = .42$ in two samples and accounted for more variance than all of the other traits combined (Hilbig et al., 2012); however, in the only other study using the HEXACO, Honesty-Humility showed no relationship with environmental behavior (Markowitz et al., 2012). Potential explanations include that the German vs. United States populations have meaningful differences; that the behavioral measures between the studies tapped different types of environmental behavior; and that because Hilbig et al. (2012) did not control for age or gender in their analyses, but Markowitz et al. (2012) did, it's possible that the relationship between Honesty-Humility and environmental behavior is a cohort effect. Another report measured the Big Five and also added a Honesty-Humility trait, creating a mix of the two approaches, and found that Honesty-Humility, Agreeableness, and Openness each predicted environmental

concern (Sibley et al., 2011). The second hypothesis is based on the existing results concerning Agreeableness and Honesty-Humility. H2: *Agreeableness and Honesty-Humility are expected to uniquely predict environmental behavior accounting for the other personality traits.* More specifically, we expected Honesty-Humility to relate more strongly than Agreeableness to pro-environmental behavior because Honesty-Humility reflects the lack of exploitation of others. In contrast, HEXACO Agreeableness most closely reflects the lack of retaliation (Hilbig et al., 2013). Next, we turn to individual differences beyond the Big Five and HEXACO frameworks, and their associations with environmental behavior.

Values, attitudes, and environmental behavior

Environmental attitudes are a key individual difference that predict behavior. As mentioned above, broad models of environmental behavior place attitudes at an intermediate casual step later than personality and values and earlier than behavior (e.g., Kaiser et al., 1999; Stern, 2000). There is substantial empirical evidence for a mediating role of attitudes between personality and behavior (Conner & Abraham, 2001) and between values and behavior (Milfont, Duckitt, & Wagner, 2010). The second paper included samples from three countries, which boosts the external validity of this claim. The third hypothesis is based on this framework and evidence. H3: *Environmental attitudes will mediate the relationships between personality traits and environmental behavior.*

Two validated self-report attitude scales show consistent associations with environmental behavior (e.g., Hirsh & Dolderman, 2007; Markowitz et al., 2012, Study 2). The New Ecological Paradigm (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000) measures environmental values and concern, and the Connectedness with Nature Scale (CNS; Mayer & Frantz, 2004) measures emotional connectedness with the natural world, and is less reflective and cognitive than the NEP. In studies where both scales are included and their common effects partialled out, the more

affective CNS appears to more strongly predict environmental behavior than the more reflective and cognitive NEP (Mayer & Frantz, 2004), which reinforces the importance of affective values in the etiology of environmental behavior. Many other environmental values measures appear in the literature, and the focus in the current paper on these two scales is because previous work suggests they provide sufficient coverage to explain the relationship between personality and behavior. In Markowitz et al. (2012, Study 2), the relationship between Openness and environmental behavior was mediated by the NEP and CNS. In Hilbig et al. (2012), the relationship between Honesty-Humility and ecological behavior was partially mediated by a related attitudes scale. In addition, Agreeableness and Openness were the strongest trait predictors of environmental concern in a large sample of German adults (Hirsh, 2010). These results show that core personality partially drives environmental attitudes and beliefs. When investigations of environmental behavior include attitude and belief measures, these studies can help verify broad models that explore the proximate and distal causes of environmental behaviors.

Besides personality traits and environmental attitudes, previous research on pro-environmental behavior has also examined the role of socio-demographic variables such as political orientation (e.g., Costa & Kahn, 2013; Gromet, Kunreuther, & Larrick, 2013). Political conservatism predicts lower concern for the natural environment, even after accounting for demographic variables related to political orientation such as age and gender (Allen, Castano, & Allen, 2007; Dunlap, Xiao, & McCright, 2001), and it also predicts less environmental behavior (e.g., Gromet et al., 2013). However, the unique predictive value of political orientation for behavior has not been demonstrated, because personality, political orientation, environmental attitudes, and behavior have not yet been modeled together. Personality and environmental attitudes may partially account for the effects of political orientation on environmental behavior.

Next, we explore the limitations of the existing literature on individual actions that affect the natural environment.

Environmental behavior

Pro-environmental behavior is multidimensional and perhaps too diverse to measure in a brief self-report scale (Balderjahn, 1988; Diekmann & Preisendörfer, 1998; Stern, 2000). Environmental behavior spans dissimilar actions such as using fabric softener during laundry (Hilbig et al., 2012) and working from home (Markowitz et al., 2012). Covering just private environmental actions is challenging with a brief measure (e.g., Kaiser et al., 1999), and therefore existing behavioral scales lack comprehensive content coverage, and may be more heterogeneous between papers than they first appear. The goal in the current study of introducing a novel behavioral scale was to specify a face-valid type of pro-environmental behavior that is of interest to public policy. Emissions-reduction is one of the most important aspects of individual environmentalism (IPCC, 2013). Emissions-reducing behaviors uniquely span diverse types of environmental actions (transportation, diet, energy use) while still belonging to a coherent category. The new scale therefore has the potential to increase construct coverage and validity.

Current study

Previous work provided important insights into which personality traits might predict individual differences in emissions-related behaviors, but this is the first study to directly test the question. A large, geographically diverse United States sample reported their personality with the 100-item HEXACO-PI-R, a psychometrically sound and well-established instrument (Lee & Ashton, 2004) that allows for facet-level analyses, and then completed a novel and meaningful measure of environmental actions: emissions-reducing behavior (see below).

In addition to the three hypotheses, demographics will be used to test for cohort effects, facet-level results will be compared to previous research, and the first examination in this

literature of 2-way trait interactions will be reported. These results will clarify the predictive power of each trait for emissions-reducing behavior and inform the mixed literature on the role of Honesty-Humility.

Material and Methods

Participants and procedure

345 United States adults completed an online survey through Amazon MTurk. Student populations have narrow geographic and age range and poor external validity for many psychological inquiries (Henrich, Heine, & Norenzayan, 2010). MTurk samples can improve external validity through more representative population sampling, and many classic effects are reliable across MTurk samples (Berinsky, Huber, & Lenz, 2012; Mason & Suri, 2012). The current sample was diverse compared to most student samples: $M(SD)_{Age} = 36.7(13.2)$ years; 53.3% female; 80.0% White, 5.8% Black, 6.7% Asian, 5.2% Latino, and 2.3% Other; modal education = Bachelor's degree (36.8%); and modal household income = $25,001-$60,000 (42.0%). Improving on previous studies that relied on a single region, Internet Protocol addresses revealed the sample spanned 47 US states and no one participated from a non-US location (MaxMind, Inc., 2013). Fifty-five additional participants did not complete the outcome measure and were excluded. This drop-out rate is typical for surveys with modest payment. To ensure a large sample, we aimed for a sample size of 300+ after exclusions, and finalized data collection before hypothesis testing.

Measures

Personality. Participants first completed the 100-question HEXACO-PI-R (Lee & Ashton, 2004), which assesses personality across six core traits and yields 24 sub-trait facets (see Tables 1 and 2 for reliability). Example item (Conscientiousness): "When working, I often set ambitious goals for myself", rated 1 (*Strongly disagree*) to 5 (*Strongly agree*). Reducing concern

about content overlap between personality and behavior, none of the items mention conservation or environmentalism, and only one refers to nature ("Sometimes I like to just watch the wind as it blows through the trees" [Openness – Aesthetic Appreciation]). As noted above, the HEXACO trait items differ from the Big Five scales, but the constructs overlap considerably and recent work suggests similar trait relationships with environmental behavior (Markowitz et al., 2012), with the possible exception of Agreeableness (see above).

Attention check. Twenty-two participants (6.4%) failed a standard attention check consisting of a question ostensibly about what activities the participant enjoys. At the end of a long instruction block, participants were asked to ignore the question, select "Other", and write a specified word to demonstrate they were paying attention (Oppenheimer, Meyvis, & Davidenko, 2009, Study 1). Carelessness in questionnaire response (defined as ≥ 5 consecutive repeated values) was uncorrelated with failing the attention check, $r(346) = .02, p = .78$, and there was no difference on visual inspection in the length or quality of written responses between individuals passing or failing the attention check. Finally, the main results did not substantively change when those who failed were excluded. The attention check appeared not to yield useful discrimination, so all participants were retained.

Environmental Attitudes and Values. Next, participants reported their attitudes and values regarding the environment with two scales. The 15-item New Ecological Paradigm (NEP; Dunlap et al., 2000) is a widely used attitudes measure, with items such as: "Humans are severely abusing the environment" and "The earth has plenty of natural resources if we just learn how to develop them" (reversed), 1 (*Strongly disagree*) to 5 (*Strongly agree*), Cronbach's alpha = .90. The 14-item Connectedness with Nature Scale (CNS; Mayer & Frantz, 2004) taps affective as well as cognitive content with items such as: "I often feel a kinship with animals and

plants" and "I have a deep understanding of how my actions affect the natural world", rated 1 (*Strongly disagree*) to 5 (*Strongly agree*), Cronbach's alpha = .90.

Environmental behaviors: Reducing emissions. Fifteen behaviors were adapted from reports of how individual behaviors impact climate change (Carbon Footprint Ltd., 2012; IPCC, 2013) and from pilot studies, and items measuring personal frequency of those behaviors were combined into a scale (see also Brick, Sherman, & Kim, in preparation). Behaviors were included when they were repeated and accessible to a wide variety of demographics, for example: "How often do you walk, bicycle, carpool, or take public transportation instead of driving a vehicle by yourself?" and "How often do you eat meat?" (reversed), rated 1 (*Never*) to 5 (*Always*); see Appendix. Actions like buying a high-efficiency furnace or insulating the home were excluded, because although these have a significant impact on emissions, they are only applicable to homeowners and are infrequent, limiting their utility for tapping ongoing psychological processes in a diverse population. The previous literature demonstrates it can be difficult to identify individual differences measures of personality that stably relate to behavior. This novel behavioral measure targets repeated actions and each data point represents an average across many individual decisions, features which help to reveal trait effects (Fleeson, 2004). Behavior frequency ratings ranged from 2.15-3.93 with skew $|x| < 1.2$, although kurtosis ranged from 1.83-3.70. Principal components analysis with oblimin rotation yielded a single coherent factor explaining 24.1% of the variance, and Cronbach's alpha was .76. Participants also reported the frequency of performing five non-emissions environmental behaviors as a pilot for future studies (see Brick, Kim, & Sherman, in preparation), and they are not discussed here further.

Uncertainty. Two exploratory questions regarding participants' feelings of uncertainty did not show significant relationships with any key variables and are not discussed further.

Political orientation. Political orientation was measured as in the American National Election Studies (Center for Political Studies, 2013), and yielded a continuous rating from 1 (*Strong Democrat*) to 7 (*Strong Republican*).

Demographics, suspicion, and fluency check. Participants reported their age, gender, education, household income, and ethnicity, guessed at the goal of the research, reported any technical problems or comments, and wrote 1-2 open-response sentences to demonstrate fluency in English. All measures and conditions are reported above and no unreported studies or samples were excluded.

Results

Alpha was set at .01 for all tests to provide a more stringent threshold in light of multiple comparisons.

Trait correlations. All analyses below have 345 participants. Descriptive statistics and zero-order trait correlations are presented for the NEP, CNS, and emissions behavior to allow the full model to be reconstructed (see Table 1). All the HEXACO traits except Emotionality ($r =$ .07, $p = .22$) were positively correlated at the zero-order level with emissions-reducing behavior, rs $\geq .17$, ps $\leq .01$. Supporting H1, this association was most strongly observed for Openness, $r =$ .28, $p < .001$ (this value was not statistically tested against the other zero-order correlations).

Facet correlations. The average correlation between facets within personality traits was $r = .35$ (range = .14-.52), showing that the facets within each trait were overlapping but distinct. Next, we report the zero-order facet correlations with the NEP, CNS, and emissions behavior (see Table 2). At least one facet from each trait was significantly correlated with behavior. The one previous study with HEXACO facets reported significant zero-order Openness, Extraversion, and Conscientiousness facet correlations with emissions-reducing behavior (Markowitz et al., 2012), and the facet effects reported there partially overlap with those

observed here. The facet most associated with environmental behavior was Openness – Aesthetic Appreciation in both studies, Markowitz et al. (2012): $r = .42$, the current study: $r = .33$, ps < .001. Aesthetic Appreciation reflects the enjoyment of beauty in music, poetry, art galleries, and wind in the trees (see Measures).

Regression. A hierarchical linear regression explored which personality traits robustly predicted emissions-reducing behavior (see Table 3). In Step 1, the six HEXACO traits were entered, and Honesty-Humility, Extraversion, Conscientiousness, and Openness were the strongest predictors of behavior (βs = .13-.23, ts $\geq$ 2.3, ps $\leq$ .02). Contrary to H2, neither Agreeableness nor Honesty-Humility uniquely predicted behavior. The significant results are vulnerable to cohort effects, so in Step 2, age, gender, income, education, and political conservatism were entered as demographic covariates. These covariates help isolate the effects of personality, and none were significant unique predictors of behavior when accounting for core traits. Although political conservatism showed a correlational trend at the zero-order level with fewer emissions-reducing behaviors, $r = -.10$, $p = .08$, in Step 2 political conservatism did not predict behavior, $p = .21$. However, these covariates did reduce the effect of Honesty-Humility to non-significance, $\beta = .08$, $t = 1.29$, $p = .20$. Further supporting H1, Openness still uniquely predicted emissions-reducing behavior ($\beta = .23$, $t = 4.50$, $p < .001$), and Conscientiousness ($\beta = .13$, $t = 2.39$, $p = .02$) and Extraversion ($\beta = .13$, $t = 2.34$, $p = .02$) showed modest unique effects. In Step 3, mean-centered traits were combined to form interaction terms for Openness x Conscientiousness, Openness x Extraversion, and Conscientiousness x Extraversion. None of the interactions was significant, ps $\geq$ .66, nor did their inclusion alter the previous results.

Mediation. In a confirmatory analysis, the NEP and CNS were entered as potential mediators of the relationship between Openness (Cronbach's alpha = .87) and emissions-reducing behavior, using nonparametric bootstrapping (Preacher & Hayes, 2008) because it

offers several advantages including no distributional assumptions. All mediation effects are reported with unstandardized coefficients and the point and interval estimates are interpreted directly avoiding the terms 'full' and 'partial' as recommended by Hayes (2013). This analysis included the covariates of age ($B = .01, t = 2.66, p < .01$), female gender ($B = -.01, t = .27, p = .79$), ethnicity (White vs. Non-White; $B = -.08, t = -1.29, p = .20$), political orientation ($B = .02, t = 1.48, p = .14$), education ($B = .02, t = 1.11, p = .27$), and income ($B = .03, t = 1.34, p = .18$). 10,000 bootstrapped samples ($N = 345$) indicated that the effects of Openness on the NEP ($B = .21, t = 4.09, p < .001$) and the CNS ($B = .48, t = 9.45, p < .001$) were both significant. The effects of the mediators on behavior were also significant, NEP ($B = .13, t = 2.80, p < .01$) and CNS ($B = .26, t = 5.58, p < .001$). As hypothesized, the NEP and CNS mediated the effect of Openness on behavior: the indirect effect of Openness on behavior was significant ($B = .15$, 95% CI: .10-.21), but the direct effect accounting for the mediators was not ($B = .06, t = 1.44, p = .15$, 95% CI: -.02-.15; overall model $R^2 = .28$). Participants who were high in Openness held positive environmental attitudes and performed more behaviors to reduce emissions, and this effect was mediated by environmental attitudes, supporting H3 (see Figure 1).

In an exploratory analysis, we tested a second mediation model using Conscientiousness for the predictor (Cronbach's alpha = .84), again including the covariates of age ($B = .00, t = 2.34, p = .02$), female gender ($B = -.03, t = .50, p = .62$), ethnicity (White vs. Non-White; $B = -.09, t = -1.44, p = .15$), political orientation ($B = .01, t = .93, p = .35$), education ($B = .02, t = 1.12, p = .26$), and income ($B = .03, t = 1.14, p = .25$). 10,000 bootstrapped samples ($N = 345$) indicated that the effects of Conscientiousness on the NEP ($B = .19, t = 2.93, p < .01$) and the CNS ($B = .22, t = 3.15, p < .01$) were both significant. The effects of the mediators on behavior were also significant, NEP ($B = .12, t = 2.52, p = .01$) and CNS ($B = .28, t = 6.51, p < .001$). The NEP and CNS mediated the effect of Conscientiousness on behavior: the indirect effect of

Conscientiousness on behavior was significant ($B = .08$, 95% CI: .03-.14), and the direct effect accounting for the mediators was still significant ($B = .15$, $t = 3.11$, $p < .01$, 95% CI: .05-.24; overall model $R^2 = .29$). Participants who were high in Conscientiousness also held positive environmental attitudes and performed more behaviors to reduce emissions, and this effect was mediated by environmental attitudes, supporting H3 (see Figure 2). To follow-up on the marginal effect of Extraversion, an exploratory mediation was also run for Extraversion. It revealed a direct effect on behavior, $B = .13$, $p < .001$, and a weak indirect path through the NEP and CNS, $B = .04$, entirely accounted for by the CNS, reflecting that about a third of the marginal total effect of Extraversion on behavior was mediated by the CNS. Please contact the first author with requests for data.

Discussion

We examined the role of personality in a critical type of environmentalism: emissions-reducing behavior. Openness and Conscientiousness independently predicted these behaviors, and their effects were mediated by pro-environmental attitudes. The finding for Openness is consistent with previous reports. However, only one paper reported a unique effect for Conscientiousness on environmental behaviors (Milfont & Sibley, 2012), and notably it included three large samples with diverse participants. The lack of other Conscientiousness findings may reflect the unique properties of emissions-reducing behaviors among other environmental actions, but may also be due to other samples having been geographically limited with potential restrictions in range on the independent and/or dependent variables. In the current study, significant zero-order correlations were observed of Emotionality, Agreeableness, and Honesty-Humility with emissions-reducing behavior, and in line with previous work distinguishing active cooperation from non-retaliation, the correlation of Honesty-Humility with behavior appeared larger than that for Agreeableness. However, these effects dropped out when controlling for the

other HEXACO traits and key demographics. Consistent with Markowitz et al. (2012), after controlling for age and gender, Honesty-Humility did not uniquely predict pro-environmental behavior. Because these results call into question previous reports of Honesty-Humility's unique role (i.e., Hilbig et al., 2012), we requested and were graciously provided access to both studies' data from Hilbig et al. (2012; data from personal communication). Using linear regression, Honesty-Humility still uniquely predicted environmental behavior when including age and gender as covariates, indicating that these mixed results for Honesty-Humility were not likely due to confounding age effects. Future research can explore other possibilities for the remaining discrepancy, including the different sample populations and environmental behavior scales. These results support H1, that Openness is a key predictor of emissions-reducing behavior, and provide evidence against H2, that Agreeableness or Honesty-Humility substantially predict such behaviors.

The current model revealed that interactions between Extraversion, Conscientiousness, and Openness did not improve predictions of emissions-reducing behavior. Each of the effects was non-significant, but not all possible interactions were tested. Further studies may choose to include trait interactions. Next, exploratory analyses were performed at the facet level, and the findings largely mirrored the factor-level zero-order correlation results, with facets from each domain correlating significantly with emissions-reducing behavior. There was no suggestion of facet-level suppression on trait-level effects. Brief personality scales that only measure traits appear sufficient for most future work on core personality traits in this area.

The facet associations can also help interpret the main results. The strongest facet predictor of emissions-reducing behaviors was Openness – Aesthetic Appreciation. In contrast, Openness – Unconventionality was uncorrelated with emissions-reducing behavior. This suggests that emissions-reducing behavior was not driven by low rebelliousness or contrariness,

as might be predicted under a model where environmentalism were partly an outlet for unconventional self-expression, and where such behavior would not reflect concerns with environmental issues beyond the need for a rebellious identity. Instead, the facet results revealed that pro-environmental behavior was predicted by appreciation and connection to the aesthetics and the natural environment. This finding, seen here and in Markowitz et al. (2012), reveals new research questions. We encourage researchers to use more detailed measures of aesthetic appreciation to further evaluate its relationship with environmental behavior and possibly identify differences between types of aesthetic targets (e.g., music; paintings). Mean shifts in personality traits are observed across the lifetime (Roberts, Walton, & Viechtbauer, 2006), so perhaps training in aesthetic appreciation such as the study of visual arts, even when thematically unrelated to nature, could increase pro-environmental behavior.

All of the Conscientiousness facets including Organization, Diligence, Perfectionism, and Prudence were significant predictors of emissions-reducing behavior, unlike in Markowitz et al. (2012). A few explanations are possible. A recent report shows Conscientiousness ratings for every US state, and it varies considerably (Rentfrow et al., 2013). The standardized scores in that report make it difficult to see if Oregon specifically has lower variance in Conscientiousness. Because the Markowitz et al. (2012) sample was entirely from the state of Oregon, that could have obscured variation in Conscientiousness facets through restricted range. However, Markowitz et al. (2012) kindly provided us with HEXACO means and standard deviations for their sample, and the values for Conscientiousness are closely overlapping with the current study (Markowitz, 2014; personal communication). Therefore, restricted range is not the explanation. Another possibility is that emissions-reducing behaviors are particularly self-sacrificing and characterized by less consumption, which contrasts with environmental behaviors that could be fun, for example attending "environmental rallies" (Markowitz et al., 2012, pp. 99). These

discrepancies reinforce the argument that covering even just private environmental actions is too ambitious for a brief measure, and suggest that previous behavioral scales may have lacked content coverage and are more varied between studies than they appear. The new scale presented here was not designed to integrate all of the previous findings, but rather to provide novel insight into emissions-reducing behaviors. A limitation of the current design is that measuring environmental attitudes before behavior could potentially have caused social desirability effects. This could compromise the direct interpretability of the means of reported behavior. However, universal increases of reported behavior would not have changed the trait findings.

The effect of Openness on emissions-reducing behavior was mediated by attitudes to the point where the direct effect became non-significant (this does not preclude the existence of additional, independent mediators). The relationship between the CNS, NEP, and environmental behavior was previously known. Incorporating the mediation results of Markowitz et al. (2012) and the current study suggest a new addition: these attitude scales meaningfully overlap with the personality construct Openness and its components, especially Aesthetic Appreciation. The effect of Conscientiousness was also mediated, but the direct effect remained significant, indicating that additional mediating variables are required to fully explain the effects of Conscientiousness on environmental behavior. Behaviors have such varied and complex causes that any effects of personality will likely be mediated and moderated by intervening individual differences (e.g., values, attitudes) and context (e.g., the presence of observers).

The lesser mediation of Conscientiousness by the NEP and CNS suggests these scales may not capture the full diversity of pro-environmental attitudes. A close examination reveals language that suggests classic, liberal environmentalism (e.g., "Like a tree can be part of a forest, I feel embedded within the broader natural world", CNS), and when they mention consequences they focus on harm and fairness, the hallmarks of liberal morality (Haidt, 2007; e.g., "Plants and

animals have as much right as humans to exist", NEP). These scales focus less on the moral

foundations associated with conservatism, such as purity, which includes concerns about

physical and spiritual contamination. We therefore call for new scales of environmental attitudes

that allow for different ways of relating to the environment. For example, a speculative scale

item that may better represent how conservatives relate to pro-environmental attitudes could be,

"When we pollute the earth, we pollute ourselves," and a potential item that might better mediate

Conscientiousness could read, "It is our duty to protect and conserve wildlife." New scales could

better mediate the effects of conservatism and high Conscientiousness on environmental

behaviors.

Recent studies have shown that congruency between environmental appeals and political

values can increase pro-environmental behavior (Feinberg & Willer, 2012; Gromet et al., 2013;

Kidwell, Farmer, & Hardesty, 2013). The current results showed no unique contribution of

political orientation for emissions-reducing behavior. Therefore, messages targeting personality

differences could be more effective than those based on political orientation. It is possible that

targeting high Openness and targeting Democrats could be aiming at the same people, but the

modest correlation between Openness and political conservatism in this sample ($r = -.14$, $p =$

.01) suggests they comprise distinct groups. The behaviors in the emissions-reducing scale do

not appear to signal environmental identity as strongly as attending environmental rallies, using

pro-environmental stickers, or driving a hybrid-electric car, all of which appear in previous work.

This weaker link between emissions-reducing behaviors and identity could explain the modest

effect of political conservatism above.

It would be unwise to generalize from these results to all cultures. Although the structure

of five or six personality traits appears universal and cross-culturally reliable (McCrae & Costa,

1997), the effects of personality on behavior may be expressed differently based on cultural and

social context. In an individualistic culture like the United States (Markus & Kitayama, 1991), higher Conscientiousness might predict certain kinds of environmental behavior, but in a collectivistic culture such as Japan, higher Conscientiousness could promote greater sensitivity to interpersonal harmony, and only predict environmental behavior when social norms reflect positive attitudes for such behavior. Thus, the effect of personality on environmental behavior could be moderated by social context. Different types of environmental behavior may even be predicted by different personality traits across populations, which could explain the mixed results for Conscientiousness between the current study and Markowitz et al. (2012). These observations open new avenues for research, and also create difficulty in interpreting results from geographically limited populations. A strength of the current study is the geographically diverse sample spanning 47 US states. Future studies are encouraged to use diverse samples and explore cultural effects through cross-cultural comparisons.

In summary, core personality traits predicted emissions-reducing behavior, in particular Openness and Conscientiousness, and these links were mediated by environmental attitudes. Political orientation had no unique contribution to predicting behavior, which suggests previous work focused on political orientation may have overlooked the relative importance of personality and environmental attitudes. Stable individual differences and social influence processes are both important for understanding and changing behaviors that affect the natural environment (see Fleeson, 2004), and core personality is a robust, reliable individual difference associated with environmental behavior.

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Table 1. *Means, standard deviations, reliability, and zero-order correlations between HEXACO traits, political conservatism, environmental attitudes, and emissions-reducing behavior.*

r(345)	H	Em	eX	A	C	O	Pol	NEP	CNS	EB
M	3.42	3.20	3.16	3.04	3.64	3.58	3.04	3.61	3.54	2.85
(*SD*)	(0.72)	(0.58)	(0.67)	(0.67)	(0.55)	(0.68)	(1.85)	(0.74)	(0.74)	(0.51)
Cronbach's alpha	.89	.80	.88	.88	.84	.87	*n/a*	.90	.90	.73
H		.11	.04	.29*	.31*	.11	-.08	.28*	.28*	.22*
Em			-.15*	-.07	.00	.00	-.12	.26*	.17*	.07
eX				.32*	.32*	.09	.09	-.05	.11	.22*
A					.13	.05	-.02	.06	.23*	.14*
C						.13	.10	.13	.17*	.25*
O							-.14	.24*	.47*	.28*
Pol								-.43*	-.22*	-.08
NEP									.57*	.36*
CNS										.47*

Note. * $p \leq .01$. Alpha = .01 to provide a more stringent threshold in light of multiple comparisons. H = Honesty-Humility, Em = Emotionality, eX = Extraversion, A = Agreeableness, C = Conscientiousness, O = Openness, Pol = political conservatism, NEP = New Ecological Paradigm, CNS = Connectedness to Nature Scale, and EB = emissions-reducing behavior.

Table 2. *Means, standard deviations, and zero-order correlations of HEXACO facets with political conservatism, environmental attitudes, and emissions-reducing behavior (N = 345).*

	M (SD)	Cronbach's alpha	Pol	NEP	CNS	EB
H: Sincerity	3.29 (0.90)	.79	-.06	.19*	.19*	.17*
H: Fairness	3.48 (1.01)	.85	.02	.12	.15*	.21*
H: Greed avoidance	3.20 (0.97)	.80	-.08	.27*	.26*	.16*
H: Modesty	3.69 (0.79)	.75	-.17*	.33*	.28*	.11
Em: Fearfulness	3.12 (0.82)	.65	-.10	.16*	-.01	.00
Em: Anxiety	3.45 (0.85)	.71	-.11	.21*	.05	-.02
Em: Dependence	2.87 (0.81)	.71	-.07	.12	.12	.08
Em: Sentimentality	3.37 (0.81)	.69	-.06	.23*	.31*	.14
eX: Social self-esteem	3.72 (0.76)	.71	.06	.02	.07	.11
eX: Social boldness	2.82 (0.89)	.76	.05	-.04	.11	.18*
eX: Sociability	2.85 (0.92)	.81	.09	-.07	.11	.24*
eX: Liveliness	3.25 (0.89)	.81	.07	-.06	.05	.14
A: Forgiveness	2.67 (0.86)	.80	.02	-.03	.13	.08
A: Gentleness	3.26 (0.84)	.78	-.04	.12	.25*	.14
A: Flexibility	2.95 (0.78)	.66	-.02	.10	.25*	.14
A: Patience	3.29 (0.91)	.79	-.01	.02	.10	.08
C: Organization	3.52 (0.90)	.78	.10	.07	.11	.16*
C: Diligence	3.83 (0.74)	.78	-.01	.14*	.19*	.18*
C: Perfectionism	3.63 (0.65)	.58	.09	.14*	.18*	.25*
C: Prudence	3.57 (0.73)	.70	.09	.03	.01	.17*
O: Aesthetic Appreciation	3.55 (0.88)	.69	-.11	.30*	.51*	.33*
O: Inquisitiveness	3.65 (0.84)	.70	-.07	.14*	.32*	.20*
O: Creativity	3.59 (0.91)	.77	-.10	.17*	.36*	.25*
O: Unconventionality	3.54 (0.76)	.63	-.15*	.16*	.29*	.10

Note. * $p \leq .01$. Alpha = .01 to provide a more stringent threshold in light of multiple comparisons. Pol = political conservatism, NEP = New Ecological Paradigm, CNS = Connectedness to Nature Scale, EB = emissions-reducing behavior.

Table 3. *Hierarchical linear regression predicting emissions-reducing behavior* ($N = 345$).

Predictor	Step 1	Step 2	Step 3
		Standardized β (*SE*)	
Honesty-Humility	.13 (.06)	.08 (.06)	.08 (.06)
Emotionality	.08 (.05)	.06 (.06)	.06 (.06)
eXtraversion	.16* (.06)	.13 (.06)	.14 (.06)
Agreeableness	.03 (.05)	.05 (.06)	.05 (.06)
Conscientiousness	.13 (.06)	.13 (.06)	.13 (.06)
Openness	.23* (.05)	.23* (.05)	.24* (.05)
Age		.08 (.06)	.08 (.06)
Female		.04 (.06)	.04 (.06)
Education		.00 (.05)	.00 (.05)
Income		.07 (.05)	.07 (.05)
Political conservatism		-.06 (.05)	-.06 (.05)
Openness × Conscientiousness			-.02 (.06)
Openness × eXtraversion			.01 (.05)
Conscientiousness × eXtraversion			.00 (.05)

Note. * $p \le .01$. Alpha = .01 to provide a more stringent threshold in light of multiple comparisons.

Appendix

Emissions-reducing behaviors (Cronbach's alpha = .78), rated from: 1 (*Never*) to 5 (*Always*).

1. When you visit the grocery store, how often do you use reusable bags?
2. How often do you walk, bicycle, carpool, or take public transportation instead of driving a vehicle by yourself?
3. How often do you drive slower than 60mph on the highway?
4. How often do you go on personal (non-business) air travel? [reversed]
5. How often do you compost your household food garbage?
6. How often do you eat meat? [reversed]
7. How often do you eat dairy products such as milk, cheese, eggs, or yogurt? [reversed]
8. How often do you eat organic food?
9. How often do you eat local food (produced within 100 miles)?
10. How often do you eat from a home vegetable garden (during the growing season)?
11. How often do you turn your personal electronics off or in low-power mode when not in use?
12. When you buy light bulbs, how often do you buy high efficiency compact fluorescent (CFL) or LED bulbs?
13. How often do you act to conserve water, when showering, cleaning clothes, dishes, watering plants, or other uses?
14. When you are in PUBLIC, how often do you sort trash into the recycling?
15. When you are in PRIVATE, how often do you sort trash into the recycling?