nature human behaviour

SUPPLEMENTARY INFORMATION

https://doi.org/10.1038/s41562-017-0240-0

In the format provided by the authors and unedited.

Corrected: Author correction

Regional ambient temperature is associated with human personality

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Regional Ambient Temperature Is Associated with Human Personality

Supplementary Information

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Supplementary Methods

Study 1: City-Level Evidence from China (N = 5,587)

1. Participants

We used the snowball sampling technique[1] to recruit students from Chinese universities as our participants. This research project was approved by the Institutional Review Board of Peking University. Upon consenting to the study, participants received a password-protected link to the online survey, which was described as helping participants get to know themselves better. Participants completed a 40-item personality inventory (see below) and reported their age, gender, birthplace, ancestral home, and whether they had migrated to a different city from birth to college.

To preclude reverse causality, where certain personalities may cause individuals to migrate to cities with certain temperatures, we limited our sample to students who had spent the entirety of their pre-college youth in their birthplace. To rule out another alternative explanation—that parents with certain personalities chose to migrate to a certain city and then gave birth to children who resemble their personalities—we further limited the sample to participants whose birthplace matched their ancestral home (i.e., *jiguan*, the home of their patrilineal ancestors). Importantly, all results remained substantively unchanged without these exclusion criteria.

Together, this yielded a total of 5,587 qualified participants (42.4% females, M_{age} = 22.07, SD_{age} = 2.05). The participants were born and raised in 59 different cities which covered all provincial-level administrative divisions in continental China (Supplementary Table 1).

2. Measures

Supplementary Table 2 details the descriptive statistics of all variables.

Supplementary Table 3 details the bivariate correlations among individual-level variables.

Supplementary Table 4 details the bivariate correlations among city-level variables.

2.1 Personality.

To measure personality traits, we employed the 40-item Mini-Markers Scale (“For

each trait, please write a number indicating how accurately that trait describes you", from 1 = *extremely inaccurate* to 7 = *extremely accurate*)[2]. This scale is commonly used to assess the Big-Five personality dimensions. Each of the five dimensions consisted of eight items, whose internal consistencies were acceptable ($\omega_{t[\text{agreeableness}]} = .79$, $\omega_{t[\text{conscientiousness}]} = .88$, $\omega_{t[\text{emotional stability}]} = .85$, $\omega_{t[\text{extraversion}]} = .83$, $\omega_{t[\text{openness to experience}]} = .88$)[3].

Although the Big Five are commonly conceived as orthogonal dimensions, a wealth of evidence suggests that some of them are highly correlated. Indeed, several studies—including those that employed the Mini-Markers Scale—have demonstrated that agreeableness, conscientiousness, and emotional stability comprise a higher-level dimension named "Alpha", and extraversion and openness to experience comprise a second higher-level dimension named "Beta".[i] Alpha represents a socialization and stability factor, whereas Beta represents a personal growth and plasticity factor[4,5]. Consistent with this work, when we aggregated the Big Five into the higher-level Alpha and Beta, both superfactors demonstrated high internal consistency ($\omega_{t[\text{Alpha}]} = .89$, $\omega_{t[\text{Beta}]} = .90$).

The city-level mean scores of each of the seven personality factors are presented in Supplementary Table 1.

2.2 Meteorological indices.

For each of the 59 cities, the China Meteorological Administration provided us with city-level data of the mean values of meteorological indices across the latest available 40 years (1971-2010), including average annual mean ambient temperature (°C), average annual minimum ambient temperature (°C), average annual maximum ambient temperature (°C), average annual air pressure (hPa), and average annual wind speed (m/s).

In line with past research[6-8], we computed a "temperature demand" variable, |mean temperature – 22°C|, which measures the extent to which a city's ambient temperature deviates from the psychophysiological comfort optimum of 22°C (about 72°F). We then computed a "temperature clemency" variable by taking its negative, –|mean temperature – 22°C|. In other words, the further a city's temperature is from 22°C, the less clement (and more demanding) it is.

2.3 Control variables.

In light of prior research on geographic personality differences (e.g., subsistence style theory[9]; pathogen prevalence theory[10]), we sought to control for the effects of economic activities, subsistence strategy, and disease prevalence. Specifically, we collected city-level data for GDP per capita, subsistence indices, population density, and influenza incidence for at least ten years that overlapped with participants' childhood. To reduce the effect of idiosyncrasies of any particular year, we computed the mean value across those years for each of these control variables. In addition, we controlled for individual-level variables age, gender, and individual response style. Finally, because fluctuation in temperature might also affect personality (over and above mean temperature), we also controlled for the standard deviation of mean temperature for each city.

GDP per capita. We extracted GDP per capita data (1000 Chinese yuan) from *China Statistical Yearbook* for years 2004 to 2013 for each city. For each city, we computed the mean GDP per capita across the ten years.

Subsistence indices. We extracted rice-farming area and wheat-farming area data from *China Statistical Yearbook* for years 2000 to 2010. For each city, we computed the mean rice-farming area (m^2/person) and wheat-farming area (m^2/person) across these years. We note that only 44 of the cities had reliable rice-farming area data and only 47 of the cities had reliable wheat-farming area data. Together, 42 cities had both reliable rice-farming area and wheat-farming area data.

Population density. We extracted population data from *China Statistical Yearbook* for years 2000 to 2010. For each city, we computed its mean population across these years. Since *China Statistical Yearbook* does not have reliable information about population density (1000 people/km^2), we computed the mean population density for each city by dividing its mean population (1000 people) by the city's area (km^2).

Influenza incidence. We obtained influenza incidence data (per 1000 people) from the Chinese Center for Disease Control and Prevention for years 2004 to 2014 for each of the 59 cities. For each city, we computed the mean incidence of influenza across these years.

Individual response style. We also computed an "acquiescent response style" score for each participant based on his/her responses to the personality items of the Mini-Markers

Scale; this is to control for individual differences in response style, where individuals from cities with more clement temperatures may "consistently agree (yea-saying) or consistently disagree (nay-saying) with questionnaire items, regardless of their content"[11]. Specifically, we computed each person's level of acquiescence as their mean response to a set of 16 pairs of Mini-Markers items with opposite implications for personality[12]. Standard Mini-Markers item numbers[2] for the 16 pairs of opposite items are as follows: four positive and four negative items of agreeableness, four positive and four negative items of conscientiousness, four positive and four negative items of extraversion, "unenvious" and "envious" of emotional stability, "relaxed" and "touchy" of emotional stability, "creative" and "uncreative" of openness to experience, "intellectual" and "unintellectual" of openness to experience. For further details, see Soto et al. (2008, Appendix)[12].

Supplementary Table 5 details the city-level bivariate correlations among personality traits, meteorological indices, and control variables.

3. Multilevel Analyses with Temperature Clemency

3.1 City-level analyses.

For each city, we computed the average of each personality trait. As predicted, temperature clemency was positively correlated with both the Alpha and Beta superfactors ($r_{\text{Alpha}} = .37$, $p_{\text{Alpha}} = .005$; $r_{\text{Beta}} = .32$, $p_{\text{Beta}} = .012$), as well as with each of the Big-Five personality factors ($r_{\text{conscientiousness}} = .38$, $p_{\text{conscientiousness}} = .003$; $r_{\text{emotional stability}} = .39$, $p_{\text{emotional stability}} = .002$; $r_{\text{extraversion}} = .27$, $p_{\text{extraversion}} = .036$; $r_{\text{openness}} = .31$, $p_{\text{openness}} = .016$) except for agreeableness ($r_{\text{agreeableness}} = .19$, $p_{\text{agreeableness}} = .160$). Supplementary Figures 1-7 present the scatterplots of temperature clemency against each of the seven personality factors. In contrast, air pressure or wind speed was not significantly correlated with Alpha, Beta, or any of the Big Five (all $|r|$'s $< .16$, all p's $> .23$).

3.2 Multilevel analyses.

Since the 5,587 Chinese participants (level 1) were nested within the 59 cities (level 2), we conducted multilevel analyses to account for the statistical dependence within each city and the fact that different cities had different sample sizes[13,14]. Because our data represented more than 50 cities and there were at least 30 participants nested within each city,

standard sample size requirements for multilevel modeling procedures were satisfied[15]. In addition, the within-group agreement measure (r_{WG}) values of Alpha, Beta, and the Big Five were all larger than .80, all ICC(1)s were larger than .10, and all ICC(2)s were larger than .70, further justifying the use of multilevel modeling[16].

Following Talhelm and colleagues[9], we conducted random-intercept-fixed-slope multilevel models (see Supplementary Tables 6-12). First, we entered the individual-level variables age, gender, and individual response style. Second, we added the city-level temperature clemency. Consistent with the city-level correlational analyses, temperature clemency was positively associated with each of the seven personality factors: Alpha (B = .02, SE = .005, p = .001), Beta (B = .02, SE = .007, p = .001), agreeableness (B = .01, SE = .007, p = .044), conscientiousness (B = .02, SE = .006, p = .001), emotional stability (B = .03, SE = .008, p = .001), extraversion (B = .02, SE = .008, p = .009), openness to experience (B = .02, SE = .006, p < .001). Third, temperature clemency remained a significant predictor when we further controlled for city-level GDP per capita, average annual rice-farming area, average annual wheat-farming area, population density, and influenza incidence (all p's < .01). As a robustness check, we also computed another version of the "temperature clemency" variable as **-(**|minimum temperature - 22°C| + |maximum temperature - 22°C|**)**, which yielded substantively similar results (see Supplementary Table 13).

In light of the climato-economic theory of culture[7,8], we also examined the interaction effect between temperature clemency and GDP per capita for each of the seven personality factors (Alpha, Beta, and Big Five). Despite the large sample size of this study, multilevel analyses did not reveal any significant interaction effects (all p's > .36).

It is noteworthy that consistent with prior work[10], influenza incidence was significantly and negatively associated with Alpha, Beta, and each of the Big-Five personality factors (marginally significant for agreeableness (p = .09) and extraversion (p = .08)) in the full models.

3.3 Effect size calculation.

To compare the variance explained by each multilevel model, we used Ω_0^2 — the generalized R^2 for linear mixed effect models[17] — computed by the following R code:

1-var(residuals(*model*))/(var(model.response(model.frame(*model*))))

To compare the effect sizes of the predictor variables in each model, we calculated their standardized partial effect sizes using *t*-to-*r* transformation[18]:

$$r = \sqrt{\left(\frac{t^2}{t^2+df}\right)}$$

4. Machine Learning Analyses

In addition to multilevel analyses, we also conducted machine learning analyses to explore which of the variables were important predictors of personality. Machine learning is an increasingly influential statistical approach that deduces patterns from existing data. One popular machine learning method—"random forest"—is an ensemble learning method that operates by constructing many "decision trees" as base learners[19]. Through a multitude of permutations, this method explores all possible relationships between predictor variables (e.g., temperature clemency, age, gender) and the outcome variable (i.e., personality), and ranks the *relative importance* of each predictor variable in predicting the outcome variable[19-22]. Following IJzerman and colleagues[20,22], we used the method of *conditional random forest*, which corrects for errors internally and improves its predictive power at each iteration.[ii] Because of repeated sampling, this method reduces analytical biases and wields a high level of predictive accuracy. In short, conditional random forest is highly useful in identifying important predictors of the outcome variable.

To implement this method of conditional random forest, we used R packages "tree"[23], "lattice" [24], and "plyr"[25]. "mtry" is "the number of variables randomly sampled as candidates at each split"[26] and recommended to be the square root of the total number of predictors[20]. Following IJzerman and colleagues[20], we ran the analyses twice for each of the seven personality factors: first an original analysis (seed = 518, mtry = 3, trees = 1000) and then a replication (seed = 815, mtry = 3, trees = 1000). Running the analyses twice enabled us to ascertain model stability through a Spearman Rank correlation between the forests[20,22]. Results revealed that the models were stable (all *r*'s > .98).

Consistent with the results of multilevel analyses, conditional random forest analyses reliably identified temperature clemency to be an important predictor of each of the seven personality factors[20-22]. For the relative importance of each predictor variable, see Figure 3a and Supplementary Figures 8-12.[iii]

Study 2: ZIP-Code Level Evidence from the United States (N = 1,660,638)

1. Participants

We used data from 1,660,638 participants from 12,499 ZIP codes of the United States (65.3% female; M_{age} = 27.05 years, SD_{age} = 11.00; 17.0% with a college degree, 9.44% with a graduate degree). The data were collected from 2009 to 2015, as part of the Gosling-Potter Internet Personality Project[27]. This research project, including a waiver of parental consent, was approved by the Institutional Review Board of the University of Texas[12]. Potential subjects could find out about this noncommercial, advertisement-free website through search engines and unsolicited links on other websites. Upon submitting their responses, participants were presented with a customized personality evaluation.

We arrived at the above sample based on the following criteria. First, consistent with the Chinese data, participants must have chosen the United States as the country in which they spent most of their youth. Second, participants must have provided a meaningful U.S. ZIP code for the question "What is the ZIP-code/postal code of the place where you spent most of your youth?" Third, the ZIP code provided must have correctly matched their answer to the question "What state did you spend most of your youth?" Fourth, for the purpose of multilevel modeling[15], we only included youth ZIP codes that had at least 30 participants (as in the Chinese data). Fifth, in line with prior work[28], we only included participants between 16 to 60 years old due to the concern that older participants might be particularly susceptible to self-selection bias. Sixth, we only included participants who completed the study in English (as opposed to Dutch, German, or Spanish). Seventh, participants must have responded with "yes" to the question "Did you answer truthfully on all of these questions?" Lastly, participants must have responded with "no" to the question "Have you ever previously filled out this particular questionnaire on this site?"

2. Measures

Supplementary Table 14 details the descriptive statistics of all variables.

Supplementary Table 15 details the bivariate correlations among individual-level variables.

Supplementary Table 16 details the bivariate correlations among ZIP-code level

variables.

2.1 Personality traits.

To measure personality traits, we employed the widely-used 44-item Big Five Inventory (BFI)[29] (from 1 = *strongly disagree* to 5 = *strongly agree*). Each of the five dimensions demonstrated high internal consistency ($\omega_{t[\text{agreeableness}]} = .84$, $\omega_{t[\text{conscientiousness}]} = .86$, $\omega_{t[\text{emotional stability}]} = .88$, $\omega_{t[\text{extraversion}]} = .91$, $\omega_{t[\text{openness to experience}]} = .84$). As with the Chinese data, we aggregated the Big Five into the higher-level Alpha and Beta, both of which demonstrated high internal consistency ($\omega_{t[\text{Alpha}]} = .90$, $\omega_{t[\text{Beta}]} = .86$).

2.2 Meteorological indices.

For each of the 12,499 U.S. ZIP codes (which correspond to 8,102 cities in the 50 U.S. states and Washington D.C.), we collected meteorological data from www.usa.com, which records average ambient temperature (converted from °F to °C), average wind speed (converted from mph to meter/sec), and average humidity. According to the website, the temperature for each ZIP code was "calculated from the historical data of 18,000+ U.S weather stations for the period of time from 1980 to 2010", and "the humidity and wind speed information were calculated from data from 15,000 worldwide stations for the period of time from 1980 to 2010."

As in Study 1, we operationalized temperature clemency as –|mean temperature – 22°C|.[iv]

2.3 Control variables.

To control for potential confounding variables, we collected ZIP-code level data for GDP per capita (1000 U.S. dollar), population density (converted to 1000 people/km^2), the percentage of civilians employed in the primary sector (e.g., agriculture, forestry, fishing, hunting), the percentage of civilians employed in the secondary sector (e.g., construction, manufacturing), and the percentage of civilians employed in the tertiary sector (i.e., service). These data were sourced from the U.S. Census American Community Survey from 2000 to 2010. We computed the mean value across those years for each of the control variables.

As in Study 1, we again computed an "acquiescent response style" score to control for individual differences in response style. Following Soto et al. (2008, Appendix)[12], we

computed each person's level of acquiescence as their mean response to a set of 16 pairs of BFI items with opposite implications for personality (e.g., Item 1 = "Is talkative," vs. Item 21 = "Tends to be quiet"). Standard BFI item numbers for the 16 pairs of opposite items are as follows: 1 and 21, 6 and 16, 31 and 36, 2 and 17, 7 and 12, 27 and 42, 32 and 37, 3 and 43, 8 and 13, 18 and 33, 23 and 28, 9 and 19, 24 and 29, 34 and 39, 5 and 35, and 30 and 41.

3. Multilevel Analyses

Because our data represented more than 50 ZIP codes and there were at least 30 participants nested within each ZIP code, standard sample size requirements for multilevel modeling procedures were satisfied[15]. The within-group agreement measure (r_{WG}) values of Alpha, Beta, and the Big Five were all larger than .70, all ICC(1)s were larger than .10, and all ICC(2)s were larger than .70, further justifying the use of multilevel modeling[16].

Since the 1,660,638 U.S. participants (level 1) were nested within the 12,499 ZIP codes (level 2), we conducted multilevel analyses (as with the Chinese data). Supplementary Tables 17-23 present the detailed results. First, we entered the individual-level variables age, gender, education level, and individual response style. Second, we added the ZIP-code level temperature clemency, which was positively associated with each of the seven personality factors (all p's < .001, except that $p_{extraversion}$ < .05). Third, the effects of temperature clemency remained robust when we further accounted for the ZIP-code level control variables (all p's < .001). It is noteworthy that temperature clemency is the only meteorological variable that was consistently associated with each of the seven personality factors; for example, neither humidity nor wind speed was significantly associated with emotional stability (both p's > .25).

4. Machine Learning Analyses

Due to the unwieldy size of the U.S. dataset, we applied the conditional random forest method to randomly generated *subsets* of the data, which were of size N = 5,587 each to match the sample size of our Chinese data. Following IJzerman and colleagues[20], we again ran the analyses twice for each of the seven personality factors: first an original analysis (seed = 666, mtry = 3, trees = 1000) and then a replication (seed = 667, mtry = 3, trees = 1000). Running the analyses twice enabled us to ascertain model stability through a Spearman Rank correlation between the forests (all r's > .99). Consistent with the results of multilevel analyses,

temperature clemency was reliably identified as an important predictor of each of the seven personality factors[20-22]. For the relative importance of each predictor variable, see Figure 3b and Supplementary Figures 13-17.[v]

Supplementary Notes

[i] We note that although widely used, the "Alpha" and "Beta" distinction is not universally accepted. For example, Ashton and colleagues (2009) questioned the existence of Alpha and Beta as two superordinate factors, and instead advocated for the HEXACO Personality Inventory of six personality factors. Nevertheless, it is important to note that in both of our studies, temperature clemency has reliable effects not only on Alpha and Beta, but also on *each* of their subordinate constituents (i.e., agreeableness, conscientiousness, and emotional stability, and extraversion and openness to experience). This suggests that our findings are not merely an artifact of constructing Alpha and Beta as outcome variables.

[ii] Unlike *conditional* random forest, typical random forests are constructed in a training dataset and then validated in a testing dataset.

[iii] On an exploratory basis, we also conducted machine learning analyses to explore the effect of temperature clemency on individual response style. Consistent with prior research (Steinmetz & Posten, 2017), conditional random forest analyses (seed = 666, mtry = 3, trees = 1000; seed = 667, mtry = 3, trees = 1000) reliably identified temperature clemency to be an important predictor of individual response style.

[iv] While a key strength of Study 2 is its use of ZIP-code level climate data (i.e., the lowest level feasible), one side effect is that minimum temperature and maximum temperature are unavailable at the ZIP-code level. Thus, we were unable to compute -(|min temperature - 22°C| + |max temperature - 22°C|) as a robustness check in Study 2.

[v] On an exploratory basis, we also conducted machine learning analyses to explore the effect of temperature clemency on individual response style. Consistent with prior research (Steinmetz & Posten, 2017) and Study 1, conditional random forest analyses (seed = 666, mtry = 3, trees = 1000; seed = 667, mtry = 3, trees = 1000) reliably identified temperature clemency to be an important predictor of individual response style.

Supplementary Tables

Supplementary Table 1. Mean Personality Scores of Each of the 59 Chinese Cities (Study 1)

#	City	Alpha	Beta	Agreeableness	Conscientiousness	Emotional stability	Extraversion	Openness
1	Heilongjiang-Qiqihar	4.88	4.58	5.39	4.84	4.40	4.38	4.78
2	Heilongjiang-Suihua	4.95	4.57	5.45	4.79	4.62	4.32	4.82
3	Heilongjiang-Harbin	5.05	4.87	5.56	5.16	4.43	4.42	5.33
4	Heilongjiang-Mudanjiang	5.11	4.77	5.50	5.07	4.77	4.50	5.04
5	Jilin-Changchun	4.73	4.64	5.32	4.69	4.18	4.25	5.02
6	Xinjiang-Urumuqi	4.99	5.00	5.46	5.03	4.48	4.80	5.19
7	Neimenggu-Chifeng	4.79	4.54	5.49	4.63	4.25	4.27	4.80
8	Liaoning-Shenyang	4.83	4.66	5.34	4.64	4.51	4.26	5.06
9	Liaoning-Jinzhou	5.01	4.93	5.50	4.78	4.75	4.63	5.23
10	Hebei-Chengde	4.77	4.59	5.24	4.64	4.43	4.25	4.92
11	Neimenggu-Hohhot	4.85	4.82	5.29	4.60	4.66	4.64	5.00
12	Neimenggu-Baotou	4.95	4.81	5.38	4.87	4.60	4.52	5.09
13	Liaoning-Dandong	5.06	4.56	5.75	4.84	4.60	4.26	4.86
14	Hebei-Qinhuangdao	4.98	5.08	5.45	4.80	4.70	4.95	5.21
15	Beijing	4.97	4.85	5.47	4.96	4.49	4.49	5.22
16	Gansu-Jiuquan	5.08	4.80	5.42	4.88	4.94	4.65	4.95
17	Tianjin	4.98	4.60	5.17	4.76	4.99	4.80	4.40
18	Hebei-Baoding	5.54	5.40	5.83	5.51	5.28	5.08	5.72
19	Liaoning-Dalian	4.91	4.93	5.37	4.86	4.48	4.68	5.18
20	Ningxia-Yinchuan	4.87	4.79	5.30	4.88	4.42	4.34	5.24
21	Shaanxi-Yulin	4.89	4.75	5.25	4.88	4.54	4.33	5.17
22	Hebei-Cangzhou	4.69	4.51	5.00	4.51	4.56	4.44	4.58
23	Hebei-Shijiazhuang	4.75	4.91	5.18	4.66	4.41	4.79	5.02
24	Shanxi-Taiyuan	4.89	4.55	5.16	4.58	4.93	4.52	4.59
25	Qinghai-Xining	4.92	5.15	5.33	4.78	4.64	4.98	5.33
26	Shandong-Jinan	5.26	5.03	5.71	5.09	4.98	4.79	5.27
27	Shandong-Weifang	4.96	4.74	5.28	4.98	4.61	4.50	4.98
28	Gansu-Lanzhou	4.83	4.99	5.24	4.81	4.45	4.60	5.38
29	Shandong-Qingdao	5.55	5.42	5.81	5.54	5.30	5.08	5.76
30	Shanxi-Yuncheng	5.02	4.87	5.55	4.91	4.60	4.53	5.21
31	Henan-Zhengzhou	4.99	4.64	5.29	4.86	4.83	4.55	4.74
32	Shaanxi-Xi'an	5.06	4.62	5.37	4.99	4.83	4.34	4.90
33	Jiangsu-Xuzhou	4.91	4.90	5.30	4.90	4.53	4.43	5.36
34	Henan-Xinyang	5.08	4.55	5.41	5.19	4.64	4.07	5.03
35	Jiangsu-Nanjing	4.92	4.82	5.58	4.75	4.42	4.50	5.14
36	Anhui-Lu'an	4.92	4.81	5.26	4.86	4.63	4.62	4.99
37	Shanghai	5.02	4.64	5.19	4.85	5.04	4.39	4.89
38	Sichuan-Chengdu	5.53	5.40	5.76	5.57	5.27	5.10	5.70
39	Hubei-Wuhan	4.85	4.62	5.19	4.79	4.58	4.35	4.89
40	Anhui-Anqing	4.96	4.82	5.35	4.91	4.62	4.59	5.05
41	Zhejiang-Hangzhou	5.02	4.84	5.44	4.83	4.80	4.50	5.17
42	Chongqing	4.88	4.92	5.24	4.79	4.60	4.75	5.10
43	Xizang-Lhasa	4.87	4.64	5.23	4.73	4.63	4.41	4.86
44	Hunan-Changde	5.16	4.79	5.53	5.04	4.90	4.46	5.12
45	Zhejiang-Jinhua	5.52	5.41	5.79	5.48	5.31	5.13	5.70
46	Hubei-Yichang	4.94	4.57	5.25	4.83	4.72	4.54	4.59
47	Sichuan-Yibin	5.52	5.38	5.77	5.52	5.27	5.07	5.69
48	Jiangxi-Nanchang	4.87	4.93	5.37	4.76	4.48	4.72	5.13
49	Hunan-Changsha	5.09	4.91	5.53	5.02	4.74	4.48	5.34
50	Zhejiang-Wenzhou	5.51	5.34	5.76	5.48	5.29	5.02	5.67
51	Jiangxi-Ji'an	4.94	4.79	5.49	4.90	4.42	4.55	5.04
52	Guizhou-Guiyang	4.86	4.82	5.30	4.73	4.55	4.35	5.30
53	Jiangxi-Ganzhou	5.07	4.74	5.53	4.96	4.73	4.36	5.12
54	Fujian-Xiamen	5.54	5.41	5.81	5.58	5.24	5.05	5.77
55	Yunnan-Yuxi	5.53	5.40	5.80	5.55	5.25	5.08	5.72
56	Guangxi-Wuzhou	5.21	4.93	5.40	5.29	4.95	4.61	5.25
57	Guangdong-Guangzhou	4.89	4.80	5.32	4.90	4.44	4.43	5.17
58	Guangxi-Nanning	4.80	4.75	5.24	4.70	4.45	4.33	5.17
59	Guangdong-Zhanjiang	5.47	5.31	5.69	5.50	5.21	5.07	5.54

Supplementary Table 2. Descriptive Statistics of Variables (Study 1)

	N	*Mean*	*SD*
Individual-Level Variables			
Age	5355	22.07	2.05
Gender (male = 0, female = 1)	5587	.42	.49
Alpha	5587	5.35	.64
Beta	5587	5.21	.74
Agreeableness	5587	5.66	.69
Conscientiousness	5587	5.32	.85
Emotional stability	5587	5.07	.88
Extraversion	5587	4.91	.89
Openness to experience	5587	5.51	.81
Response style	5587	4.22	.32
City-Level Variables			
Average annual mean ambient temperature (℃)	59	13.26	5.08
Temperature clemency (℃)	59	-8.79	4.99
Average annual air pressure (hPa)	59	971.57	69.31
Average annual wind speed (m/s)	59	2.31	.80
GDP per capita (1000 yuan)	59	35.58	17.96
Population density (1000/km^2)	59	.51	.46
Average annual rice-farming area (m^2/person)	44	232.93	245.46
Average annual wheat-farming area (m^2/person)	47	146.35	198.20
Average annual influenza incidence (per 1000 ppl.)	59	.65	.53

Supplementary Table 3. Bivariate Correlations Among Individual-Level Variables (Study 1)

	1	2	3	4	5	6	7	8	9
1. Alpha									
2. Beta	.55**								
3. Agreeableness	.76**	.43**							
4. Conscientiousness	.79**	.45**	.39**						
5. Emotional stability	.84**	.43**	.51**	.46**					
6. Extraversion	.42**	.88**	.36**	.28**	.36**				
7. Openness to experience	.54**	.85**	.39**	.51**	.38**	.49**			
8. Response style	-.02	.14**	-.07**	.17**	-.15**	-.03*	.28**		
9. Age	.30**	.27*	.21**	.29**	.21**	.19**	.27**	.16**	
10. Gender (1 = female)	-.11**	-.08**	.00	-.15**	-.10**	.01	-.17**	-.10**	-.17**

Note. * $p < .05$. ** $p < .01$.

Supplementary Table 4. Bivariate Correlations Among City-Level Variables (Study 1)

	1	2	3	4	5	6	7
1. Temperature clemency							
2. Air pressure	.39**						
3. Wind speed	-.29*	.31*					
4. GDP per capita	.04	.07	.23†				
5. Population density	.39**	.17	.07	.23†			
6. Rice-farming area	.30*	.22	-.18	-.38*	.12		
7. Wheat-farming area	.14	.01	.01	-.21	.05	-.36*	
8. Influenza incidence	.15	-.34**	-.38**	.22†	-.03	-.11	-.03

Note. † $p < .10$. * $p < .05$. ** $p < .01$.

Supplementary Table 5. City-Level Bivariate Correlations Among Personality Traits, Temperature Clemency, and Control Variables (Study 1)

	Alpha	Beta	Agreeableness	Conscientiousness	Emotional stability	Extraversion	Openness to experience
Temperature clemency	.37**	.32*	.19	.38**	.39**	.27*	.31*
Air pressure	.12	-.03	.16	.13	.07	-.03	-.02
Wind speed	.02	-.06	.10	.02	-.04	-.06	-.05
GDP per capita	-.10	.03	-.15	-.12	-.03	.06	.01
Population density	.11	.00	-.06	.06	.25	.02	-.02
Rice-farming area	.02	-.08	.08	.06	-.07	-.12	-.04
Wheat-farming area	.02	-.08	-.16	.06	.10	-.04	-.10
Influenza incidence	-.37**	-.29*	-.34**	-.30*	-.24†	-.18	-.18

Note. † $p < .10$. * $p < .05$. ** $p < .01$.

Supplementary Table 6. Temperature Clemency Predicting Alpha (Study 1)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	5.15 (.14)***	5.33 (.15)***	6.13 (.30)***
Temperature clemency		**.02 (.006)*** **	**.04 (.012)*** **
Age	.03 (.004)***	.03 (.004)***	.03 (.004)***
Gender	-.04 (.02)*	-.04 (.02)*	-.03 (.02)
Response style	-.19 (.03)***	-.19 (.03)***	-.22 (.03)***
GDP per capita			-1.90e-03 (3.02e-03)
Rice-farming area			-.17 (.23)
Wheat-farming area			-.04 (.32)
Population density			-.0002 (.0001)
Influenza incidence			-.28 (.10)**
Temperature SD			-.12 (.37)
Random Effects			
Intercept	.05 (.01)	.05 (.01)	.04 (.01)
Model Fit Statistics			
AIC	9413	9413	7907
BIC	9453	9459	7990
$\boldsymbol{\Omega_0^2}$	.20	.20	.18

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 7. Temperature Clemency Predicting Beta (Study 1)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	3.54 (.17)***	3.73 (.18)***	4.47 (.32)***
Temperature clemency		**.02 (.007)****	**.05 (.01)*****
Age	.03 (.005)***	.03 (.005)***	.02 (.005)***
Gender	.01 (.02)	.01 (.02)	.03 (.02)
Response style	.17 (.03)***	.17 (.03)***	.15 (.03)***
GDP per capita			-2.58e-03 (3.09e-03)
Rice-farming area			-.58 (.24)*
Wheat-farming area			-.21 (.33)
Population density			-.0001 (.0001)
Influenza incidence			-.24 (.10)*
Temperature SD			.17 (.38)
Random Effects			
Intercept	.06 (.01)	.05 (.01)	.04 (.01)
Model Fit Statistics			
AIC	11033	11032	9273
BIC	11072	11079	9356
$\boldsymbol{\Omega_0^2}$	.17	.17	.15

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 8. Temperature Clemency Predicting Agreeableness (Study 1)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	5.97 (.16)***	6.09 (.17)***	6.87 (.29)***
Temperature clemency		**.01 (.007)***	**.03 (.01)****
Age	.03 (.004)***	.03 (.004)***	.02 (.005)***
Gender	.08 (.02)***	.08 (.02)***	.09 (.02)***
Response style	-.28 (.03)***	-.28 (.03)***	-.36 (.03)***
GDP per capita			-6.57e-04 (3.39e-03)
Rice-farming area			.10 (.26)
Wheat-farming area			-.07 (.37)
Population density			-.0002 (.0002)
Influenza incidence			-.19 (.11)†
Temperature SD			-.39 (.44)
Random Effects			
Intercept	.05 (.01)	.05 (.01)	.06 (.02)
Model Fit Statistics			
AIC	10741	10747	8967
BIC	10780	10793	9044
$\boldsymbol{\Omega_0^2}$	.12	.12	.11

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 9. Temperature Clemency Predicting Conscientiousness (Study 1)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	2.79 (.19)***	2.99 (.20)***	3.40 (.32)***
Temperature clemency		**.02 (.006)*** **	**.04 (.011)*** **
Age	.04 (.005)***	.04 (.005)***	.05 (.006)***
Gender	-.12 (.02)***	-.12 (.02)***	-.11 (.02)***
Response style	.30 (.03)***	.29 (.03)***	.27 (.04)***
GDP per capita			-1.34e-03 (2.92e-03)
Rice-farming area			-.22 (.23)
Wheat-farming area			.11 (.31)
Population density			-.0001 (.0001)
Influenza incidence			-.32 (.10)***
Temperature SD			.24 (.36)
Random Effects			
Intercept	.05 (.01)	.04 (.01)	.03 (.01)
Model Fit Statistics			
AIC	12532	12531	10553
BIC	12572	12577	10637
$\boldsymbol{\Omega_0^2}$	.17	.17	.15

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 10. Temperature Clemency Predicting Emotional Stability (Study 1)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	6.58 (.20)***	6.83 (.21)***	7.83 (.38)***
Temperature clemency		**.03 (.008)*** **	**.06 (.015)*** **
Age	.02 (.005)***	.02 (.005)***	.02 (.006)***
Gender	-.08 (.02)***	-.08 (.02)***	-.05 (.02)*
Response style	-.57 (.04)***	-.57 (.04)***	-.58 (.04)***
GDP per capita			-4.57e-03 (3.76e-03)
Rice-farming area			-.46 (.29)
Wheat-farming area			-.16 (.40)
Population density			-.0003 (.0001)
Influenza incidence			-.33 (.12)**
Temperature SD			-.08 (.47)
Random Effects			
Intercept	.09 (.02)	.08 (.02)	.06 (.02)
Model Fit Statistics			
AIC	12902	12901	10815
BIC	12941	12947	10898
$\boldsymbol{\Omega_0^2}$	.18	.18	.17

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 11. Temperature Clemency Predicting Extraversion (Study 1)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	4.74 (.20)***	4.92 (.22)***	5.78 (.37)***
Temperature clemency		**.02 (.008)****	**.06 (.014)*****
Age	.03 (.006)***	.03 (.006)***	.02 (.006)***
Gender	.14 (.02)***	.14 (.02)***	.16 (.03)***
Response style	-.20 (.04)***	-.20 (.04)***	-.21 (.04)***
GDP per capita			-4.24e-03 (3.57e-03)
Rice-farming area			-.76 (.28)**
Wheat-farming area			-.23 (.38)
Population density			-.0001 (.0002)
Influenza incidence			-.20 (.12)†
Temperature SD			.19 (.44)
Random Effects			
Intercept	.07 (.02)	.06 (.02)	.05 (.02)
Model Fit Statistics			
AIC	13356	13359	11200
BIC	13396	13405	11283
$\boldsymbol{\Omega_0^2}$	.11	.11	.11

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 12. Temperature Clemency Predicting Openness to Experience (Study 1)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	2.29 (.18)***	2.49 (.19)***	3.05 (.32) ***
Temperature clemency		**.02 (.006)*** **	**.05 (.011)** ***
Age	.03 (.005)***	.03 (.005)***	.03 (.005) ***
Gender	-.11 (.02)***	-.11 (.02)***	-.10 (.02) ***
Response style	.54 (.03)***	.54 (.03)***	.52 (.04)***
GDP per capita			-1.05e-03 (2.94e-03)
Rice-farming area			-.40 (.23)
Wheat-farming area			-.16 (.31)
Population density			-.0001 (.0001)
Influenza incidence			-.28 (.10)**
Temperature SD			.24 (.36)
Random Effects			
Intercept	.06 (.01)	.04 (.01)	.03 (.01)
Model Fit Statistics			
AIC	11864	11861	10000
BIC	11904	11907	10084
$\boldsymbol{\Omega_0^2}$	.21	.21	.17

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 13. Temperature Clemency Predicting Alpha, Beta and Big Five (Study 1), where temperature clemency = -(|min temperature - 22°C| + |max temperature - 22°C|)

	Alpha	Beta	Agreeableness	Conscientiousness	Emotional stability	Extraversion	Openness to experience
Fixed Effects							
Intercept	6.13 (.30)***	4.47 (.32)***	7.04 (.35)***	3.40 (.32)***	7.83 (.39)***	5.78 (.37)***	3.05 (.32) ***
Temperature clemency	.02 (.006)**	.03 (.006)***	.01 (.005)**	.02 (.006)***	.03 (.007)***	.03 (.007)***	.02 (.006) ***
Age	.03 (.004)***	.02 (.005)***	.02 (.005)***	.05 (.006)***	.02 (.006)***	.02 (.006)***	.03 (.005) ***
Gender	-.03 (.02)	.03 (.02)	.08 (.02)***	-.11 (.02)***	-.05 (.02)*	.16 (.03)***	-.10 (.02) ***
Response style	-.22 (.03)***	.15 (.03)***	-.36 (.03)***	.27 (.04)***	-.58 (.04)***	-.21 (.04)***	.52 (.04)***
GDP per capita	-1.81e-03 (3.08e-03)	-2.53e-03 (3.11e-03)	-6.74e-04 (3.42e-03)	-1.22e-03 (2.96e-03)	-4.47e-03 (3.84e-03)	-4.21e-03 (3.56e-03)	-9.47e-04 (2.99e-03)
Rice-farming area	-.12 (.23)	-.52 (.24)*	.10 (.26)	-.17 (.23)	-.39 (.29)	-.71 (.27)**	-.34 (.23)
Wheat-farming area	-.04 (.33)	-.23 (.33)	-.07 (.37)	.11 (.32)	-.17 (.41)	-.26 (.38)	-.17 (.32)
Population density	-.0002 (.0001)	-.0001 (.0001)	-.0002 (.0002)	-.0002 (.0001)	-.0003 (.0002)	-.0002 (.0002)	-.0001 (.0001)
Influenza incidence	-.27 (.10)**	-.22 (.10)*	-.18 (.12)	-.31 (.10)**	-.31 (.13)*	-.19 (.12)	-.26 (.10)**
Temperature SD	-.19 (.38)	.12 (.38)	-.44 (.44)	.18 (.36)	-.16 (.47)	.16 (.44)	.17 (.37)
Random Effects							
Intercept	.04 (.01)	.04 (.01)	.06 (.02)	.03 (.01)	.06 (.02)	.05 (.02)	.03 (.01)
Model Fit Statistics							
AIC	7910	9275	8969	10556	10818	11202	10004
BIC	7993	9358	9046	10640	10901	11285	10087
Ω_0^2	.18	.15	.11	.15	.17	.11	.17

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
$^{\dagger}p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$

Supplementary Table 14. Descriptive Statistics of Variables (Study 2)

	N	*Mean*	*SD*
Individual-Level Variables			
Age	1,660,638	27.05	11.00
Gender (male = 0, female = 1)	1,660,638	.65	.48
Below college	1,660,638	.74	.44
College degree	1,660,638	.17	.38
Graduate degree	1,660,638	.09	.29
Alpha	1,660,638	3.54	.54
Beta	1,660,638	3.50	.56
Agreeableness	1,660,638	3.81	.66
Conscientiousness	1,660,638	3.63	.70
Emotional stability	1,660,638	3.13	.82
Extraversion	1,660,638	3.31	.84
Openness to experience	1,660,638	3.65	.66
Response style	1,660,638	3.32	.25
ZIP-Code Level Variables			
Temperature clemency (℃)	1,660,638	-8.84	4.29
Average wind speed (m/s)	1,660,594	7.14	1.77
Average humidity (%)	1,660,193	76.70	3.84
GDP per capita ($1000)	1,660,079	27.78	11.94
Population density (1000/km^2)	1,660,021	1.37	3.29
% Civilians employed in the primary sector	1,660,079	1.47	2.81
% Civilians employed in the secondary sector	1,660,079	18.11	6.81
% Civilians employed in the tertiary sector	1,660,079	80.42	7.56

Supplementary Table 15. Bivariate Correlations Among Individual-Level Variables (Study 2)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Alpha												
2. Beta	.233											
3. Agreeableness	.736	.153										
4. Conscientiousness	.734	.111	.315									
5. Emotional stability	.768	.254	.364	.326								
6. Extraversion	.284	.768	.176	.164	.290							
7. Openness to experience	.070	.758	.057	.004	.095	.164						
8. Age	.178	.061	.083	.225	.090	.007	.087					
9. Female	-.020	-.012	.109	.080	-.217	.059	-.077	.029				
10. Below college	-.086	-.074	-.002	-.137	-.050	.002	-.115	-.446	-.021			
11. College degree	.065	.039	.010	.098	.036	-.003	.062	.279	.016	-.755		
12. Graduate degree	.046	.062	-.010	.081	.030	.002	.094	.314	.012	-.539	-.146	
13. Response style	-.145	.118	-.016	-.135	-.165	-.034	.217	-.118	-.030	.085	-.054	-.059

Note. | *r* | larger than .003 are significant at $p < .0001$.

Supplementary Table 16. Bivariate Correlations Among ZIP-Code Level Variables (Study 2)

	1	2	3	4	5	6	7
1. Temperature clemency							
2. Humidity (%)	.11						
3. Wind speed (m/s)	-.31	.17					
4. GDP per capita	-.10	-.07	.00				
5. Population density	-.01	-.34	-.25	.04			
6. % Civilians in the primary sector	.06	.15	.07	-.20	-.15		
7. % Civilians in the secondary sector	-.14	.07	.05	-.34	-.23	.07	
8. % Civilians in the tertiary sector	.11	-.12	-.07	.38	.26	-.44	-.93

Note. All variables are correlated at $p < .01$, except that wind speed and GDP per capita are correlated at $p = .10$.

Supplementary Table 17. Temperature Clemency Predicting Alpha (Study 2)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	4.276*** (.006)	4.305*** (.006)	4.453*** (.016)
Temperature clemency		**.003*** (.000)**	**.003*** (.000)**
Age	.008*** (.000)	.008*** (.000)	.008*** (.000)
Gender	-.034*** (.001)	-.035*** (.001)	-.035*** (.001)
College degree	.022*** (.001)	.022*** (.001)	.024*** (.001)
Graduate degree	-.009*** (.002)	-.009*** (.002)	-.006*** (.002)
Response style	-.280*** (.002)	-.280*** (.002)	-.281*** (.002)
Wind speed			.001* (.0004)
Humidity			-.001*** (.000)
GDP per capita			-.002*** (.000)
Population density			-.001** (.000)
% Civilians in the primary sector			-.0002 (.0002)
% Civilians in the secondary sector			.0001 (.0001)
Random Effects			
Intercept	.003*** (.000)	.003*** (.000)	.003*** (.000)
Model Fit Statistics			
AIC	2489357	2488992	2486462
BIC	2489455	2489103	2486646
$\boldsymbol{\Omega_0^2}$	.06	.06	.06

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 18. Temperature Clemency Predicting Beta (Study 2)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	2.438*** (.006)	2.457*** (.006)	2.489*** (.014)
Temperature clemency		**.002*** (.000)**	**.002*** (.000)**
Age	.002*** (.000)	.002*** (.000)	.003*** (.000)
Gender	-.012*** (.001)	-.012*** (.001)	-.011*** (.001)
College degree	.060*** (.001)	.061*** (.001)	.057*** (.001)
Graduate degree	.113*** (.002)	.114*** (.002)	.108*** (.002)
Response style	.293*** (.002)	.293*** (.002)	.293*** (.002)
Wind speed			-.001*** (.000)
Humidity			-.0004* (.0002)
GDP per capita			.002*** (.000)
Population density			.002*** (.000)
% Civilians in the primary sector			-.003*** (.000)
% Civilians in the secondary sector			-.002*** (.000)
Random Effects			
Intercept	.002*** (.000)	.002*** (.000)	.001*** (.000)
Model Fit Statistics			
AIC	2677088	2676922	2671830
BIC	2677186	2677033	2672014
$\boldsymbol{\Omega_0^2}$	.03	.03	.03

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 19. Temperature Clemency Predicting Agreeableness (Study 2)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	3.626*** (.007)	3.651*** (.008)	3.838*** (.018)
Temperature clemency		**.003*** (.000)**	**.003*** (.000)**
Age	.006*** (.000)	.006*** (.000)	.006*** (.000)
Gender	.146*** (.001)	.146*** (.001)	.146*** (.001)
College degree	-.044*** (.001)	-.043*** (.001)	-.042*** (.001)
Graduate degree	-.099*** (.002)	-.098*** (.002)	-.095*** (.002)
Response style	-.016*** (.002)	-.016*** (.002)	-.017*** (.002)
Wind speed			.001* (.0005)
Humidity			-.002*** (.000)
GDP per capita			-.001*** (.000)
Population density			-.002*** (.000)
% Civilians in the primary sector			.0001 (.0002)
% Civilians in the secondary sector			.001*** (.000)
Random Effects			
Intercept	.003*** (.000)	.003*** (.000)	.003*** (.000)
Model Fit Statistics			
AIC	3196801	3196595	3193740
BIC	3196899	3196706	3193924
$\boldsymbol{\Omega_0^2}$	.03	.03	.03

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 20. Temperature Clemency Predicting Conscientiousness (Study 2)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	4.246*** (.008)	4.258*** (.008)	4.431*** (.019)
Temperature clemency		**.001*** (.000)**	**.001*** (.000)**
Age	.012*** (.000)	.012*** (.000)	.012*** (.000)
Gender	.100*** (.001)	.100*** (.001)	.099*** (.001)
College degree	.083*** (.002)	.083*** (.002)	.085*** (.002)
Graduate degree	.059*** (.002)	.059*** (.002)	.064*** (.002)
Response style	-.307*** (.002)	-.307*** (.002)	-.308*** (.002)
Wind speed			.001* (.0005)
Humidity			-.002*** (.000)
GDP per capita			-.002*** (.000)
Population density			-.001*** (.000)
% Civilians in the primary sector			.0002 (.0003)
% Civilians in the secondary sector			.001*** (.000)
Random Effects			
Intercept	.004*** (.000)	.004*** (.000)	.003*** (.000)
Model Fit Statistics			
AIC	3286934	3286890	3283199
BIC	3287032	3287001	3283383
$\boldsymbol{\Omega_0^2}$	.08	.08	.08

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 21. Temperature Clemency Predicting Emotional Stability (Study 2)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	5.038*** (.009)	5.091*** (.009)	5.177*** (.022)
Temperature clemency		**.005*** (.000)**	**.005*** (.000)**
Age	.005*** (.000)	.005*** (.000)	.005*** (.000)
Gender	-.388*** (.001)	-.389*** (.001)	-.389*** (.001)
College degree	.027*** (.002)	.027*** (.002)	.028*** (.002)
Graduate degree	.011*** (.002)	.012*** (.002)	.012*** (.002)
Response style	-.546*** (.003)	-.547*** (.003)	-.548*** (.003)
Wind speed			.0001 (.001)
Humidity			-.0003 (.0003)
GDP per capita			-.001*** (.000)
Population density			.001*** (.000)
% Civilians in the primary sector			-.001*** (.000)
% Civilians in the secondary sector			-.002*** (.000)
Random Effects			
Intercept	.005*** (.000)	.005*** (.000)	.004*** (.000)
Model Fit Statistics			
AIC	3777106	3776482	3773694
BIC	3777204	3776592	3773878
$\boldsymbol{\Omega_0^2}$	.09	.09	.09

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Table 22. Temperature Clemency Predicting Extraversion (Study 2)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	3.589*** (.009)	3.594*** (.010)	3.652*** (.021)
Temperature clemency		**.0004* (.0002)**	**.001*** (.000)**
Age	.001*** (.000)	.001*** (.000)	.001*** (.000)
Gender	.102*** (.001)	.102*** (.001)	.103*** (.001)
College degree	-.017*** (.002)	-.017*** (.002)	-.020*** (.002)
Graduate degree	-.013*** (.002)	-.013*** (.002)	-.018*** (.002)
Response style	-.110*** (.003)	-.110*** (.003)	-.109*** (.003)
Wind speed			.0004 (.001)
Humidity			-.001*** (.000)
GDP per capita			.002*** (.000)
Population density			-.0005 (.0003)
% Civilians in the primary sector			-.001*** (.000)
% Civilians in the secondary sector			.0001 (.0001)
Random Effects			
Intercept	.003*** (.000)	.003*** (.000)	.002*** (.000)
Model Fit Statistics			
AIC	3986503	3986500	3983067
BIC	3986601	3986610	3983252
$\boldsymbol{\Omega_0^2}$	.01	.01	.01

Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

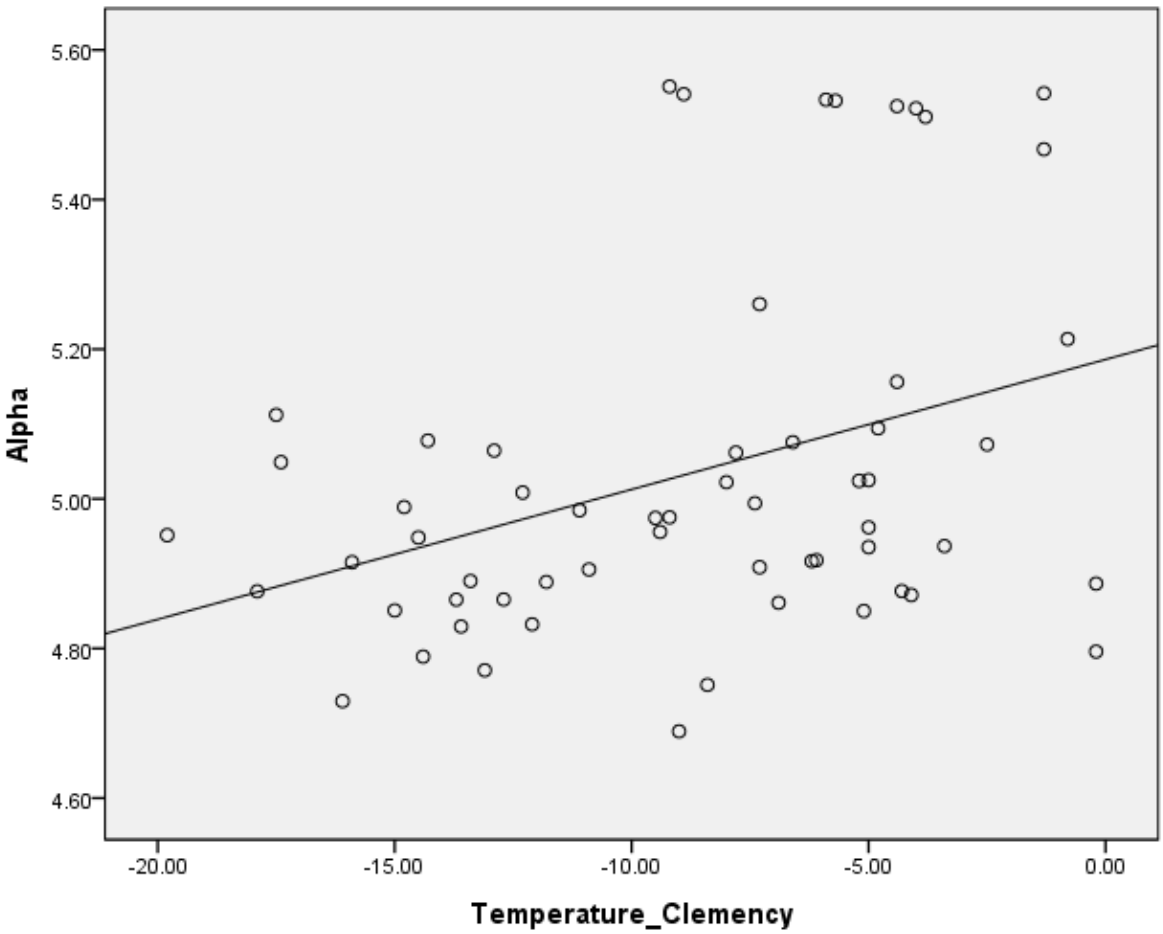
Supplementary Table 23. Temperature Clemency Predicting Openness to Experience (Study 2)

	Multilevel Models		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	1.522*** (.007)	1.552*** (.007)	1.562*** (.018)
Temperature clemency		**.003*** (.000)**	**.002*** (.000)**
Age	.004*** (.000)	.004*** (.000)	.004*** (.000)
Gender	-.103*** (.001)	-.103*** (.001)	-.103*** (.001)
College degree	.122*** (.001)	.122*** (.001)	.119*** (.001)
Graduate degree	.213*** (.002)	.214*** (.002)	.209*** (.002)
Response style	.615*** (.002)	.615*** (.002)	.615*** (.002)
Wind speed			-.003*** (.000)
Humidity			.0005* (.0002)
GDP per capita			.001*** (.000)
Population density			.004*** (.000)
% Civilians in the primary sector			-.005*** (.000)
% Civilians in the secondary sector			-.004*** (.000)
Random Effects			
Intercept	.005*** (.000)	.005*** (.000)	.002*** (.000)
Model Fit Statistics			
AIC	3089026	3088771	3082981
BIC	3089124	3088882	3083166
$\boldsymbol{\Omega_0^2}$	.09	.09	.09

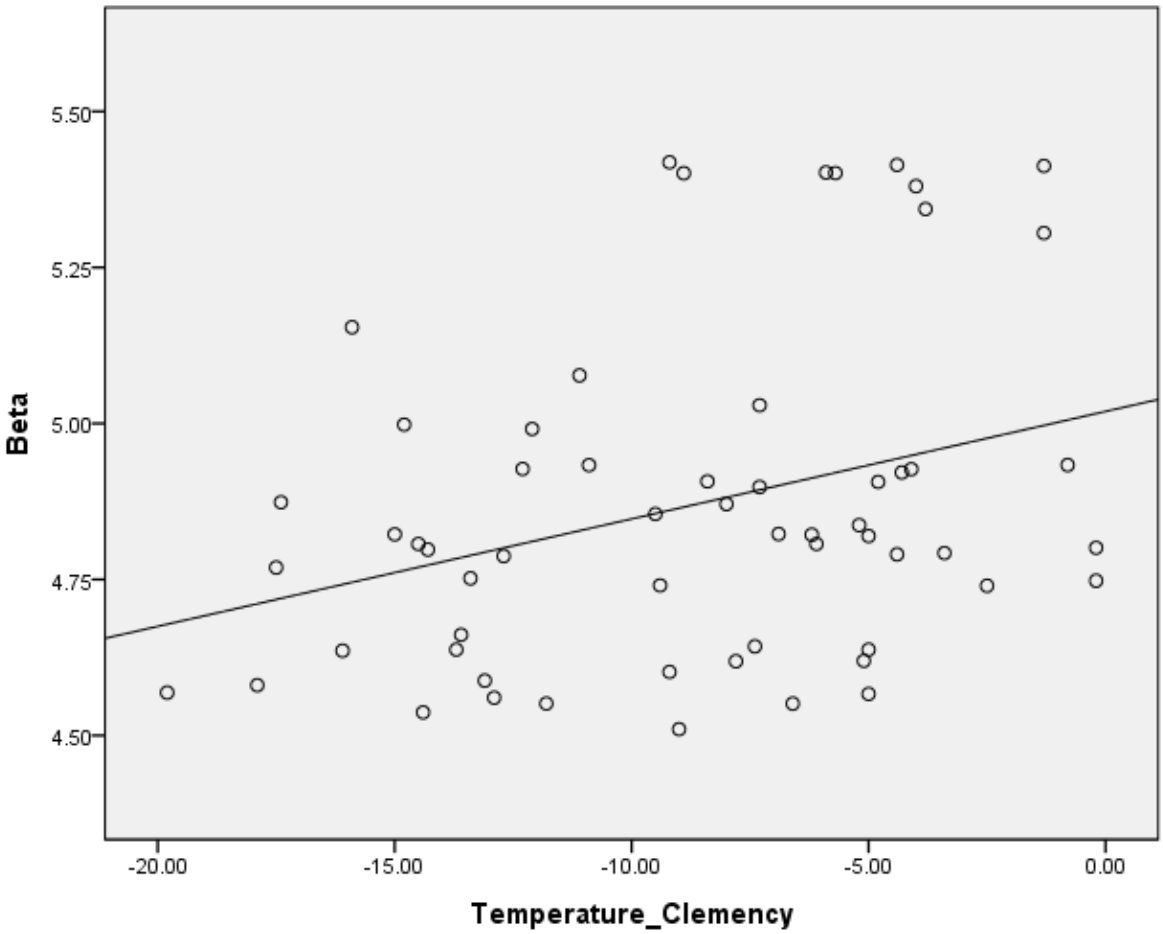
Note. Unstandardized regression coefficients are displayed, with standard errors in parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Supplementary Figures

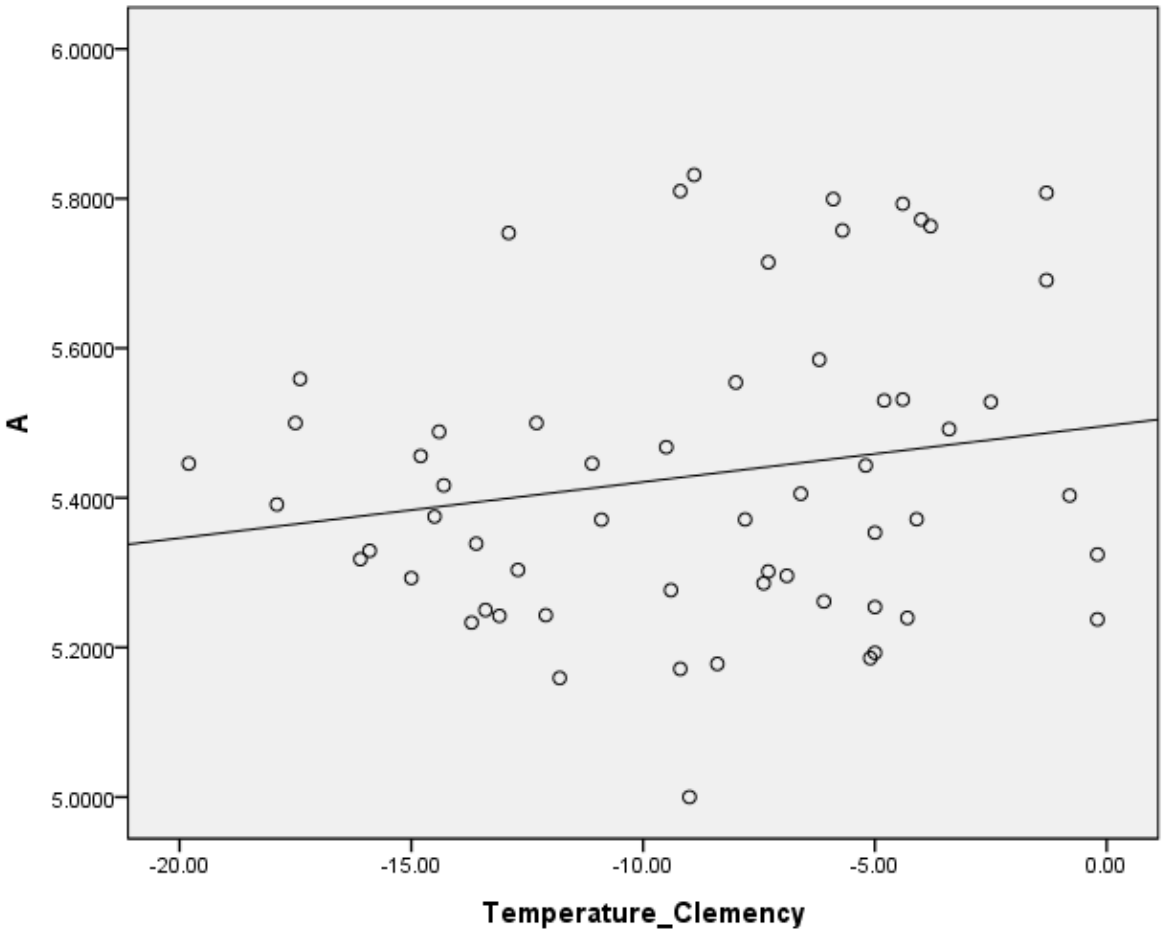
Supplementary Figure 1. Scatter Plot of Temperature Clemency and Alpha (Study 1)



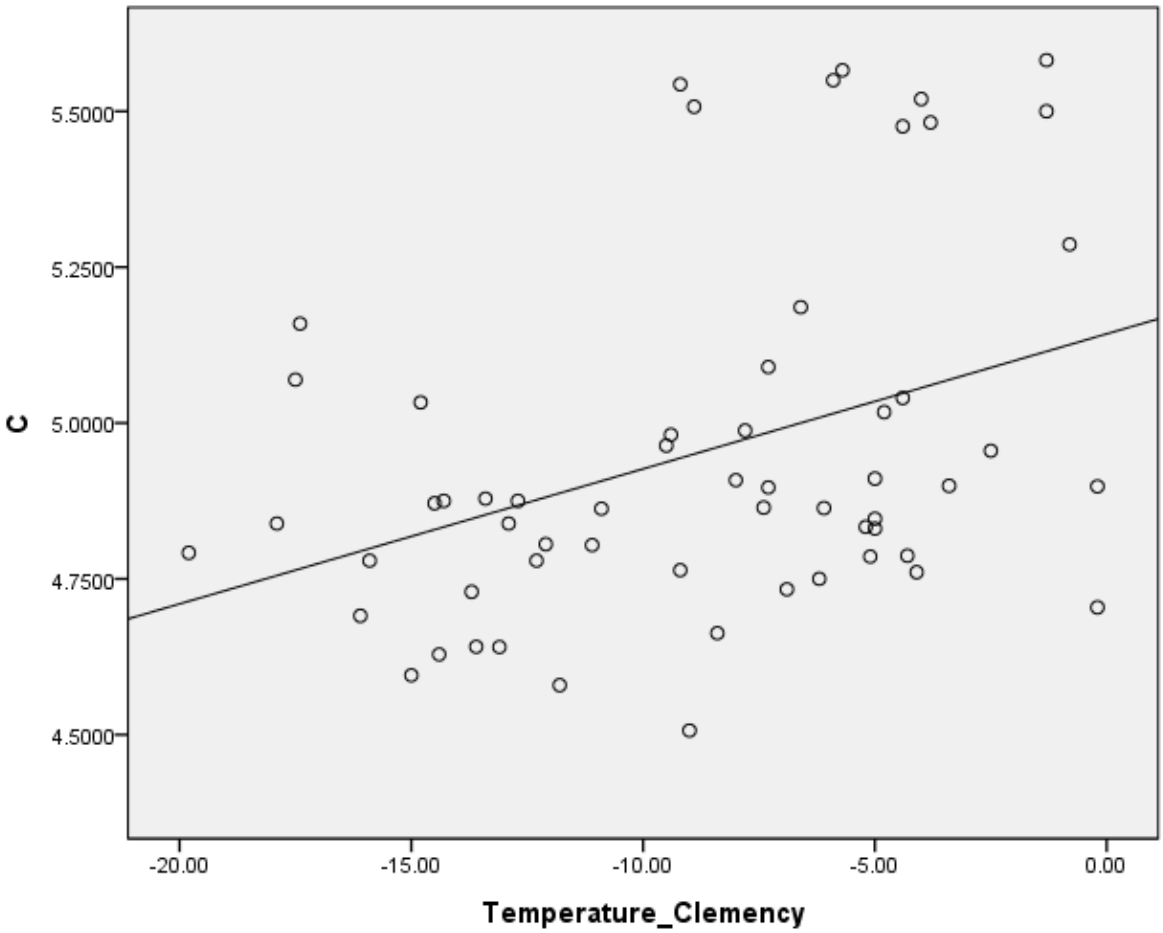
Supplementary Figure 2. Scatter Plot of Temperature Clemency and Beta (Study 1)



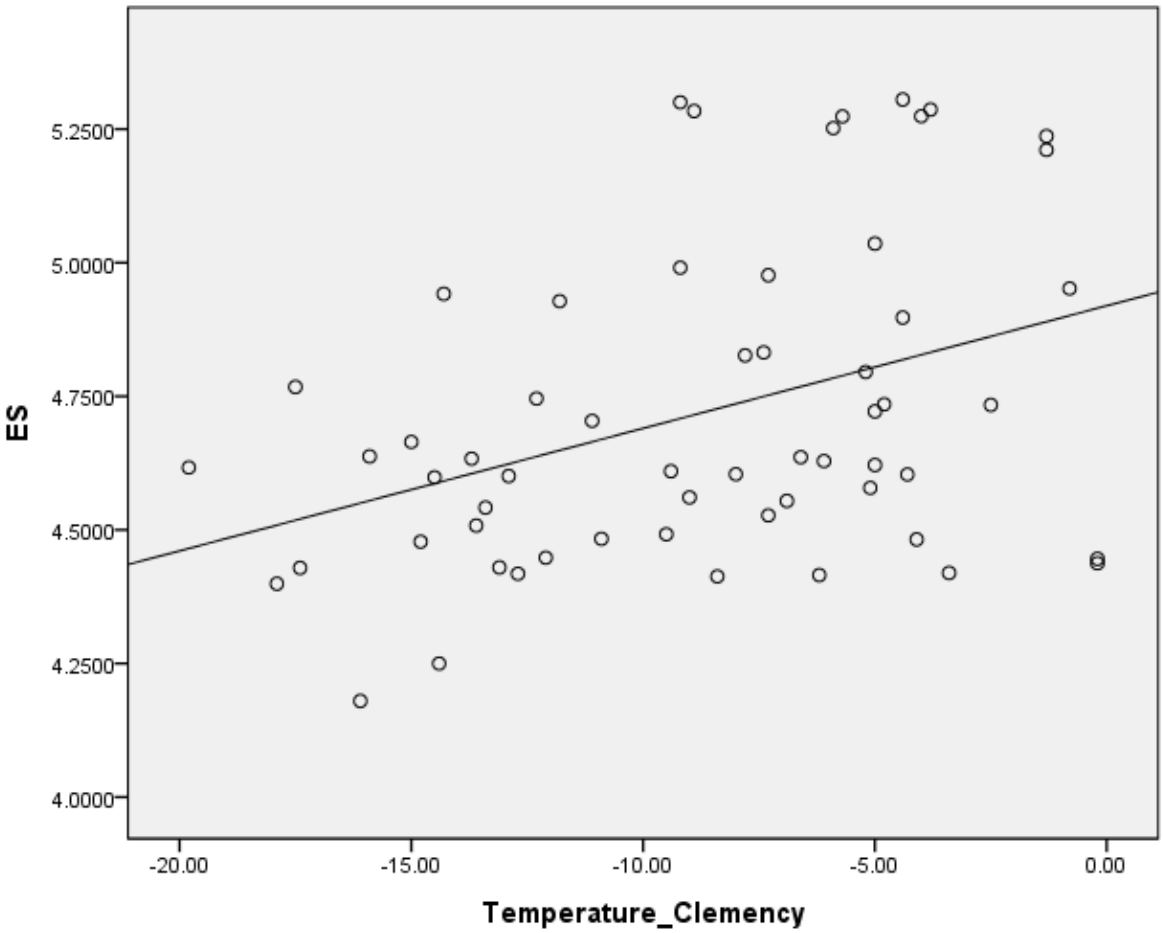
Supplementary Figure 3. Scatter Plot of Temperature Clemency and Agreeableness (Study 1)



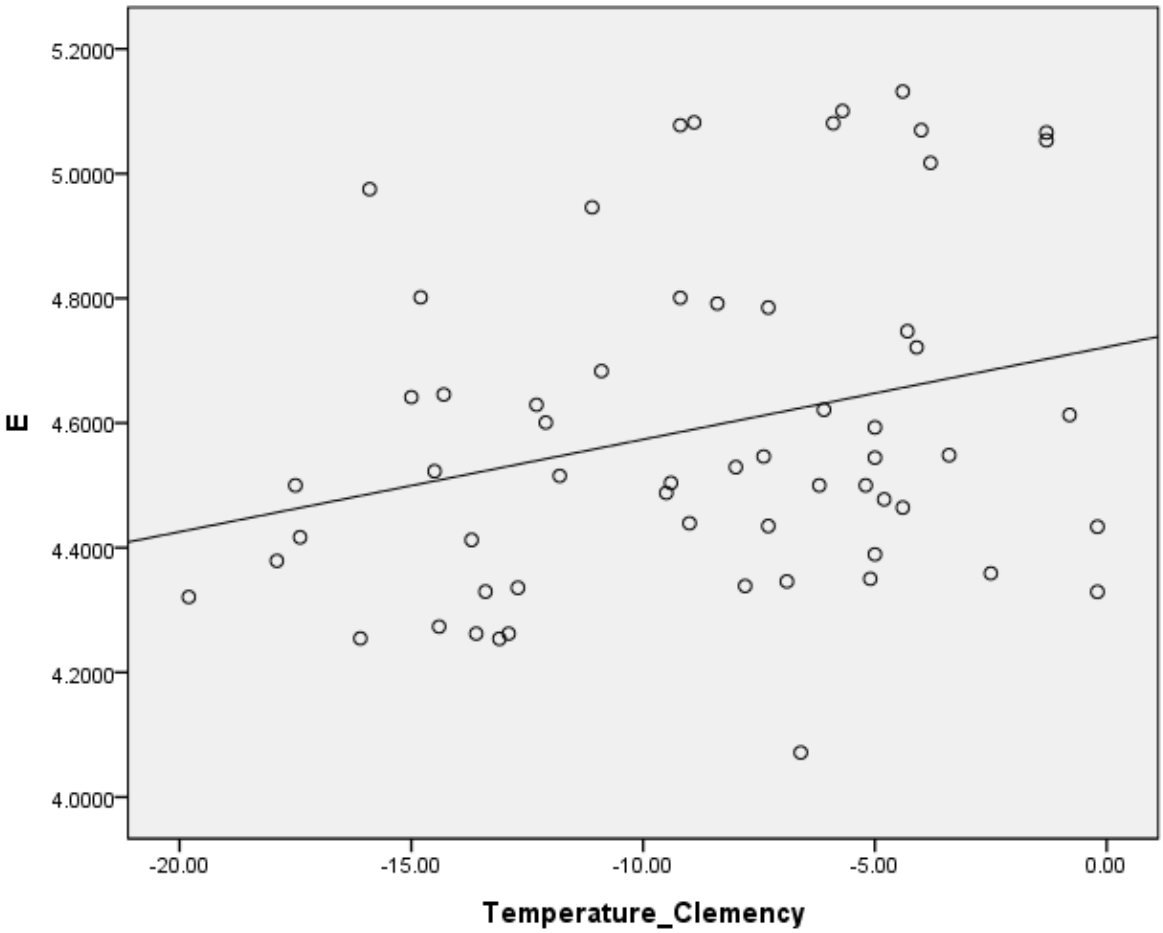
Supplementary Figure 4. Scatter Plot of Temperature Clemency and Conscientiousness (Study 1)



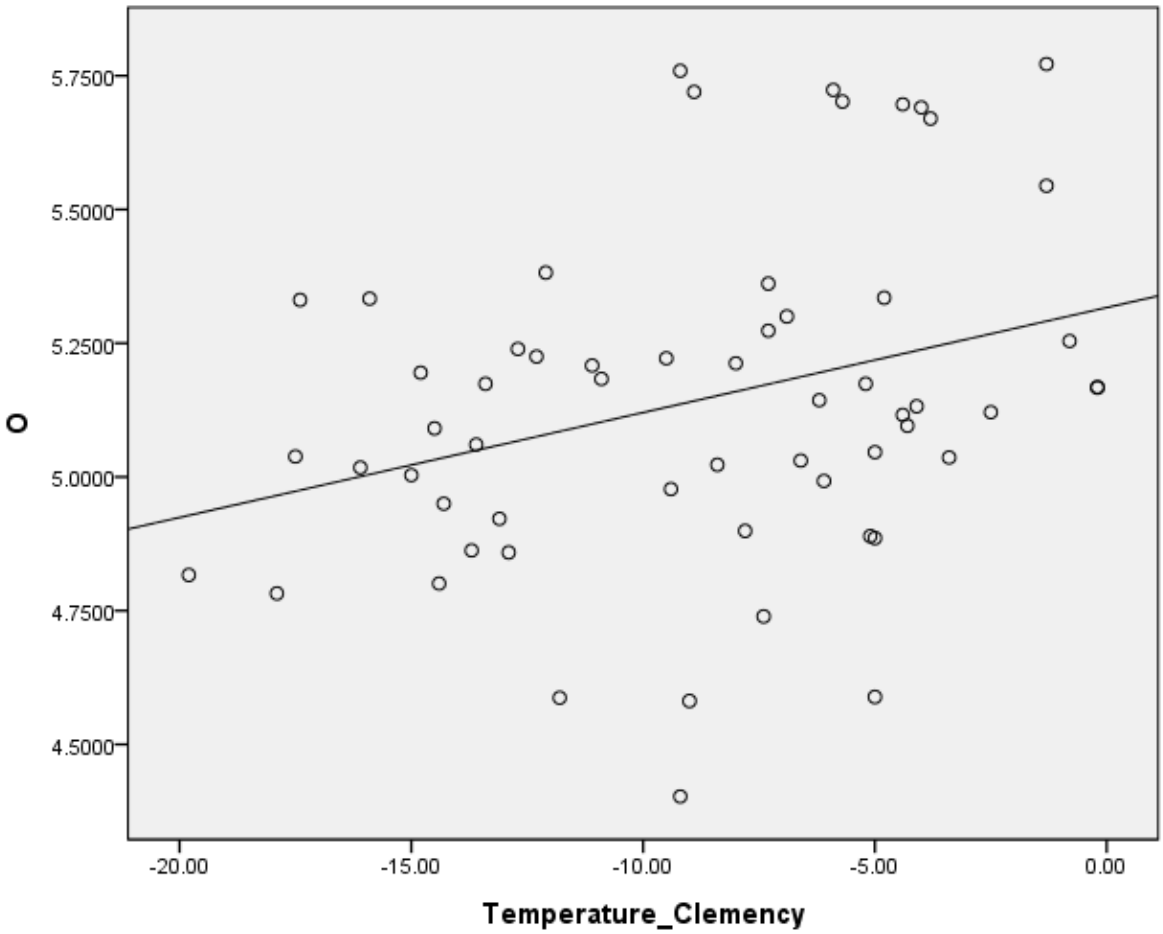
Supplementary Figure 5. Scatter Plot of Temperature Clemency and Emotional Stability (Study 1)



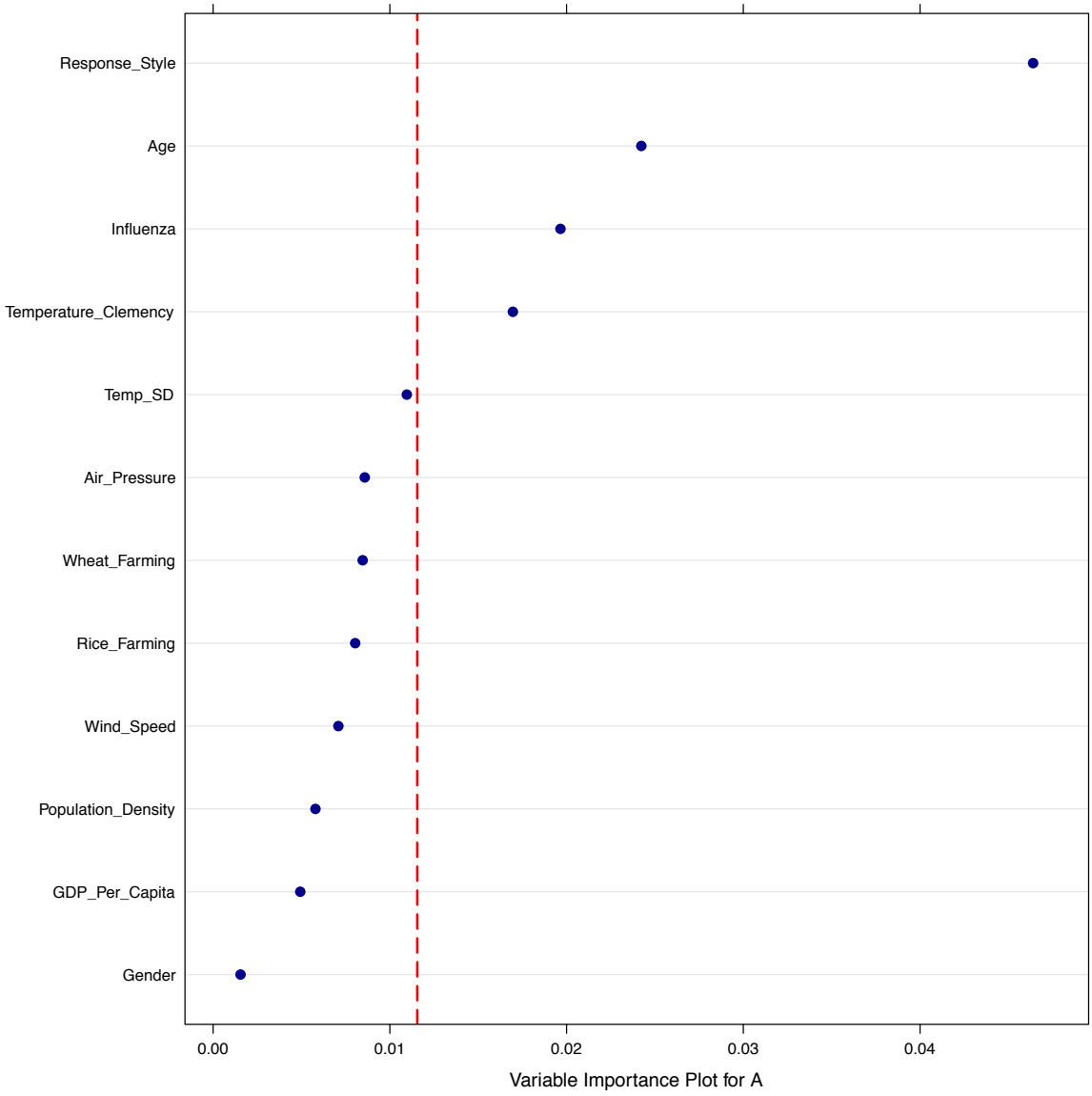
Supplementary Figure 6. Scatter Plot of Temperature Clemency and Extraversion (Study 1)



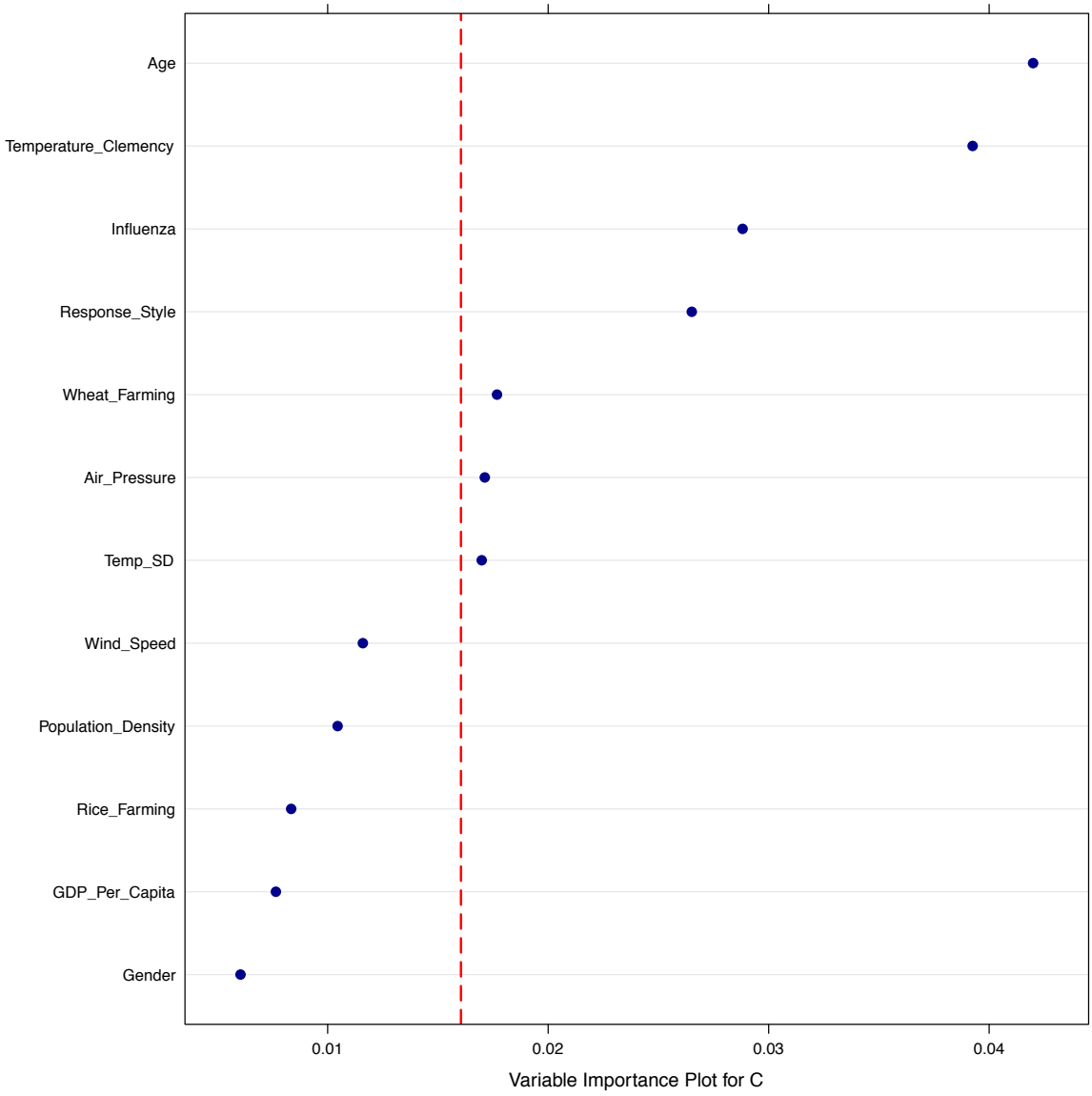
Supplementary Figure 7. Scatter Plot of Temperature Clemency and Openness (Study 1)



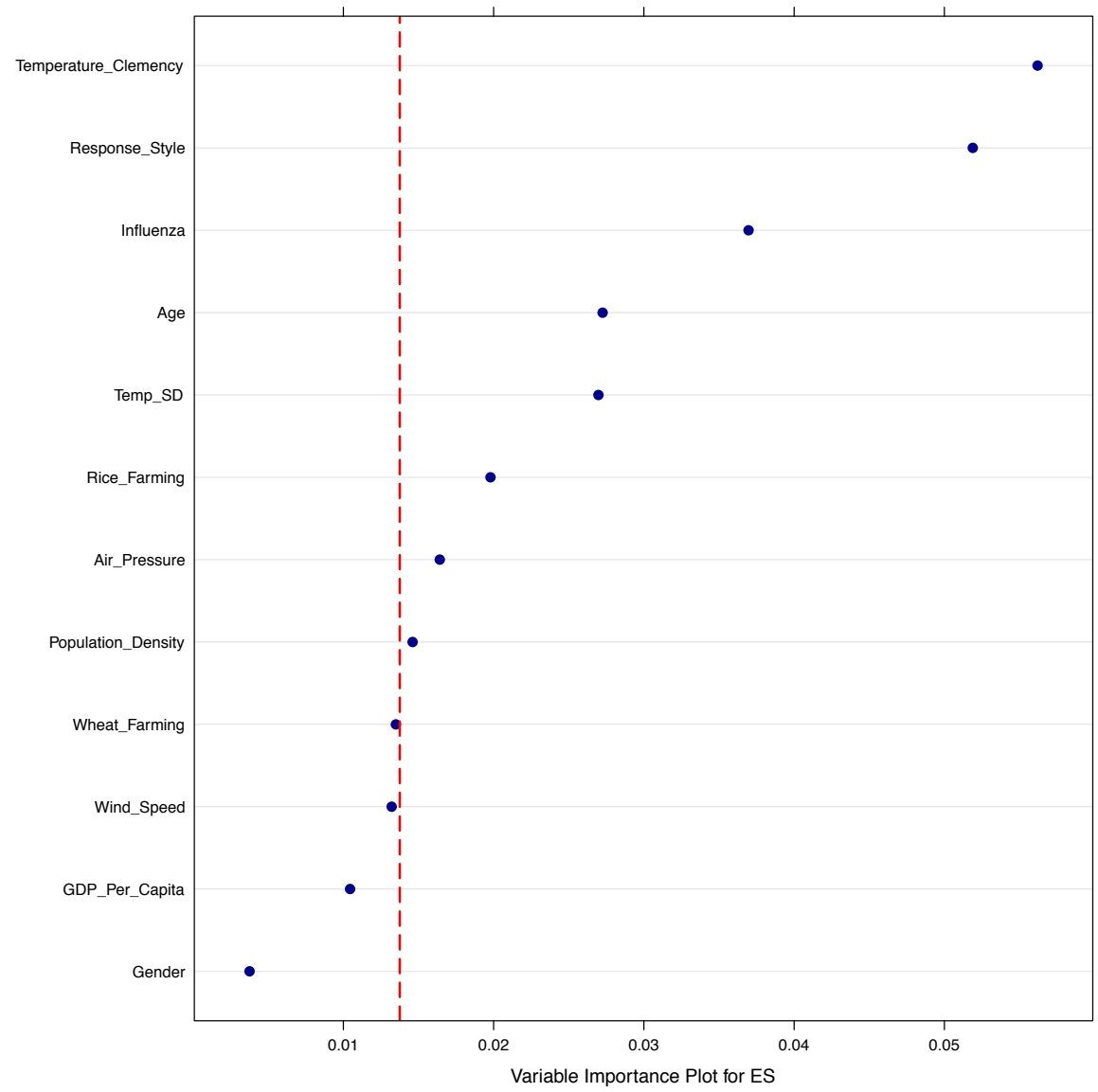
Supplementary Figure 8. Variable Importance Plot for Agreeableness (Study 1)
Variables to the right of the red line are likely important predictors rather than random noise.



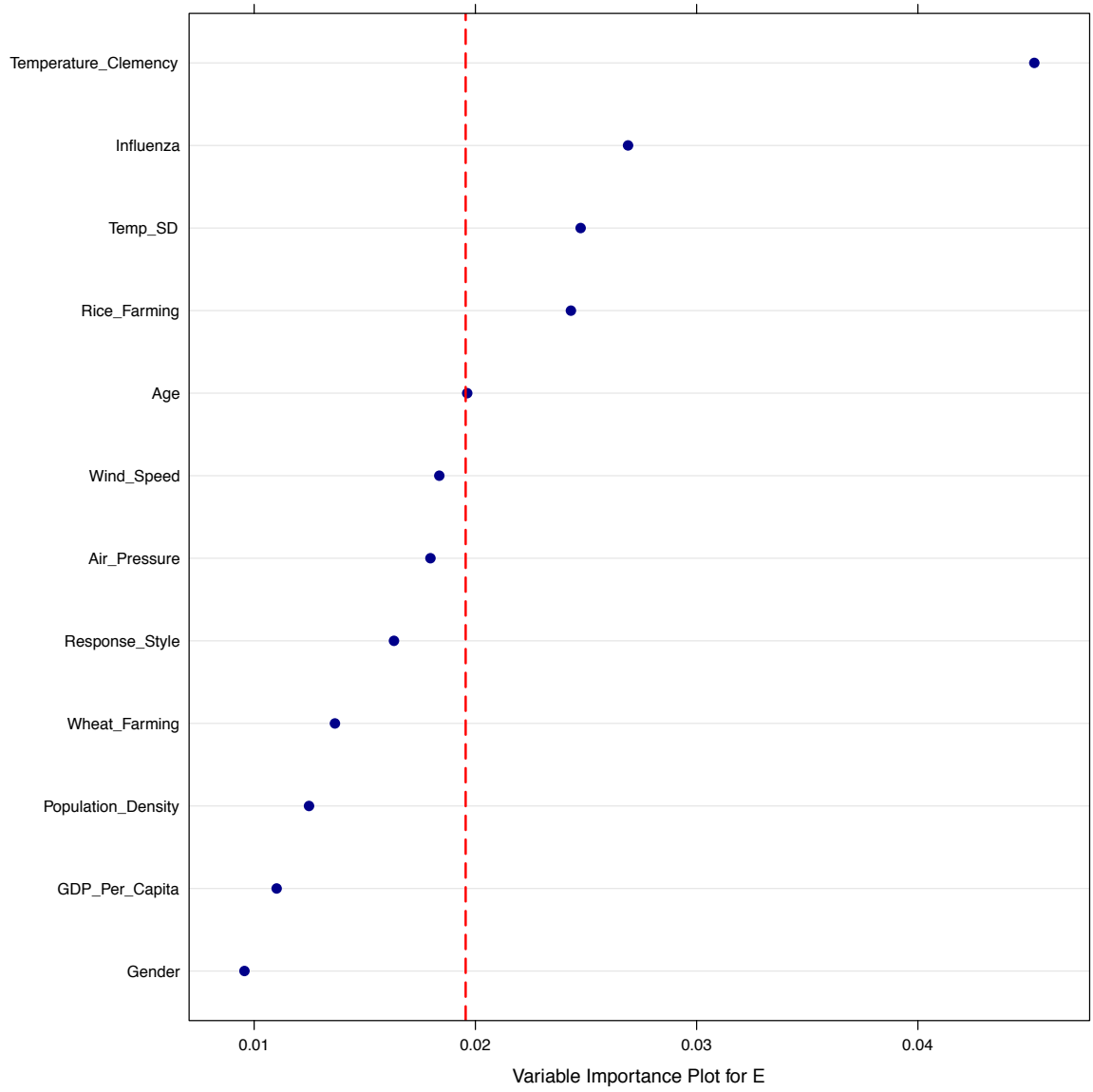
Supplementary Figure 9. Variable Importance Plot for Conscientiousness (Study 1)
Variables to the right of the red line are likely important predictors rather than random noise.



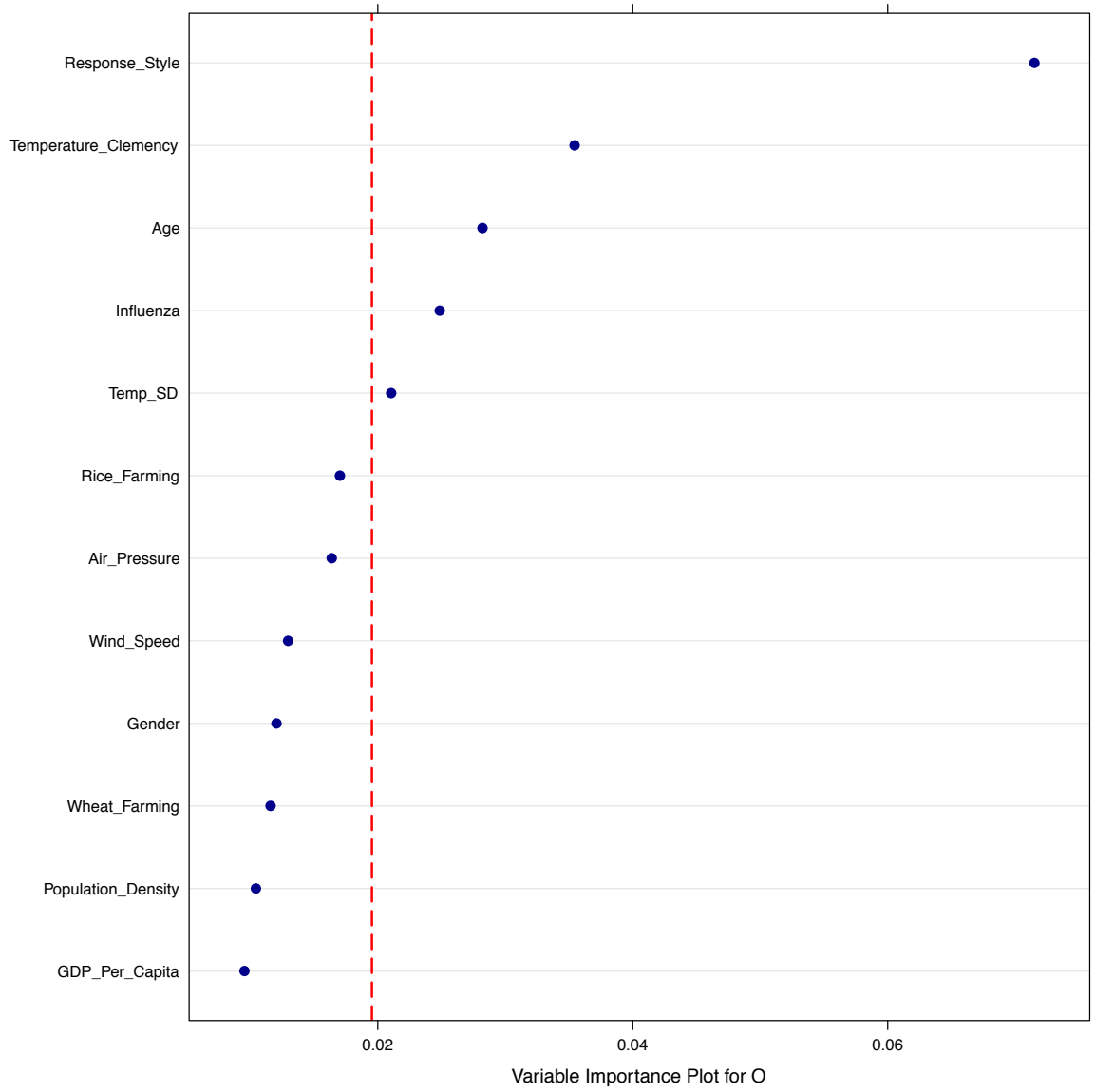
Supplementary Figure 10. Variable Importance Plot for Emotional Stability (Study 1)
Variables to the right of the red line are likely important predictors rather than random noise.



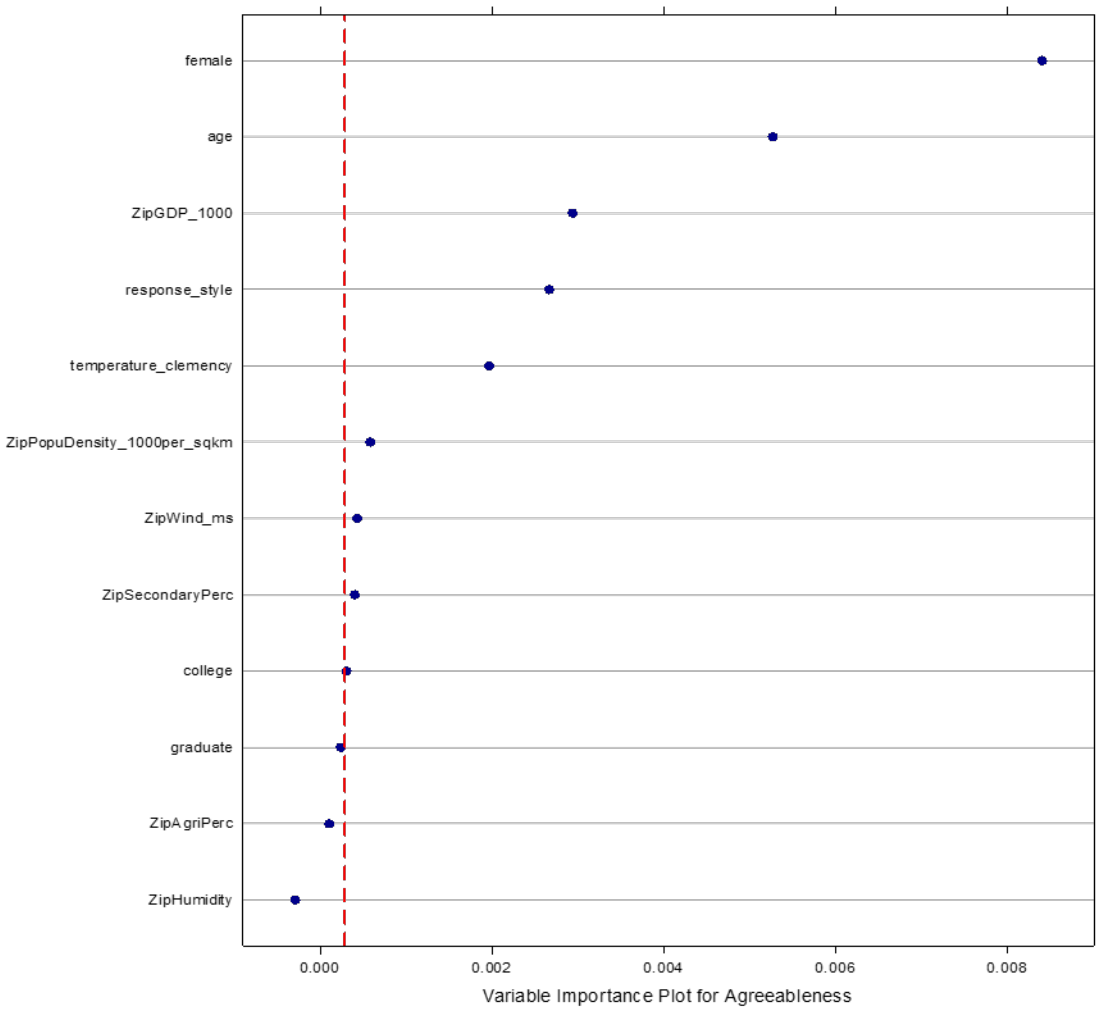
Supplementary Figure 11. Variable Importance Plot for Extraversion (Study 1)
Variables to the right of the red line are likely important predictors rather than random noise.



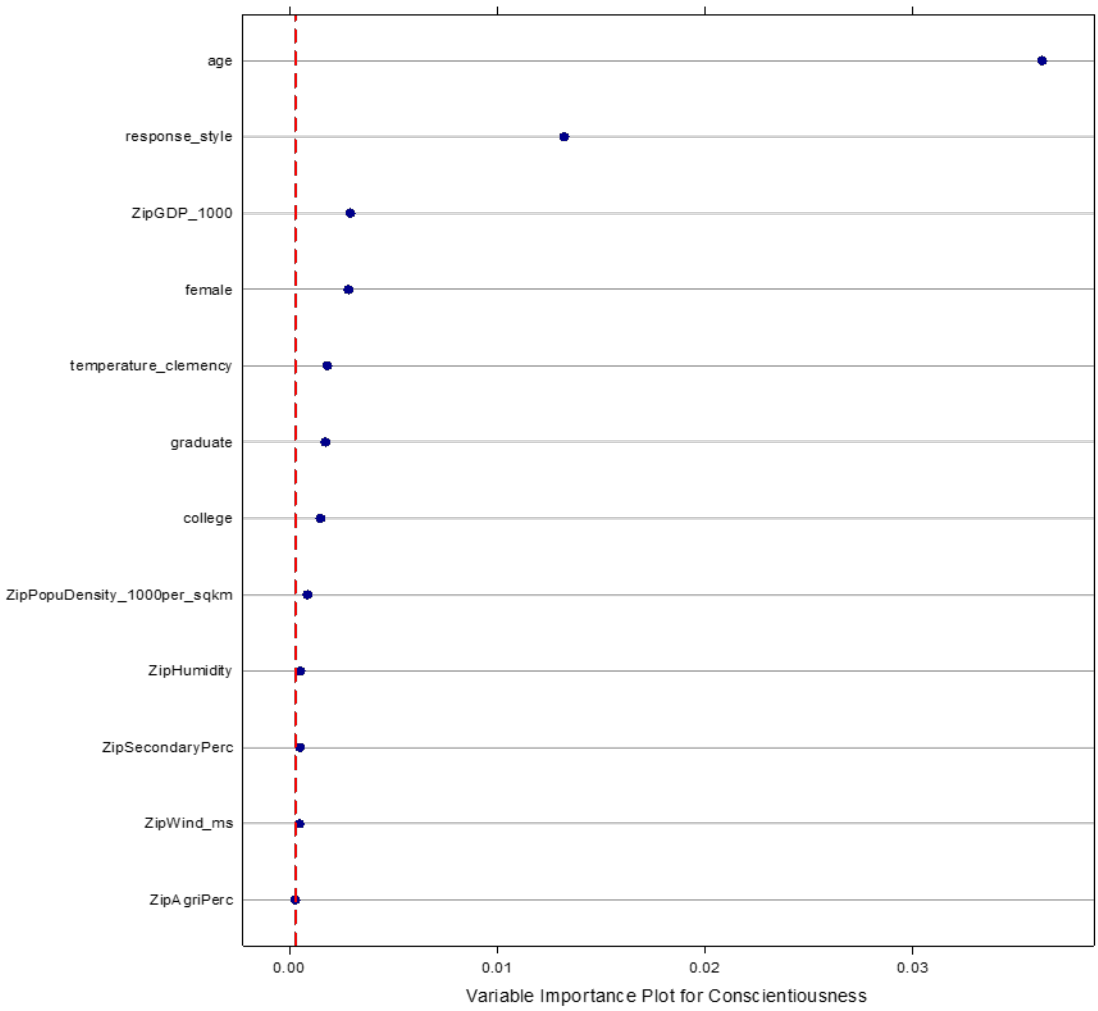
Supplementary Figure 12. Variable Importance Plot for Openness to Experience (Study 1)
Variables to the right of the red line are likely important predictors rather than random noise.



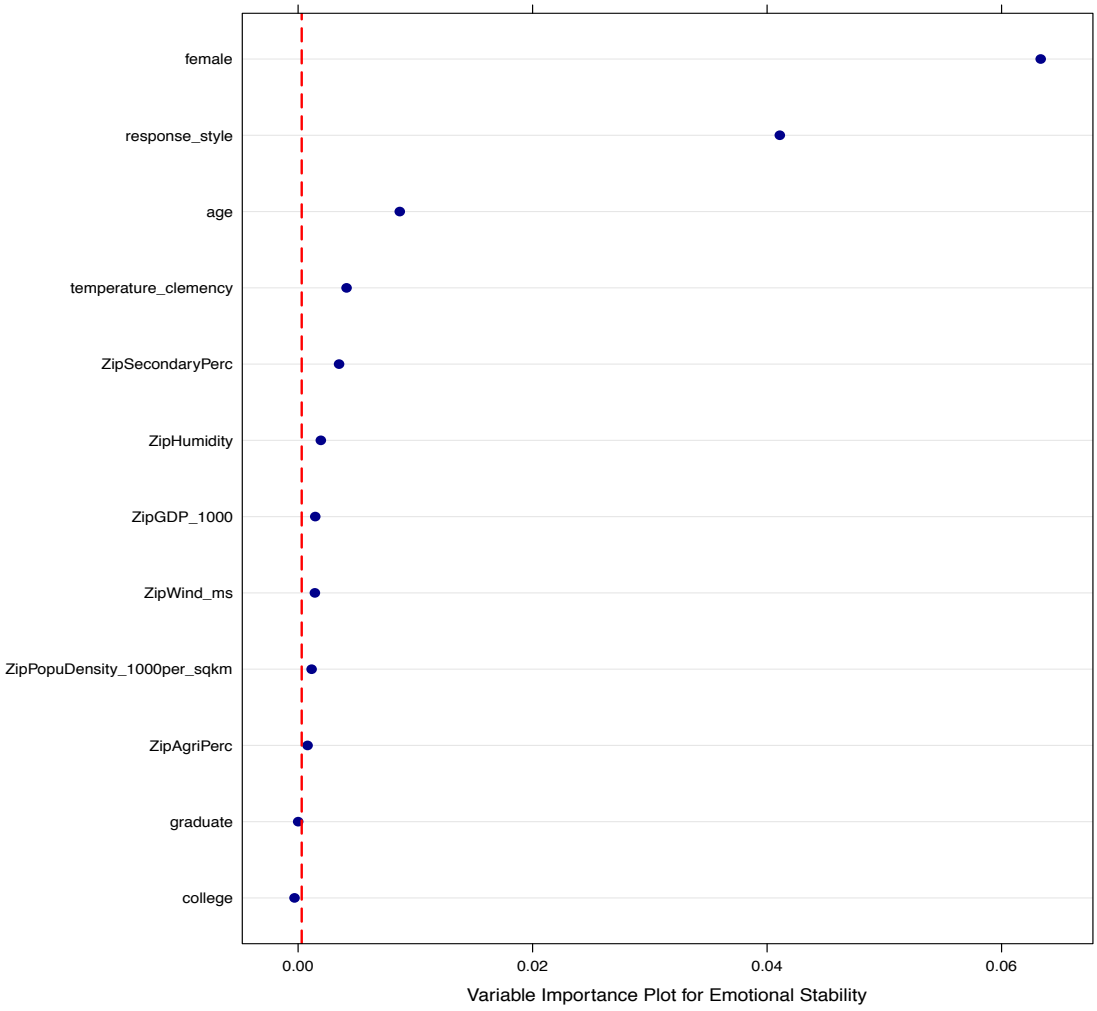
Supplementary Figure 13. Variable Importance Plot for Agreeableness (Study 2)
Variables to the right of the red line are likely important predictors rather than random noise.



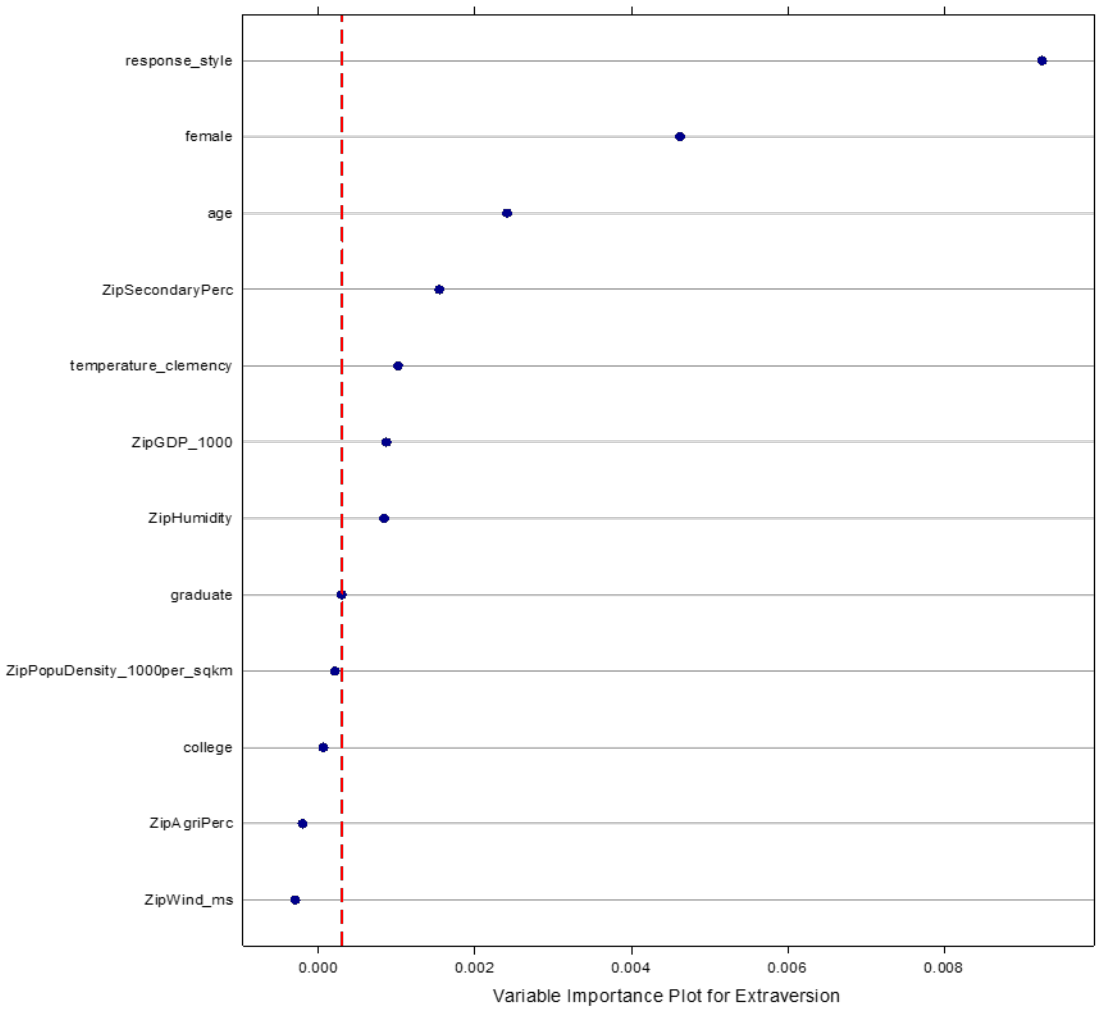
Supplementary Figure 14. Variable Importance Plot for Conscientiousness (Study 2)
Variables to the right of the red line are likely important predictors rather than random noise.



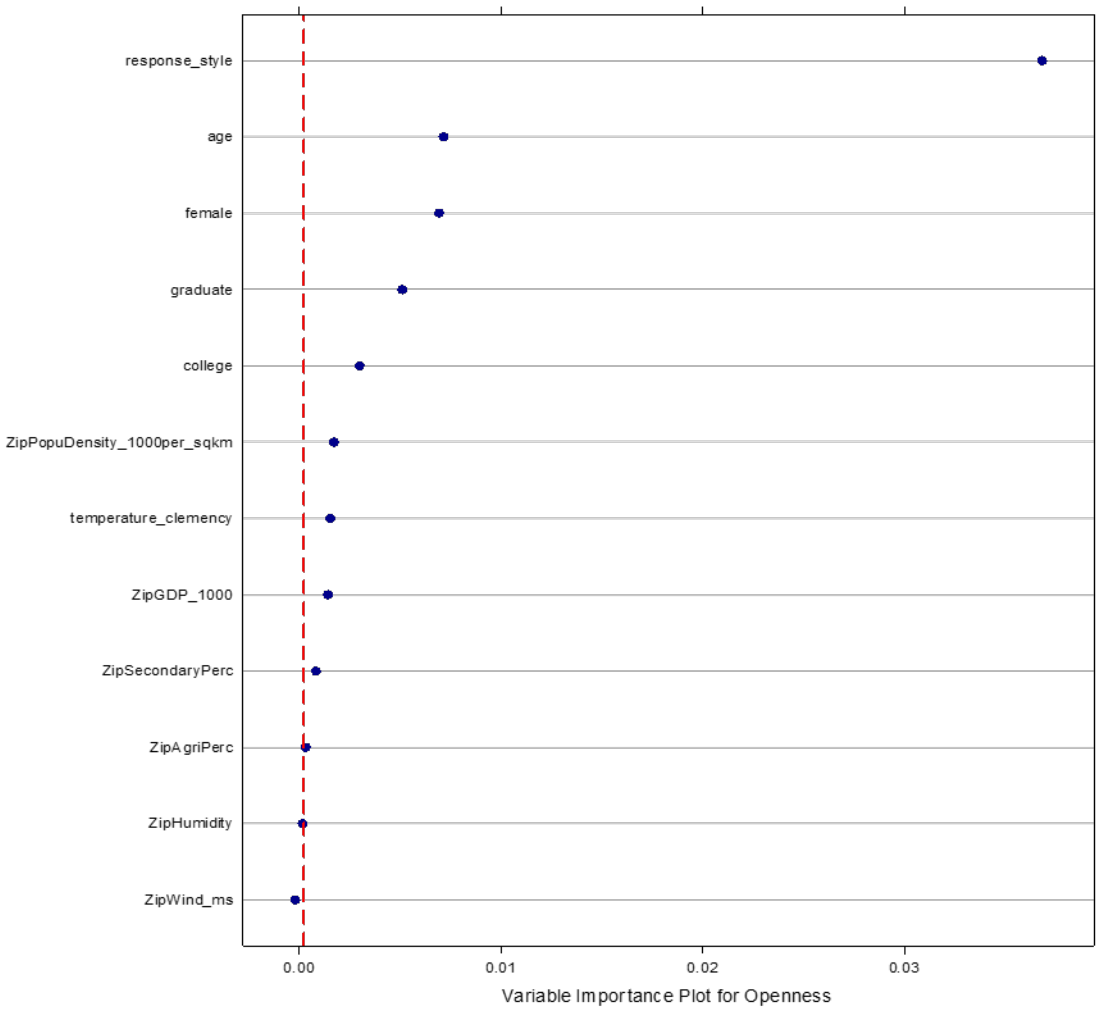
Supplementary Figure 15. Variable Importance Plot for Emotional Stability (Study 2)
Variables to the right of the red line are likely important predictors rather than random noise.



Supplementary Figure 16. Variable Importance Plot for Extraversion (Study 2)
Variables to the right of the red line are likely important predictors rather than random noise.



Supplementary Figure 17. Variable Importance Plot for Openness to Experience (Study 2)
Variables to the right of the red line are likely important predictors rather than random noise.



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