On the relationship between Openness to Experience, political orientation, and pro-environmental behavior

Sina A. Klein\textsuperscript{a,}\textsuperscript{*}, Daniel W. Heck\textsuperscript{b}, Gerhard Reese\textsuperscript{a}, Benjamin E. Hilbig\textsuperscript{a}

\textsuperscript{a} University of Koblenz-Landau, Germany
\textsuperscript{b} University of Mannheim, Germany

ARTICLE INFO

Keywords:
Openness
Political orientation
Environmentalism
Public goods

ABSTRACT

Previous research consistently showed that Openness to Experience is positively linked to pro-environmental behavior. However, this does not appear to hold whenever pro-environmental behavior is mutually exclusive with cooperation. The present study aimed to replicate this null effect of Openness and to test political orientation as explanatory variable: Openness is associated with a left-wing/liberal political orientation, which, in turn, is associated with both cooperation and pro-environmental behavior, thus creating a decision conflict whenever the latter are mutually exclusive. In an online study ($N = 355$) participants played the Greater Good Game, a social dilemma involving choice conflict between pro-environmental behavior and cooperation. Results both replicated prior findings and suggested that political orientation could indeed account for the null effect of Openness.

Among the many types of behavior that are influenced by personality, attention has increasingly focused on pro-environmental behavior (PEB) – arguably due to its drastically increasing real-life relevance. Within the five-factor model of personality (McCrae & Costa, 1999), the traits most commonly linked to PEB are Openness to Experience (simply termed Openness in what follows) and Agreeableness (Hirsh, 2010; Hirsh & Dolderman, 2007; Markowitz, Goldberg, Ashton, & Lee, 2012; Milfont & Sibley, 2012; Nisbet, Zelenski, & Murphy, 2008). Similarly, within the HEXACO model of personality (Ashton & Lee, 2007), Openness and, to a certain extent, Honesty-Humility (Brick & Lewis, 2014; Hilbig, Zettler, Moshagen, & Heydasch, 2013; Lee, Ashton, Choi, & Zachariassen, 2015; Markowitz et al., 2012) have been linked to PEB.

Although the results of the above studies are largely consistent, recent evidence suggests that they may have been partial overgeneralizations. Specifically, Klein, Hilbig, and Heck (2017) argued that existing research regarding PEB in general and the effects of personality on PEB in particular is limited to a specific subset of relevant real-life situations. That is, most studies relied on pro-environmental attitudes, behavioral intentions, or self-reported behavior as a measure for PEB rather than actual behavior. More importantly, even when actual PEB was assessed, PEB was almost always confounded with cooperation. For example, in a common resource dilemma (Hardin, 1968), choosing the sustainable option simultaneously implies cooperating with one’s group in the dilemma (Klein et al., 2017; Zelenski, Dopko, & Capaldi, 2015).

As a result, previous research has been limited to intentions and attitudes for PEB and/or situations in which PEB is aligned with cooperation.

However, there are many real-life situations in which PEB and cooperation are mutually exclusive or even in direct conflict, for example when deciding between organic versus fair trade products or when arguing with one’s flat mates about getting a green energy plan despite its increased cost. In the former example, the organic product is the pro-environmental choice whereas the fair trade product is the cooperative choice. Thus, since there is no product combining both attributes, PEB and cooperation are mutually exclusive. In the latter scenario, one can either cooperate with one’s flat mates and choose a cheaper but unsustainable energy plan or behave pro-environmentally and choose the green energy plan, implying non-cooperation. This situation involves direct conflict between the two types of behavior. As these examples demonstrate, corresponding situations are common in real life and arguably deserve more attention in empirical research.

Klein et al. (2017) developed a social dilemma paradigm in which PEB and cooperation are mutually exclusive (or in direct conflict) and used it to test the role of personality in PEB. In this so-called Greater
Good Game, individuals play in anonymous groups of three and choose between (1) keeping their endowment, (2) cooperating by contributing it to a group account where it is doubled and shared between all group members (essentially a public goods condition; Kollock, 1998; van Dijk & Wilke, 1995), and (3) behaving pro-environmentally by contributing it to a donation account where it is also doubled and given to an environmental organization. As players can only choose one option, cooperation and PEB are mutually exclusive. In other words, non-selfish behavior can only be cooperative or pro-environmental but never both.

Klein et al. (2017) found that individuals high in Honesty-Humility were more likely to contribute to either greater good (environment or cooperation) than individuals low in Honesty-Humility, thus behaving less selfishly which is consistent with many prior findings on Honesty-Humility (Hilbig et al., 2015; Hilbig, Glocèrner, & Zettler, 2014; Hilbig, Zettler, Leist, & Heydasch, 2013; Zhao, Ferguson, & Smillie, 2017; Zhao & Smillie, 2015). More importantly, Openness neither predicted (non-) selfishness nor – more crucially still – whether non-selfish individuals chose PEB over cooperation or not. Thus, although prior research had found that Openness increased PEB once the latter was perfectly in line with cooperation, it appears that Openness cannot predict PEB once the latter is mutually exclusive with cooperation.

To account for this unexpected finding, Klein et al. (2017) proposed a possible explanation based on political orientation as a relevant variable linking Openness to PEB. Specifically, high Openness is typically associated with a liberal and left-wing political orientation (e.g. Brick & Lewis, 2014; Jost, Glaser, Kruglanski, & Sulloway, 2003; Zettler & Hilbig, 2010). A liberal and left-wing political orientation, in turn, is associated with both prosocial and thus cooperative (van Lange, Bekkers, Chiurumbolo, & Leone, 2012) and pro-environmental tendencies (Dietz, Stern, & Guagnano, 1998, but see Baldwin & Lammers, 2016). Thus, in previous research confounding PEB with cooperation, individuals with a liberal and left-wing political orientation experienced no particular conflict: There was always a choice option maximizing both their pro-environmental and pro-social motives. By contrast, in the Greater Good Game, PEB and cooperation are mutually exclusive which results in a conflict for left-wing/liberal individuals: It is only possible to maximize one of their motives while sacrificing the other. As a result, it is plausible that political orientation (and therefore, also Openness) no longer predicts PEB/cooperation – essentially, because there is no consistent pattern how left-wing/liberal individuals decide in this situation of conflicting motives.

Although plausible, this account was mere post-hoc speculation, implying that a direct empirical test is necessary. The purpose of the present study is thus twofold. First, we aimed to replicate the results of Klein et al. (2017) that Honesty-Humility predicts non-selfish behavior and Openness does not predict the choice between PEB and cooperation in the GGG. Second, and more importantly, we aimed to provide first evidence on whether the absence of an effect of Openness on pro-environmental behavior in the GGG can be attributed to political orientation, as proposed but not tested in Klein et al. (2017). Specifically, the statistical hypotheses associated with the substantive research questions of the present investigation were:

**Hypothesis 1.** High Honesty-Humility is associated with more non-selfish behavior in the GGG.

**Hypothesis 2.** Openness is not associated with pro-environmental behavior versus cooperation in the GGG (i.e., when PEB and cooperation are mutually exclusive).

**Hypothesis 3.** Political orientation is negatively associated with Openness, such that a more left-wing/liberal political orientation is associated with higher Openness.

**Hypothesis 4.** Left-wing/liberal political orientation is not associated with pro-environmental behavior versus cooperation in the GGG (i.e., when PEB and cooperation are mutually exclusive).

### 1. Methods

#### 1.1. Design

The study was conducted online via Amazon Mechanical Turk. In the quasi-experimental design, Honesty-Humility and Openness as well as political orientation served as predictors for decision behavior in the GGG.

#### 1.2. Material

##### 1.2.1. Personality

Honesty-Humility and Openness (as well as the remaining four basic personality dimensions which are not pertinent to the present investigation) were assessed with the 60-item HEXACO Personality Inventory Revised (Ashton & Lee, 2009). The five point Likert-type scale ranged from “I strongly disagree” to “5 strongly agree”. Internal consistencies for Honesty-Humility and Openness were acceptable ($\alpha_{\text{Honesty-Humility}} = .79$ and $\alpha_{\text{Openness}} = .81$, respectively) and both scales had typical means and standard deviations ($M_{\text{Honesty-Humility}} = 3.48, SD_{\text{Honesty-Humility}} = 0.70, M_{\text{Openness}} = 3.65, SD_{\text{Openness}} = 0.70$; Ashton & Lee, 2009). Table 1 shows internal consistencies, means and standard deviations for the other personality factors as well as correlations between personality factors.

##### 1.2.2. Political orientation

Political orientation was assessed by asking participants to place themselves both on the left−/right-wing and the liberal/conservative continuum (Graham, Haidt, & Nosek, 2009; Jost & Thompson, 2000; Zettler & Hilbig, 2010; Zettler, Hilbig, & Haubrich, 2011). Both questions were presented with a nine point Likert-type scale with low scores indicating a left-wing/liberal orientation and high scores indicating a right-wing/conservative orientation, respectively.

##### 1.2.3. Greater Good Game

The Greater Good Game was used in its baseline version (Klein et al., 2017), in which PEB and cooperation are mutually exclusive. Specifically, participants choose between (1) keeping their endowment, (2) contributing it to a public goods account of their group, or (3) investing it in environmental conservation. In the baseline condition of the game, choosing one option does not bear any monetary consequences for the other two accounts, thus rendering the options mutually exclusive without direct conflict. Both the money in the public goods account and the money for environmental conservation are doubled by the experimenter. The former is equally distributed across all group members and the latter is donated to an environmental conservation organization. The environmental organization to which the

### Table 1

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>PO</th>
<th>HH</th>
<th>Em</th>
<th>Ex</th>
<th>Ag</th>
<th>Co</th>
<th>Op</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO</td>
<td>.87</td>
<td>2.33</td>
<td>.05</td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH</td>
<td>.38</td>
<td>.70</td>
<td>.05</td>
<td></td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Em</td>
<td>3.17</td>
<td>.62</td>
<td>.12</td>
<td>.22</td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex</td>
<td>3.13</td>
<td>.78</td>
<td>.10</td>
<td></td>
<td>.03</td>
<td>.28</td>
<td>.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ag</td>
<td>3.30</td>
<td>.75</td>
<td>.05</td>
<td>.29</td>
<td>.03</td>
<td>.21</td>
<td></td>
<td>.09</td>
<td>.78</td>
</tr>
<tr>
<td>Co</td>
<td>3.53</td>
<td>.54</td>
<td>.06</td>
<td>.29</td>
<td></td>
<td>.21</td>
<td></td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>Op</td>
<td>3.65</td>
<td>.70</td>
<td>.23</td>
<td>.18</td>
<td>.06</td>
<td>.14</td>
<td>.07</td>
<td>.27</td>
<td>.81</td>
</tr>
</tbody>
</table>

Notes: PO = Political orientation (higher scores = more right-wing/conservative); HH - Op = HEXACO factors; Internal consistencies (Cronbach's $\alpha$) are reported in the main diagonal.

* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$. 
(hypothetical) donations would be given in this study was the World Wildlife Fund (WWF).

1.3. Procedure

First, participants provided informed consent and responded to demographic questions and the two questions assessing political orientation. Next, participants filled in the personality inventory and a number of other short scales which were not pertinent to the present investigation. The order of all inventories was randomized. The GGG was then explained in detail and participants were given an example. To ensure that all participants understood the task, two comprehension checks followed. In case of an incorrect answer, participants were taken back to the instructions until both comprehension checks were answered correctly. Once this was the case, participants completed 20 hypothetical trials of the GGG with starting endowments ranging from 0.50 USD to 10.00 USD in 0.50 USD steps presented in random order. The questionnaires throughout the study entailed four attention checks such as “Please respond with ‘strongly agree’” (compare Goodman, Cryder, & Cheema, 2013). Only participants who answered all four attention checks correctly and made no more than two mistakes in the comprehension checks for the GGG received a 1.50 USD flat fee as compensation and were included in the analysis. These inclusion criteria were set a-priori. All materials and instructions are available on [https://osf.io/gxjc9/].

1.4. Analytical strategy

The structure of the GGG can be modeled with a multinomial processing tree (MPT) model (Batchelder & Riefer, 1999) with two parameters (see Klein et al., 2017). Parameter $s$ distinguishes between the selfish choice (probability $s$) and any of the two non-selfish choices (probability $1 - s$). Given a non-selfish choice, parameter $e$ distinguishes between pro-environmental behavior (probability $e$) and cooperation (probability $1 - e$). To account for individual differences, we used a Bayesian hierarchical extension of the MPT model. In these hierarchical MPT models, the two probability parameters $s$ and $e$ are modeled similarly as in a logistic regression. Thus, it is possible to include personality factors as predictors for the model parameters. Fitting the model in the Bayesian framework has the advantage that credibility intervals have a simple interpretation as the range of the most plausible parameter values given the data (Morey, Hoekstra, Rouder, & Wagenmakers, 2016). Moreover, the Bayes factor allows quantifying evidence both for and against an effect of personality traits on the model parameters (Wagenmakers, 2007). For instance, a Bayes factor of $BF_{10} = 3$ implies that the odds in favor of the alternative hypothesis $H_1$ (which assumes a non-zero effect) versus the null hypothesis $H_0$ increase by a factor of three in light of the data. Vice versa, a Bayes factor of $BF_{01} = 3$ (note the difference in the subscript) indicates corresponding evidence in favor of the null hypothesis $H_0$ versus the alternative hypothesis $H_1$.

All hierarchical MPT models were fitted using the R package TreeBUGS (Heck, in press; Heck, Arnold, & Arnold, 2018), which draws posterior samples of the parameters using Markov chain Monte Carlo methods. We used 8 chains with 80,000 iterations each, which resulted in a good convergence for all models as indicated by both graphical checks and convergence diagnostics. The complete data and R code are available on [https://osf.io/gxjc9/].

1.5. Sample

As the concept of power is not defined for the Bayesian hierarchical MPT model, we based our sample size considerations on Klein et al. (2017). In their second study, 156 participants completed 20 trials of the GGG each, resulting in a total of 3120 observations. The resulting Bayes factor for the absence of an effect of Openness on parameter $e$ was close to three indicating only moderate evidence for the null hypothesis. We thus aimed for a larger sample size for the present study, thereby increasing the chances to observe decisive Bayes factors ($> 3$) for all hypotheses. Participants were only included in the sample if they met the criteria for the attention and comprehension checks (see above, $n = 37$ did not fulfill these criteria).

The final sample consisted of 355 participants (and thus 7100 observations). All participants were US citizens and aged between 19 and 69 years ($M = 35.2, SD = 10.1$). Gender was approximately evenly distributed (44% female). Most participants were native speakers (96%) and in employment (79%) with either a college/university (64%) or High School degree (28%).

2. Results

Participants rated themselves slightly more left- than right-wing orientated ($M = 3.91, SD = 2.31$ on a nine point scale) and rather more liberal than conservative ($M = 3.84, SD = 2.42$). The two items for political orientation correlated highly ($r = .95, p < .001$), and hence, we used the mean of these items per individual as a single measure of political orientation for all further analyses (cf. Jost & Thompson, 2000). Table 1 summarizes all means, standard deviations, and correlations between variables.

In the GGG, cooperation (47.27%) was the most frequent choice followed by the selfish option (42.79%). Correspondingly, the pro-environmental option was chosen least frequently (9.94%). Comparing the environmental option followed by the selfish option (42.79%). Correspondingly, the pro-environmental option was chosen least frequently (9.94%). Comparing these results to those reported by Klein et al. (2017), the rank order of preferences is identical. However, the absolute rate of selfish behavior in the present study was larger as compared to the two studies of Klein et al. (2017). In a hierarchical multinomial model without any predictors for the parameters, the posterior means for the overall group-level means were $s = .43$ for the probability of selfish vs. non-selfish choices (with a 95% credibility interval of [.39; .47]) and $e = .19$ for the probability of pro-environmental vs. cooperative choices (95%CI [16; .23]).

To replicate the results of Klein et al. (2017), we fitted a hierarchical MPT model with Honesty-Humility as predictor for parameter $s$ and with Openness as predictor for parameter $e$. The regression coefficient for Honesty-Humility on parameter $s$ was estimated to be $\beta = -0.682$ with a 95%CI of [$-1.047$; $-0.330$]. The Bayesian credibility interval excludes zero, thus indicating that higher values of Honesty-Humility indeed lead to smaller values of parameter $s$, that is, more non-selfish choices. Substantively, the fitted model predicts that the probability of behaving selfishly decreases from 50.2% to 34.9% for participants one SD above versus one SD below the mean on the Honesty-Humility scale. The Bayes factor in favor of the hypothesis that $\beta$ was smaller than zero versus exactly zero was $BF_{01} = 201$, thus indicating extreme evidence for Hypothesis 1. The regression coefficient for Openness on parameter $e$ was estimated to be $\beta = -0.142$ with a 95%CI of [-0.424, 0.134].

Data was collected in two waves because the Bayes factor was not decisive for all hypothesized effects with the first sample ($n = 202$). Importantly, this is a valid strategy in the Bayesian framework, since optional stopping is not a problem for the Bayes factor or Bayesian inference in general (Rouder, 2014). We simulated the possible trends for the indecisive Bayes factor with the data of the first wave to determine the sample size of the second wave ($n = 153$).

4 To take group variability into account, we used the bivariate inverse-probit transformation (Heck et al., 2018).
As the Bayesian credibility interval included zero, Openness did not seem to have an effect on parameter $e$ and therefore, no effect on the choice between pro-environmental and cooperative behavior. This was confirmed by the Bayes factor for the null hypothesis that $\beta$ is zero versus the two-sided alternative that it differs from zero, which was $BF_{01} = 24.1$. This provides strong evidence for Hypothesis 2 that Openness does not predict PEB versus cooperation. Altogether, the analysis fully replicates the results of Klein et al. (2017).

For the analysis of the hypotheses regarding political orientation, we first computed the zero-order correlation of political orientation and Openness. Political orientation correlated significantly with Openness such that a more left-wing/liberal political orientation was associated with higher values in Openness ($r = -0.23, p < .001$). The Bayes factor (Wetzels & Wagenmakers, 2012) in favor of the hypothesis that the correlation between political orientation and Openness is negative versus zero was $BF_{01} = 1545$, which indicates extreme evidence for the alternative hypothesis. Therefore, Hypotheses 3 is supported.

Next, we fitted an MPT model with political orientation as predictor for parameter $e$ to test whether political orientation is associated with decision behavior in the GGG. The regression coefficient was estimated to be $\beta = -0.056$ with a 95%CI of $[-0.142, 0.031]$. The Bayesian credibility interval included zero, thus indicating that political orientation did not predict the choice between pro-environmental and cooperative behavior. Correspondingly, the Bayes factor in favor of the null hypothesis that $\beta$ is zero versus the alternative hypothesis that $\beta$ differs from zero was $BF_{01} = 5.5$, which provides moderate evidence for Hypothesis 4.\(^5\)

3. Discussion

Previous research has almost consistently shown that high trait Openness is typically associated with more PEB (Brick & Lewis, 2014; Hilbig, Zettler, Moshagen et al., 2013; Lee et al., 2015; Markowitz et al., 2012). However, Klein et al. (2017) argued that previous studies almost exclusively investigated situations in which PEB and cooperation were aligned whereas scenarios in which PEB and cooperation are mutually exclusive or in direct conflict have been largely neglected in the literature. First evidence on such situations was provided in a recent study by Klein et al. (2017) who showed that in a situation of mutual exclusiveness, Openness did not predict PEB (versus cooperation).

The present study aimed to replicate these results and additionally investigate whether the null effect of Openness on PEB can be explained through political orientation: Because a left-wing/liberal political orientation – a well-established outcome of high trait Openness – is associated with both the tendency to cooperate (van Lange et al., 2012) and the tendency to show PEB (Dietz et al., 1998), it is plausible that political orientation creates a choice conflict in situations in which cooperation and PEB are mutually exclusive. As a consequence, political orientation and thus, by implication, Openness, cannot predict behavior in such situations.

In the present study, we assessed both personality and political orientation as well as choice behavior in the GGG, a game disentangling PEB and cooperation. First, fully replicating the results of Klein et al. (2017), the rank order of preferences in the GGG was cooperation, followed by selfish behavior and finally PEB. In other words, most participants opted for cooperation and fewest for PEB. Second, also replicating Klein et al. (2017), high Honesty-Humility was again associated with more non-selfish choices in the GGG and Openness did not predict PEB versus cooperation. Most importantly, results revealed that a left-wing/liberal political orientation – although associated with Openness in the typical direction – could not predict PEB in a situation of mutual exclusiveness with cooperation. The empirically observed pattern – that Openness was associated with a left-wing/liberal political orientation, and neither of the two predicted PEB in the GGG – is thus fully compatible with the explanation that a left-wing/liberal political orientation creates a choice conflict in situations in which PEB and cooperation are mutually exclusive and thus neither political orientation nor Openness can predict behavior in such situations. However, as correlational studies cannot prove or disprove mediation hypotheses such as the present research question but merely provide supporting evidence (Fiedler, Schott, & Meiser, 2011), these results have to be interpreted with caution.

Overall, the present study contributes to our understanding of personality traits in general and Openness in particular as predictors of PEB. Whereas the predictive power of Openness on PEB was consistent over all previously investigated situations, Klein et al. (2017) and the present study show that this is not the case in a situation where PEB is mutually exclusive with cooperation. Furthermore, the present study provides first evidence on why this might be the case and generalizes the findings of Klein et al. (2017) by using a diverse sample and an online setting instead of a student sample in a lab setting.

As an outlook, the current study opens up various paths for future research. For example, the finding that the pro-environmental choice was least likely chosen suggests that participants may generally give priority to altruistic as compared to biospheric value orientations (Schultz, 2001). In turn, one may speculate that this effect can reverse once the pro-environmental choice is framed as an altruistic issue, for instance once the pro-environmental choice is framed as an action that will benefit one’s social group (or, on a larger scale, humanity as a whole) in the long run. By implication, framing the pro-environmental choice as a cooperative option should also dissolve the conflict experienced by individuals high in Openness and with a left-wing/liberal political orientation: If an option combines cooperative and pro-environmental tendencies, this option should be preferred over an option only serving one motive. Future research should investigate whether and how framing of choice options even in situations in which cooperation and PEB are mutually exclusive can dissolve the choice conflict of individuals with both cooperative and pro-environmental tendencies and thereby promote PEB.

Acknowledgments

Preparation of this manuscript was supported by the research-training group Statistical Modeling in Psychology, funded by the German Research Foundation (DFG; GRK 2277) and a grant from the German Research Foundation to the last author (DFG; HI 1600/6-1).

References


---

\(^5\) As a robustness check, we also fitted a model with both Openness and political orientation as predictors for both parameters, $s$ and $e$. All Bayes factors were in support for the null hypotheses (the only exception was an indecisive $BF_{01} = 2.6$ for the effect of Openness on parameter $e$). In conclusion, results support the main hypothesis regarding Openness, political orientation, and parameter $e$. 

---


