Good ethics cannot stop me from exploiting: The good and bad of anthropocentric attitudes in a game environment

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Abstract Video games have the potential to be a tool for communicating pro-environmental values. The present study examines the correlation between players’ environmental attitudes and their interaction with virtual natural resources. This study constructs Bayesian ordinal logistic models to analyze survey data of 640 Animal Crossing: New Horizon (ACNH) players from 29 countries. Results show that the frequency of catching in-game animals (fish and insects) is positively correlated with the level of human centeredness in environmental attitudes. In addition, less anthropocentric players tend to use more sustainable methods to collect woods in ACNH. Such a particular way of interacting with in-game animals and trees based on their species may be attributable to players’ environmental attitudes and game designs. This paper discusses how game design can play a role in promoting pro-environmental behaviors and highlights the moral implications of interactions with non-human beings.

Keywords Animal Crossing: New Horizon · Anthropocentrism · Environmental attitudes and behaviors · Video game behaviors

INTRODUCTION

Anthropocentric beliefs can be found in many cultures. Their manifestation is diverse, depending on how societies perceive their relationship with nature and non-human beings. For example, the Inuit believe that showing disrespect to animals would bring misfortune, so hunters would avoid causing unnecessary pain when killing (Noske 1997). However, hunting is still allowed because they also believe that animals agree to be hunted by humans to reproduce and thrive (Rasing 1988). While Judeo-Christianity traditions arguably embrace the idea of human dominion over the earth despite concerns about the underlying environmentally destructive behaviors and attitudes, other interpretations of the Bible suggest the feasibility of a harmonious human–nature relationship where humans protect and take care of God’s creations, including nature and non-human beings (White 1967; Dobel 1977; Grey 1998; Fleck 2001; McLaughlin 2017). However, the concept of “anthropocentrism” as relating to human dominion over nature faces criticism due to the inconsistent interpretations, such as how anthropocentric beliefs can encourage people to protect nature and non-human beings (Hayward 1997; Noske 1997; Kopnina et al. 2018).

Anthropocentrism is a major topic in environmental attitude studies. This paper investigates the association between anthropocentric attitudes and in-game environmental behaviors of Animal Crossing: New Horizon (ACNH) players because the game was suggested to influence environmental attitudes in players (Fisher et al. 2021). Released by Nintendo in March 2020, ACNH attracted nearly 20 million people in just 9 months during the COVID-19 pandemic (Lane 2021). The virtual sandbox environment of ACNH allows players to interact with nature in many ways. For instance, the Inuit believe that showing disrespect to animals would bring misfortune, so hunters would avoid causing unnecessary pain when killing (Noske 1997).
life situations (e.g., purchasing and improving properties, trading items between players). Thus, players need to solve practical problems while playing (Mateer and O’Roark 2020).

To explore how human-centered worldviews correlate with players’ interactions with non-human entities in the virtual environment, this paper uses Bayesian ordinal logistic models to analyze survey data of 640 ACNH players from 29 countries. The findings are expected to expand our understanding of the psychology of anthropocentrism and provide preliminary empirical evidence on the correlations between in-game behaviors and environmental attitudes.

**LITERATURE REVIEW**

**Anthropocentrism and anthropocentric attitudes**

The term “anthropocentrism,” first coined in the middle of the nineteenth century, refers to human centeredness in environmental ethical views (Campbell 1983). Much disagreement about anthropocentrism concentrates on the inconsistent meaning of “anthropocentrism.” In a strong sense, anthropocentric perspectives consider the value of non-human beings based on their utilitarian value for humans (Callicott 1984; Norton 1994; Carter 2007; Palmer et al. 2014). Meanwhile, Hayward (1997) argued that anthropocentrism is different from speciesism and human chauvinism because the latter two give human privileges over others for arbitrary moral reasons (Hayward 1997; Kopnina et al. 2018). Mylius (2018) criticized previous definitions for creating a false impression about anthropocentrism. He suggested that we should seriously connect it to “contemporary life and contemporary question” to understand the concept.

According to Mylius (2018), using a strong definition of anthropocentrism can be too rigid in many ways. Anthropocentric beliefs do not necessarily consider humans as the only ones with moral importance and lead to a hostile human–nature relationship. Current debates on anthropocentrism have focused on anthropocentric views originating from the West, and numerous works argued that they conditioned environmentally destructive behaviors (White 1967; Turner 2009). For example, White (1967) criticized the anthropocentric view in Judeo-Christian traditions for identifying humans as the supreme ruler of nature and its non-human members, contributing to the ecological crisis. It inadequately gives moral consideration to nature and acknowledges the intrinsic values of non-human contents like trees (Diehm 2008) and animals (Singer 1995; Regan 2004; Steiner 2005). However, McLaughlin (2017) found that other parts of the Bible imply a much more peaceful relationship between humans and nature, not human dominion. Anthropocentric beliefs in other societies show that they could result in benign human–nature interactions. Some Australian Aboriginal hunting tribes are found to assign substantial moral and religious significance to nature (Rasing 1988; Noske 1997). They believe that animals need humans to perform rituals to survive and thrive (Bennett 1983; Morton 1991). In these examples, anthropocentrism refers to human-centered worldviews, and it could bring in both positive and negative human–nature relations. Therefore, anthropocentricity and bio-centricity in environmental perspectives do not have to be mutually exclusive. An individual with strong bio-centric beliefs can also be anthropocentric without feeling any conflict. This ambivalent attitude toward nature can be documented under the term “anthro-bio-centrism” (Davis 2020).

With its complex nature, an anthropocentric attitude is complicated to measure. Attitudes are favorable or unfavorable evaluations of objects and are constructed by three components: affect, cognition, and behavioral predispositions (Olson and Zanna 1993; Gifford and Sussman 2012). However, there is no consensus on the method of measuring environmental attitudes. Some researchers approach this question by simply asking people whether they have negative or positive opinions about specific subjects such as marine conservation (Marshall et al. 2010), poaching (Sundström et al. 2020), and natural resources (Chase and Levine 2018). Some evaluated attitude through its components (i.e., affect, cognition, and behavioral predispositions) or related constructs such as values (Shin et al. 2017; Glikman et al. 2019). To predict environmental behaviors, many empirical studies used the latter approach by applying models such as Wildlife Value Orientations (Fulton et al. 1996), New Environmental Paradigm (Dunlap et al. 2000), Two Major Environmental Values (Bogner and Wiseman 2006) since values are powerful predictors of attitudes and behaviors. However, attitudes are more reliable than values when predicting behaviors because values represent sets of desirable means or ends and, thus, broader than attitudes (Rokeach 1973). Values and general attitudes can predict behaviors with low accuracy, whereas attitudes toward specific matters can predict corresponding behaviors with high accuracy (Ajzen 2012).

As anthropocentrism is an abstract concept, empirical studies need to survey attitudes toward specific matters to determine anthropocentric orientation. For example, Gagnon Thompson and Barton (1994) investigate whether human needs (e.g., resources for future generations) or the intrinsic value of nature motivate conservation. This paper chooses the 12th item in New Ecological Paradigm Scale by Dunlap et al. (2000) to measure anthropocentric attitudes. This scale has been used to evaluate environmental
Video games and attitudinal changes

This section focuses on whether video games could change attitudes, incorporate new information, and transfer it to players. There are two notable conversations in the field of game studies. The first is that violent games have been argued to produce aggressive thoughts and eventually induce violent behaviors in real life (Squire 2002). However, new evidence suggests that video games are not related to violent behaviors (Przybylski and Weinstein 2018). The second conversation concerns game as an educational tool, which evolved into a large body of game-based learning literature. A thorough discussion about the state of the art of these topics is necessary to understand the potential link between game-playing and attitudinal changes.

The views about violence and video games are mixed. The General Aggression Model (GAM), a notable theoretical framework proposed by Anderson and his colleagues, specified two major players who could increase the risk of aggression: person and situation factors (Allen et al. 2018). Briefly, this framework assumed that the accessibility of violent concepts due to repetitive exposure to violent game content primes the formation of aggressive thoughts and emotions. The magnitude of violent content effects could be offset or augmented by personal traits (Allen et al. 2018). According to Anderson et al. (2010), aggression effects of violent games were reported in experimental, cross-sectional, and longitudinal studies and seemed to be consistent across ages, gender, and cultures. However, this analysis was argued to have substantial publication bias in experimental research, and the adjustment of which resulted in a reduction of aggression effect (Hilgard et al. 2017). The inconsistency of empirical evidence made it impossible to claim that violent games have aggression effects (Elson and Ferguson 2014).

Empirical evidence suggested that it was not violent game contents but factors such as competition (Adachi and Willoughby 2011) and outcome (Breuer et al. 2015) that triggered aggressiveness. In addition to this, the GAM framework was also criticized for: (1) underestimating human ability to separate game space from reality; and (2) assuming that individuals seemed to lack control over the information being absorbed or rejected while playing. As humans can recognize that social characters in games are not real, they do not give them moral consideration regardless of how they look like a human (Hartmann and Vorderer 2010; Ferguson and Dyck 2012). Therefore, people, who believe killing humans wrong in real life, think it is okay to kill human characters in the game (Hartmann 2017). The influence of violent games on players’ real life may be limited because of the drastic differences between reality and in-game environments (Ferguson and Dyck 2012). In a physical world, people would expect negative consequences of perpetrating violence due to moral standards, laws, etc.

Meanwhile, digital environments provide freedom with almost no obligations to follow real-life standards. Games may reward a player for killing instead of punishing, and players may have no negative feelings after conducting a harmful action against others (Hartmann 2017). When these barriers between game and reality exist, players may refrain from turning in-game thoughts and actions into reality, making it hard to use games to change attitudes and behaviors (Whitty et al. 2011; Daneels et al. 2018). Besides, some scholars argued that the relationship between video games and behaviors could be reverse causality. Although the direction of causality has yet been decisive, players’ personalities and value systems were found to be associated with their in-game behaviors (Worth and Book 2015; Wang and Yu 2017; Seong et al. 2019).

Digital game-based learning studies showed some potential influences of games on human attitudes and behaviors. Games have been used in many subjects, such as language (My Spanish Coach) and science (Physicus, GeoWorld, Universe Sandbox), but their effects on learning outcomes were mixed. Young et al. (2012) performed a meta-analysis with 37 articles examining the relationship between gaming and academic achievement and found positive effects in some subjects (language learning, history, and physical education) but not others (science and math). Meanwhile, Vogel et al. (2006) showed that digital game-based learning consistently created better cognitive outcomes and attitudes toward the subject than traditional methods. They also found that the limitation in freedom to navigate themselves in games could mitigate such positive effects.

Although it is still uncertain that games impact players, there is firm evidence that incorporating and transferring information in games could be much easier than traditional methods (books, classrooms, etc.). Environmental educational game studies show this advantage. In a virtual world that imitates reality well, players obtain experience as if it is real (Ahn et al. 2014). When most people cannot access
the wilderness, virtual experience with games could allow players to have a new perception of nature and increase connectedness with nature (Yeo et al. 2020). Players were recorded to exhibit out-of-game environmental-friendly attitudes and behaviors after playing games, such as energy saving (Orland et al. 2014; Ro et al. 2017; Casals et al. 2020), recycling (Centieiro et al. 2011), and waste reduction (Ahn et al. 2014). Hence, even though humans are equipped to distinguish between fictional and real worlds, which could mitigate games’ effect on humans (Ferguson and Dyck 2012), games are still a promising communication tool that helps impart knowledge and potentially change attitudes and behaviors. However, the ability to make attitudinal changes depends on in-game elements, such as narrative, esthetics, and core game mechanics, which play important roles in facilitating learning outcomes (Alexiou and Schippers 2018).

The design of ACNH offers an opportunity to explore the correlation between the in-game behaviors of ACNH players and their beliefs in anthropocentrism. It is a simulation game where players generate and design the environment of their islands within a pre-programmed “everyday life” narrative. Players follow this pre-programmed narrative with the general goal of building and decorating the island. They are involved in economic activities and human–nature affairs, which resemble those in real life. They collect, create, and sell items (fish, bugs, gold, fruits, etc.) to earn money, pay off mortgages, donate to museums, buy new items, etc. During this process, players have to interact with in-game nature and non-human beings (plants, flowers, fish, bugs) and can engage in both pro-environmental activities and environmentally destructive ones (Fisher et al. 2021). Players have a certain degree of freedom to create their own storyline, explore ways to upgrade their island, and interact with in-game nature because the missions in Animal Crossing are open ended, and players are not obliged to do them (Kim 2014). For example, they can go fishing for museum donations or money or be involved in other activities (seeking gold, collecting clams, planting flowers and plants). However, activities such as catching fish and bugs and seeking fossils could be more attractive to players because they help earn money fast and are required items if players want to upgrade their museum collection.

This paper explores the correlation between in-game behaviors of ACNH players and their beliefs in anthropocentrism. As the idea “human was meant to rule over nature” was argued to be associated with environmental-destructive behaviors, we hypothesize that individuals, who exploit in-game resources such as fish, bugs, and trees more frequently, are more likely to agree with the idea of human dominion than individuals who exploit less frequently. Given the environmental crisis and the urgent need to change human behaviors and attitudes for the better, we hope this paper can provide more insights for game designers and other stakeholders in promoting pro-environmental attitudes through games.

### MATERIALS AND METHODS

#### Materials

The current analysis employs a dataset of 640 ACNH game players from 29 countries worldwide. The dataset results from a survey conducted from 15 to 30th May 2020. Survey participants are ACNH game players coming from multiple social networks, such as Facebook, Reddit, etc. The data collection process consisted of three steps to ensure the rigor of the research methodology, the community standard’s obligation, and respondents’ rights.

First, a pilot test was conducted with 15 students in Japan, Singapore, the USA, and Vietnam playing ACNH. The students were recruited from the personal networks of the authors. After completing the survey, all respondents were kindly requested to provide feedback on questions’ appropriateness and check errors. Next, the authors contacted the moderation team of ACNH communities for content validation and permission to post the questionnaire in the community. Lastly, the questionnaire was publicized with an explanation of its purpose and contents and the admins/moderation teams’ agreement for complying with the communities’ rules and standards. Before starting the questionnaire, all respondents were required to read and agree to a consent form regarding their confidentiality, the handling of research data, and the disclosure of research outcomes (Appendix S1).

Eventually, a total of 640 ACNH game players responded to the questionnaire. The majority of the respondents (55%) were from the USA and Canada, while the remaining 28.13%, 14.38%, and 2.50% of respondents were from Asia, Europe, and other countries (e.g., Argentina, Australia, and New Zealand), respectively. Respondents were relatively young, 26.1 years old on average. More female game players (64.38%) participated in the survey than their male counterparts (35.63%).

#### Bayesian model

For exploring the association between the resource exploiting behaviors of ACNH game players and their attitudes toward the idea of “human over nature,” we employ a Bayesian ordinal logistic analysis by implementing the *rethinking* R package (McElreath 2018). This section will explain why a Bayesian analysis was chosen.
First, the samples used in the current study are relatively complex due to their distinct socio-cultural backgrounds. Previous studies have shown that socio-cultural factors moderate the relationship between intentions and behaviors regarding environmental issues (Chwialkowska et al. 2020; Koon et al. 2020), so such effects might also exist in the current study. Because the Bayesian inference approach treats all the uncertainties probabilistically, it helps consider the unmodelled moderating effects and view them as a probability (McElreath 2020).

Second, the sample size of this study is relatively small. Bayesian analysis can be beneficial in two aspects. Bayesian analysis is not conditional on the asymptotic assumption, so its inference manners using small and large data sets are similar, enhancing Bayesian analysis’s prediction accuracy when analyzing a small number of observations (Uusitalo 2007). Moreover, by integrating the MCMC algorithm, Bayesian analysis offers scientists the flexibility and possibility to analyze complex models (Dunson 2001).

Third, in the Bayesian model, the prior distribution acts as one of its assumptions and does not necessarily represent the investigator’s personal belief in parameter values (Gelman and Shalizi 2013). Due to its connection to the data, when the investigators incorporate the prior to combine it with the data in the model, the prior can be checked through its implications about the posterior distribution and thus, is a testable part of the model. In addition, it acts as a device that stabilizes the estimates and makes the model less sensitive to data when the prior distribution is informative or weakly informative (Gelman and Shalizi 2013). For these reasons, investigators check the models in the Bayesian analysis procedure and select ones by comparing how well they predict new data (McElreath 2018).

### Variable description and data pre-processing

This sub-section describes the analyzed variables and how the models are specified and simulated using the MCMC method. There are seven variables comprised in the analysis (see Table 1).

The measure of attitudes toward the environment among game players is the item numbered 12th in the revised New Ecological Paradigm Scale (NEPS) by Dunlap et al. (2000). This item belongs to a sub-section consisting of three items in NEPS that concern anti-anthropocentrism. Nonetheless, an internal consistency test with Cronbach’s $\alpha$ shows a low degree of internal reliability of this sub-scale (Cronbach’s $\alpha = 0.56$). This may be attributable to the complexity of the concept “anthropocentrism” as forementioned and the cultural diversity of the sample. Due to this low internal consistency, this paper is only concerned with the 12th NEPS item, which assesses attitudes toward the idea “Human was meant to rule the rest of nature” because environmental-destructive behaviors were argued to be the product of this idea (White 1967; Fleck 2001). In this paper, players’ attitudes toward the idea of human dominion were measured ordinally on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

For investigating the resource exploiting behaviors of game players in ACNH, game players were asked about the frequency of four activities (i.e., fishing, catching bugs, taking wood, and cutting down the tree), ranging from 1 (never) to 4 (often). Then, the frequency of fishing, catching bugs, and taking woods was coded as 0 if the players never or seldomly do them, and as 1 if the players sometimes or often do them. The frequency of chopping down trees was coded as 0 if the players never cut down trees. Otherwise, it was coded as 1. In ACNH, a player must tap a tree at least three times to cut it down, so the wood can be exploited without cutting down the tree. Therefore, the decision of whether to cut down the tree or not is worth exploring because it can directly link to the nature-destructive behaviors of game players. For comparing the association of the behaviors exploiting wood with and without cutting down a tree, we added an interaction variable between two variables, “CutTree” and “TakeWood,” into the model. We also investigated the explanatory power of players’ biological sex in predicting their attitudes toward the idea of human dominance because a significant difference between sexes in their environmental perception was found in an early study using the same dataset, which signals that confounding between sex and other predictor variables might occur (Vuong et al. 2021a, b).

### Model construction and comparison

The Bayesian analysis procedure normally consists of three steps: model construction, model fitting, and model interpretation and improvement. As the outcome variable was measured ordinally, ten ordinal logistic models were constructed to explore the power of gender and in-game behaviors in predicting the “human over nature” attitudes. Table 2 lists the formula of the ten examined models: All of the above models were constructed similarly, except that they contain different combinations of predictors. This section will only explain the model with all five predictors (model.full in Table 2), its corresponding mathematical form, and the choice of priors. This will help the readers understand the other models (the detailed mathematical form and explanation of which is provided in Appendix S3). Below is the mathematical form of model.full, which represents the log-cumulative odds that a response value $y_i$ is equal or smaller than a possible response value $k$: 

$$
\text{logit}^{-1}(P(y_i \leq k | \theta)) = \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p + \theta,
$$

where $\theta$ represents the effects of the prior distribution, and $x_1, \ldots, x_p$ are the predictors.
Table 1 Description of the outcome and predictor variables used in ten examined models

| Variable type          | Variable   | Scale                              | Scale of measurement | Description                                                                 |
|------------------------|------------|------------------------------------|----------------------|-----------------------------------------------------------------------------|
| Outcome variable       | Attitude   | Strongly agree = 5 to strongly disagree = 1 | Ordinal              | The environmental attitudes of a game player toward human dominion          |
| Predictor variable     | Fishing    | 0 = Never, seldom; 1 = Often, sometimes | Binary               | The frequency that a game player goes fishing in ACNH                      |
| Predictor variable     | CatchBug   | 0 = Never, seldom; 1 = Often, sometimes | Binary               | The frequency that a game player catches bugs in ACNH                       |
| Interaction variable   | TakeWood   | 0 = Never, seldom; 1 = Often, sometimes | Binary               | The frequency that a game player takes wood from trees in ACNH              |
| Interaction between two variables | CutTree | 0 = Never; 1 = Often; sometimes, seldom | Binary               | Whether a game player frequently cuts down trees after taking wood or not  |
| Predictor variable     | Gender     | Male = 1 and Female = 0             | Binary               | The biological sex of a game player                                         |

Table 2 Examined models and their corresponding formulas. Attitude, Gender, Fishing, CatchBug, TakeWood and CutTree respectively represents the player’s environmental attitudes toward human dominion, the player’s gender, the player’s frequency of going fishing in ACNH, the player’s frequency of catching bugs in ACNH, the player’s engagement in chopping wood in ACNH, and the player’s engagement in chopping down trees.

| Model name (as coded in R) | Formula                                                                 |
|-----------------------------|-------------------------------------------------------------------------|
| model.gender                | Attitude ~ Gender                                                        |
| model.fish                  | Attitude ~ Fishing                                                       |
| model.bug                   | Attitude ~ CatchBug                                                      |
| model.wood                  | Attitude ~ TakeWood                                                      |
| model.tree                  | Attitude ~ TakeWood + TakeWood * CutTree                                 |
| model.animal                | Attitude ~ Fishing + CatchBug                                            |
| model.treegender            | Attitude ~ Gender + TakeWood + TakeWood * CutTree                       |
| model.animalgender          | Attitude ~ Gender + Fishing + CatchBug                                   |
| model.animaltree            | Attitude ~ Fishing + CatchBug + TakeWood + TakeWood + CutTree            |
| model.full                  | Attitude ~ Gender + Fishing + CatchBug + TakeWood + TakeWood + CutTree   |

Model:  $\text{Attitude} \sim \text{Gender} + \text{Fishing} + \text{CatchBug} + \text{TakeWood} + \text{TakeWood} \times \text{CutTree}$

\[
\log \frac{\Pr(y_i \leq k)}{1 - \Pr(y_i \leq k)} = \sum_{k} \phi_i - \phi_i
\]

\[
\phi_i = \beta_{\text{Gender}} \times \text{Gender}_i + \beta_{\text{Fishing}} \times \text{Fishing}_i + \beta_{\text{CatchBug}} \times \text{CatchBug}_i + \beta_{\text{TakeWood}} \times \text{TakeWood}_i + \beta_{\text{TakeWood, i}} \times \text{TakeWood}_i \times \text{CutTree}_i
\]

where $\text{Fishing}_i$ indicates the frequency of fishing in row $i$, $\text{CatchBug}_i$ indicates the frequency of catching bugs in row $i$, $\text{TakeWood}_i$ indicates the frequency of taking wood in row $i$, $\text{CutTree}_i$ indicates the frequency of cutting down trees in row $i$, and $\text{Gender}_i$ indicates the gender of the player in row $i$. $\phi_i - \phi_i$ is the log-cumulative odds of outcome value $k$. The prior of $\phi$ is assumed to be weakly informative, i.e., $N(0, 10)$. That $\beta$ is positive indicates that its corresponding predictor variable and the outcome variable (attitudes) have a positive association (McElreath 2020).
overfitting. Lastly, the posterior coefficients of the model with better performance are diagnosed using trace plots and Gelman Shrink Factor plots (Brooks and Gelman 1998).

RESULTS

Model comparison

Table 3 presents the WAIC score of ten models, which calculates the out-of-sample deviance and is used to compare models for their predictive performance. A lower WAIC score indicates a better model in terms of predictive performance (not causal inference).

The models which include gender result in substantially lower WAIC scores than those which do not, indicating that players’ gender can predict their anthropocentric attitudes better than other variables. Even the WAIC score of the model that includes all the in-game behaviors (model.full) is higher than that of the model that includes only gender (model.gender) by 84.7 points. However, both WAIC and Akaike weights indicate that the model that includes gender, fishing, catching bugs, taking wood, and the interaction variable (model.full in Table 2) has the best prediction ability about players’ attitudes toward the ideas of human dominion. As such, we will assess the reliability of this model and then present its results (The results of other models are shown in Appendix S3).

Technical validation

This section assesses the reliability of model.full by diagnosing the posterior coefficients’ convergence. The posterior results are presented in Table 4, with all coefficients’ chains diagnosed to be well convergent. To be specific, the Markov chains of a posterior coefficient are considered to be convergent when the coefficient’s effective sample size is greater than 1000 (n_eff > 1000) and the Gelman shrink factor equals 1 (Rhat = 1). However, these metrics should only be used for detecting signals of danger but not signals of safety. Visually diagnosing the convergence using trace plots and Gelman plots can help validate the results (McElreath 2020). Figure 1 shows the trace plots of all coefficients’ Markov chains. Each plot illustrates the motion of four chains after the warmup period with 2000 iterations. The Markov chains in these plots are relatively healthy since they are stationary and well mixing around the same values.

Main findings

This section summarized the result of Model B. The negative mean of $\beta_{Gender} (-1.61)$ implies that male players tend to be more anthropocentric oriented than females; the relatively small standard deviation indicates that this correlation is reliable. The means of $\beta_{Fishing}$ and $\beta_{CatchBug}$ are positive, indicating that the higher frequency of in-game fishing and catching bugs is positively associated with anthropocentric attitudes. $\beta_{TakeWood}$ has a mean of -0.58, which means that a higher frequency of in-game exploitation of wood decreased the likelihood that players would support the idea of human dominion. However, regular wood collectors who cut down trees are more likely to agree that humans were meant to rule over nature because the mean of $\beta_{TakeWood\cdotCutTree}$ is positive. This association is reliable because of the small SD.

Table 3 WAIC score for model comparison. SE denotes the standard error of WAIC. Respectively, dWAIC and dSE is the difference between the WAIC scores (the model with dWAIC = 0 is the better one) and its standard deviation. pWAIC is a prediction penalty and is close to the number of parameters

| Model name     | WAIC   | SE    | dWAIC | dSE  | pWAIC | Akaike weight |
|----------------|--------|-------|-------|------|-------|---------------|
| model.full     | 1826.2 | 26.76 | 0.0   | NA   | 8.5   | 0.96          |
| model.treegender | 1832.7 | 25.92 | 6.4   | 6.80 | 6.5   | 0.04          |
| model.animalgender | 1837.3 | 26.40 | 11.1  | 7.27 | 6.8   | 0.00          |
| model.gender   | 1843.2 | 25.25 | 16.9  | 9.47 | 4.8   | 0.00          |
| model.animaltree | 1927.9 | 22.09 | 101.7 | 18.72| 7.7   | 0.00          |
| model.animal   | 1934.6 | 21.41 | 108.4 | 19.24| 5.9   | 0.00          |
| model.bug      | 1936.4 | 21.03 | 110.1 | 19.61| 4.8   | 0.00          |
| model.fish     | 1942.5 | 20.83 | 116.2 | 20.12| 4.9   | 0.00          |
| model.tree     | 1943.8 | 20.63 | 117.5 | 20.49| 5.6   | 0.00          |
| model.wood     | 1946.3 | 20.29 | 120.0 | 20.46| 4.9   | 0.00          |
the Fishing coefficient. However, a majority of the Fishing coefficient’s distribution is still located on the positive side. These distributions show that the predictive effects of Fishing, CatchBug, TakeWood, and the interaction between TakeWood and CutTree are reliable (see Fig. 2).

### DISCUSSION

This paper examines the relationship between players’ interactions with natural resources in a virtual environment and their anthropocentric beliefs. Our model comparison

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**Table 4** Estimated posteriors of the relationship between attitudes toward the environment and the frequencies of exploiting behaviors

| Variable                      | Mean | SD  | 5.5%  | 94.5% | n_eff | Rhat |
|-------------------------------|------|-----|-------|-------|-------|------|
| $\beta_{\text{Gender}}$      | -1.61| 0.16| -1.87 | -1.36 | 10626 | 1    |
| $\beta_{\text{Fishing}}$     | 0.21 | 0.15| -0.03 | 0.46  | 13222 | 1    |
| $\beta_{\text{CatchBug}}$    | 0.36 | 0.15| 0.12  | 0.61  | 12743 | 1    |
| $\beta_{\text{TakeWood}}$    | -0.58| 0.36| -1.15 | -0.01 | 7810  | 1    |
| $\beta_{\text{TakeWood} \times \text{CutTree}}$ | 1.03 | 0.35| 0.46  | 1.59  | 7892  | 1    |

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**Fig. 1** Trace plots of all coefficients
shows that gender can be a strong indicator of anthropocentric attitudes, and female players tend to be less anthropocentric than males. Frequently exploiting virtual animals (i.e., fish and bugs) is positively associated with the probability that players have anthropocentric attitudes. Regular wood collectors are less likely to be anthropocentric, but regular wood collectors who cut down trees are more inclined to the idea of human dominion. Before discussing these correlations any further, we should note that the correlations between attitudes and in-game behaviors in our findings are preliminary; they are not enough to infer causality. However, even when modeling is never enough to answer causality questions, it is worth discussing what these correlations could imply to deepen our appreciation of how in-game interactions reveal the complexity of human behaviors regarding anthropocentrism.

**Anthropocentrism toward animals in the game environment**

In the game Animal Crossing: New Horizons, the frequency of catching fish and insects is correlated with more favorable attitudes toward human dominion, which supports the hypothesis tested in this research. It is still unclear whether these game activities encourage attitudinal changes or the anthropocentric attitudes that drive the engagement in these activities. Some features in ACNH could make the former scenario plausible. Although catching bugs and fish is not compulsory, players do these activities to earn money or enrich their museum collections, which may indirectly help them pay off their mortgages, increase their island’s rating, unlock new features, and get rewards. They are the fastest ways to earn money in the game, encouraging players to catch fish and bugs more. These features resemble how fish and insects are exploited for human benefits in real life, so virtual fishing and catching bugs could increase the likelihood that players assign utilitarian value rather than intrinsic value to non-human beings.

Even though the correlation between anthropocentric attitudes and the frequency of catching in-game animals was found to be positive in this study, this correlation is weak, which can be attributable to some game features. Some ACNH insects have unique features which send contradictory environmental messages: (i) some of them (tarantula, scorpion, and wasps) are the only animals that could attack players, (ii) some can only be caught if players chop down trees and leave the stumps for them to stay. If the game had some effect on players’ attitudes, the first feature should have encouraged players to think that humans are not superior to other species, weakening their anthropocentric attitudes. Meanwhile, the second feature encourages environmental damage. These contradictions may hinder the game from making pro-environmental attitudinal changes.

Another factor that potentially contributes to the weak correlation between in-game activities and attitudes is human’s ability to separate game space and reality, regardless of how well games resemble reality. Studies about the aggressive effects of violent games showed that non-aggressive players could put their personal values and beliefs aside while playing so they could enjoy the game and shoot human game characters (Hartmann and Vorderer 2010). In the case of ACNH, regardless of how the game could transcend reality, players still recognize that their game experience is not real. Hence, even players who strongly disagree with the idea of human dominion can go fishing frequently in the game while understanding that this can be an environmental-destructive behavior. Another reason can be that ACNH only features small-scale and recreational fishing, which is presumed to be more sustainable as opposed to the industrial fishery (Martin 2005). Meanwhile, this type of fishing is often unmonitored and unmanaged; it accounts for a large portion of fish being exploited worldwide and is a major threat to the aquatic ecosystem (Booth et al. 2019; Mackay et al. 2020).

Due to the detachment between virtuality and reality, it is unlikely that players would ask ethical questions when interacting with in-game animals, especially when the question of whether humans should extend moral consideration to animals is astoundingly difficult to answer in real life, and it is equally hard to practice animal ethics. In reality, claiming moral significance on behalf of animals, even “developed” ones, sounds unreal or receives a lower priority than human needs (Midgley 1998). Even when it may feel ethically wrong when harming “developed” animals like fish, birds, and cows, it may not feel the same.
when harming insects like bees and spiders. This is because individuals have strong reasons against killing animals whose ability to feel pain is known, but the reasons against painlessly killing are weak (Harman 2011). People often do not feel wrong when taking a trivial insect’s life, as Lockwood (1987) said, which implies how morally marginal insects are. Previous research discussed how arbitrarily individuals give and do not give moral consideration to different non-human creatures (Korsgaard 1996; Singer 2011). This can also be the case in a virtual environment because the results of this paper show in-game harmful actions toward bugs have a stronger correlation with anthropocentrism than those toward fish, a “more sentient” animal.

Humans and trees

Our results support Bosselmann’s findings (2010) that people who believe more strongly in human dominion are more likely to act destructively toward trees. We found that players who collect wood more frequently are less likely to be anthropocentric, but those who collect wood and cut down trees are more inclined to agree with the idea of human dominion. This is attributable to game features. If players want to achieve more than 4 stars in their island rating (which is not compulsory), they must maintain the number of trees below 220. Otherwise, they will get warnings from the system for keeping an island too rural and underdeveloped (AnimalCrossingWiki, n.d.). Not only trees but the system of island rating also encourages extensive intervention into the in-game environment; therefore, it is closely related to the idea of human dominion, which prioritizes human benefits over nature.

Although anthropocentric viewpoints argue that human benefits justify environmental-destructive behaviors, cutting down trees was strongly associated with anthropocentrism even when this activity has long-term consequences. In ACNH, players need a qualified ax and hit a tree three times to chop down trees. This leaves a stump, and the tree can’t grow back. By hitting once or twice, players will obtain woods falling from the tree without cutting it down. Trees can be planted but need 3 days to grow to their full size and at least three more days to grow fruits, so cutting down trees is less efficient in terms of resources management. As in ACNH, in real life, where trees take much longer to fully grow that short-term economic gain is often prioritized over sustainability, and the environment is one of the major obstacles to forest conservation and restoration in real life (Golub 2021; Sanford 2021; Vuong et al. 2021a, b).

Players, who refrain from chopping down trees, are more likely to disagree that humans are meant to rule over nature. This suggests that less anthropocentric individuals tend to care more about long-term benefits, avoiding overexploiting natural resources. However, it should be noted that these behaviors do not necessarily stem from non-anthropocentric ideas, which are argued to influence positive behaviors toward these entities. The idea of resource protection based on future benefits is anthropocentric. Hence, arguing that anthropocentrism is only associated with negative behaviors may restrict our understanding of environmental views.

Players’ gender and in-game variables

The results of this study have two important implications about the association between players’ gender and their attitudes towards the idea of human dominion over nature. First, the model comparison analysis showed that players’ biological sex is better at predicting their attitudes toward human dominion than the examined in-game variables. That players’ properties in the real world have better explanatory power than those in the virtual worlds may be resulted from the fact that players can separate between these two worlds. This consolidated our previous implication about players’ ability to distinguish reality and virtuality as a pivotal factor in the correlation between players’ environmental attitudes and their in-game behaviors.

In coherence with Vuong et al. (2021a, b), which used the same dataset, this paper also found a gender difference in players’ anthropocentric attitudes; and female players tend to be less anthropocentric than males. It implies that female players may be less likely to explain their environmental views, attitudes toward non-human subjects and perhaps their environmental behaviors based on utilitarian reasons than their counterparts. However, when the idea of human dominance over nature is a complex matter, this result should not be viewed as an indicator of female players being more pro-environmental than male players. As noted previously, being anthropocentric is not always associated with environmental-destructive behaviors. Anthropocentric individuals can exhibit pro-environmental ones such as resource protection and conservation due to utilitarian reasons.

LIMITATIONS

In this section, we would like to note some limitations of this study as exploratory research into the association between players’ attitudes toward an anthropocentric idea and their in-game behaviors. First, the paper found a relatively weak correlation between the frequency of catching animals and anthropocentric attitudes, which implies that there are factors that undermine games’ effect on attitudes, such as the human ability to separate reality and game space, if games have any effect on human attitudes. When being in a virtual environment, it is unlikely that players will ask ethical questions when interacting with virtual animals. Second,
when this exploratory experiment was conducted in a game environment, the sample was relatively small (640 respondents). The authors acknowledged these limitations of the study, and we strongly recommend researchers interpret these preliminary results with caution (Vuong 2020).

CONCLUSION

Based on a Bayesian analysis of ACNH players’ attitudes and their interactions with in-game animals and plants, this paper suggests that anthropocentrism has certain potentials and caveats when encouraging pro-environmental behaviors. The analysis shows players behave with a sense of superiority over other animals, especially insects. Environmental-destructive actions toward in-game animals and trees are positively associated with anthropocentrism. In addition, more anthropocentric individuals may be more inclined toward short-term rewards even though there will be long-term consequences featured in the game. This implies that short-term benefits can be the obstacles to conservation and pro-environmental efforts. From the perspective of conservation and environmental research, as our results show that players were found still to carry out exploitative behaviors (toward trees) regardless of how much they reject anthropocentric ideas, understanding anthropocentrism in a strong sense like Callicott (1984) would limit our understanding of environmental views and create a bias against anthropocentric views. Our analysis also shows that players’ gender can provide better predictability about their anthropocentric attitudes than other variables, which may be related to players’ ability to separate virtual and real worlds. Finally, our results carry important implications for the future of game design. Even though the game ACNH encourages players to perform many pro-environmental activities (e.g., planting trees and flowers, recycling), in-game features also incentivize players to exploit in-game resources (e.g., chop down trees to collect bugs, island rating system), which may eventually promote the idea of human dominion. Thus, it implies how in-game incentives with good intentions (e.g., improving the island condition) can encourage environment-destructive behaviors. Here, striking a balance between compelling game features and the promotion of virtues in designing a game is a complex, non-linear process, demanding careful counterfactual analysis of the interaction of game features and human psychology.

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Data availability The data that supports the findings of this study is available at https://osf.io/p8q9c/ (accessed on 1 April 2021).

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