

An Interdisciplinary Analysis of the Influence of Immersive Gaming Environments on Environmental Perceptions

Abstract

This project investigates whether playing environmentally themed video games—specifically *Animal Crossing*—is linked to greater climate awareness and concern. By combining player behavior data with global climate opinion data, the study uses interactive visualizations to explore correlations between in-game actions and real-world environmental perception. The findings offer new insights into the potential of virtual worlds as tools for climate engagement and education.

Contribution to SDGs



Fig 1. SDG logo gotten from official branding website

This project primarily supports Sustainable Development Goal (SDG) 13: Climate Action and SDG 17: Partnerships for the Goals. By investigating how immersive virtual game environments influence individuals' environmental awareness, the study contributes to raising education and public concern on climate issues, supporting SDG 13's target of improving knowledge and capacity for climate mitigation and adaptation (UNDP, 2021). Additionally, the project embodies the spirit of SDG 17 by fostering interdisciplinary collaboration between psychology, game design, and climate science to address complex global challenges. By integrating behavioral data from virtual environments with public opinion datasets, the study demonstrates how cross-sector partnerships can generate deeper insights into promoting environmental responsibility through innovative digital platforms (Flanagan & Nissenbaum, 2014).

Team Contribution Statement

Gbemisayo contributed to the literature review, data cleaning and background research, identifying the project's place in current scholarship and outlining future directions. Hailee designed and implemented the visualizations, including selecting appropriate formats, merging datasets, using Streamlit for accessibility, and applying colorblind-safe palettes. Both worked on the poster.

Table of Contents

- Background and Motivation
 - Literature Review
 - Why Animal Crossing?
- Research Question
- Application Scenarios
- Methodology
 - Visualization Techniques
 - Data Source and Integration
 - Advanced Tools
- Results
- Intellectual Merit and Practical Impact
 - Academic Contributions
 - Practical Impact
- Reflection on Growth and Learning
 - Hailee Cunningham
 - Gbemisayo Adelaja
- Supplementary Materials
 - Acknowledgement
 - Disclaimer
- References

Team members

Hailee Cunningham

Gbemisayo Adelaja

Course

INFOSCI 301

Data visualisation and Aesthetics

Instructor

Prof. LuYao Zhang

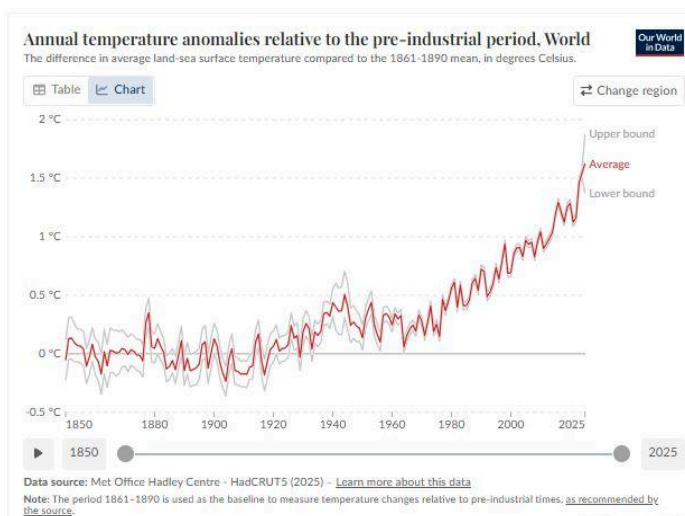
Background and motivation

Literature review

This research explores the intersection of game design, psychology, and climate perception by investigating whether environmentally immersive virtual game worlds—especially those simulating ecosystems, environmental consequences, or sustainability narratives—can foster greater climate awareness among players. As video games with ecological themes become more popular, they present a unique opportunity to assess whether virtual experiences influence real-world environmental concern and behavior.

This question is significant across disciplines. It offers insights for game designers crafting impactful narratives and suggests that games could serve as informal educational tools for climate communication. More broadly, it contributes to understanding how digital experiences might shape public opinion and decision-making on global issues like climate change.

Recent studies affirm the potential of games for climate engagement. Ouariachi et al. (2019) identified game elements that enhance cognitive, emotional, and behavioral responses to climate narratives. Bekoum Essokolo and Robinot (2022) found that immersive games can reduce the psychological distance to environmental issues. Carman et al. (2024) reported that players are slightly more likely than non-players to engage in climate-related actions. However, existing work typically relies on case studies or surveys. This project builds on prior research by integrating behavioral gameplay data with large-scale public opinion data to explore correlations between in-game actions and climate attitudes—an approach that has not yet been thoroughly explored in the field.



This interactive chart from Our World in Data illustrates carbon emissions across time and regions, offering users control over what they explore. It inspired our own design approach—prioritizing interactivity, accessibility, and comparative clarity. Just as this visualization helps viewers make sense of complex climate data, our project uses interactive tools to link gameplay behavior with environmental concern across countries,

encouraging exploration and insight without requiring technical expertise.

Why Animal Crossing?

We chose *Animal Crossing: New Horizons* (ACNH) as the subject of this project due to its unique focus on community building and environmental interaction within a simulated world. In ACNH, players are immersed in a real-time environment where they gather resources, interact with anthropomorphic animal neighbors, and engage in activities like fishing, bug catching, and donating to the museum. The game emphasizes a direct relationship with nature, making it a valuable lens through which to examine players' attitudes towards environmental issues.

Moreover, the game's popularity—boasting 47.4 million lifetime sales (Statista, 2025)—and its release during the COVID-19 pandemic made it an ideal candidate for exploring how immersive virtual environments can shape players' awareness of environmental concerns. Given the extensive data available on the game and its widespread appeal, ACNH serves as an accessible and relatable platform for studying the influence of virtual ecosystems on real-world attitudes and behaviors.

Research Question

“How does engagement with environmentally immersive virtual game environments correlate with players’ real-world climate concern across different countries, and what patterns emerge when in-game behavior is compared to public climate opinion data?”

Application Scenarios

Our findings can inform the game design industry by highlighting how specific environmental mechanics and narratives influence player awareness, encouraging the development of games that both entertain and educate. Climate communication specialists and environmental educators could use these insights to create more emotionally resonant and engaging public campaigns through gamified platforms.

Policy makers and non-governmental organizations might leverage such visualizations to identify regions or demographics where digital climate engagement is effective, supporting targeted outreach and informal climate education efforts. Additionally, interactive storytelling and edtech sectors can apply these results to develop immersive learning experiences that promote sustainability mindsets.

By linking in-game behavior with real-world attitudes, this project demonstrates how virtual experiences can play a practical role in climate action and public engagement strategies across disciplines.

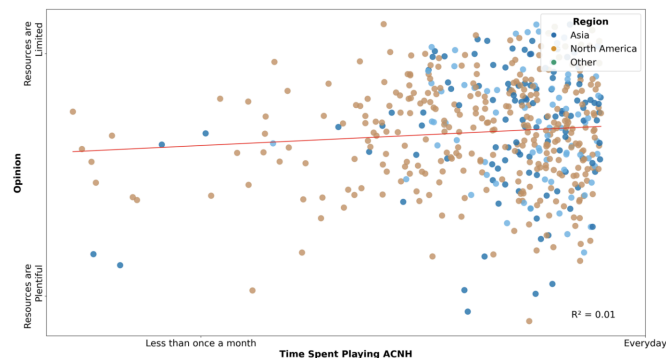
Methodology

Visualization Techniques

Select the agreement statement to analyze:

Resource Limits and Overpopulation

Fig 1. Opinion on: Resource Limits and Overpopulation by Time Playing ACNH



This scatterplot shows the relationship between time spent playing *Animal Crossing: New Horizons* and agreement with environmental statements. It uses position on a common scale for both axes, a highly effective quantitative channel (Munzner, 2014). A line of best fit and R^2 correlation coefficient summarize the direction and strength of correlation. This dual approach prevents misinterpretation of visual patterns, as emphasized by Anscombe's Quartet, which shows that similar statistical

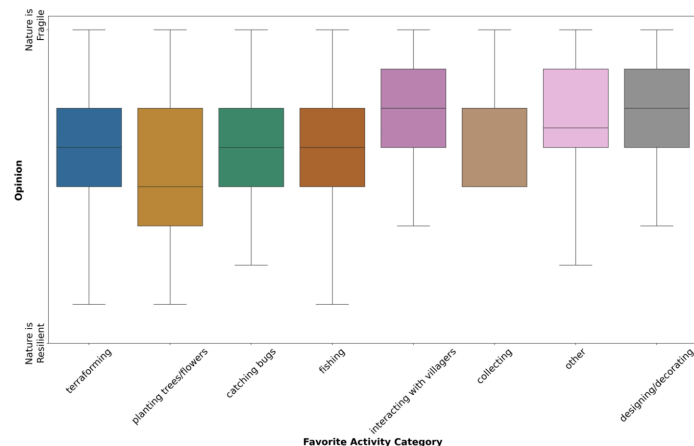
summaries can mask different data distributions (Anscombe, 1973). Data points are colored by region using hue, an appropriate channel for categorical distinction. Interactivity allows users to filter by question, supporting task abstraction like comparison and exploration.

This box plot shows the distribution of environmental opinions based on players' favorite activities in *Animal Crossing: New Horizons*. Box plots visualize median, quartiles, and outliers, offering insight into both central tendencies and spread—crucial for comparative and exploratory tasks (Munzner, 2014). Using the same categories as Figure 1, this graph enables users to explore how in-game behavior may relate to climate concern.

Select the agreement statement to analyze:

Natures Balance and Fragility

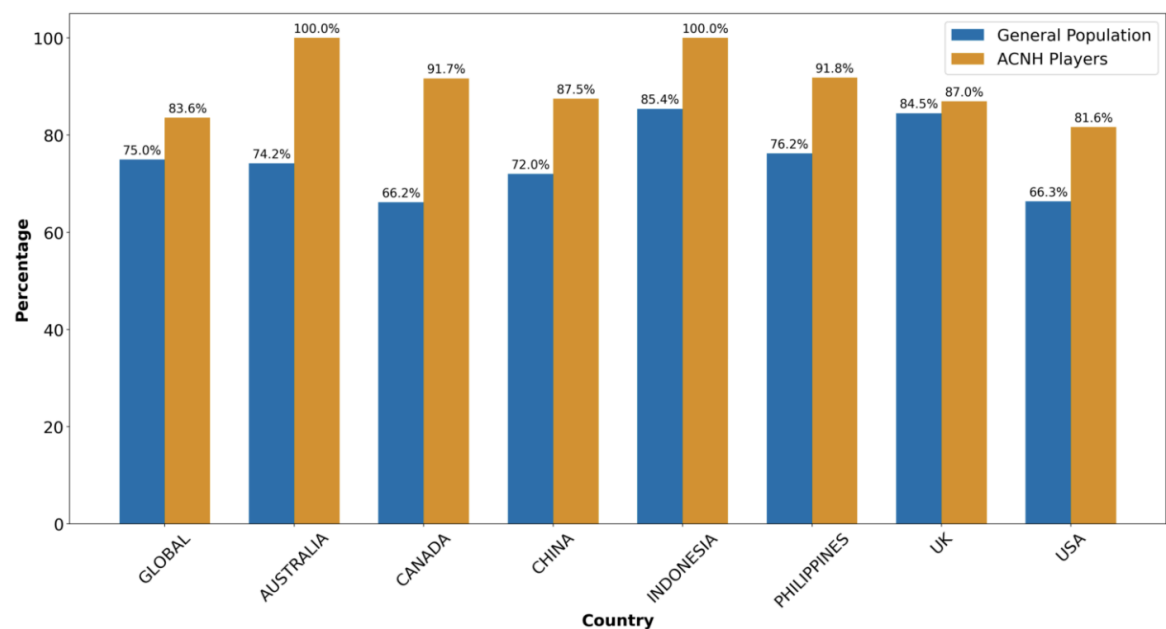
Fig 2. Opinion on: Natures Balance and Fragility by Favorite ACNH Activity



By grouping data categorically and employing horizontal position and length (highly accurate channels),

the plot reveals variability and skewness across player groups. Prior work supports box plots for capturing complex group-level differences (Wilkinson, 2005; Tufte, 1983).

Fig 3. Percentage of Population Concerned for Environmental Future



This grouped bar chart compares levels of environmental concern between the general population and *Animal Crossing* players across countries. By using adjacent bars aligned on a common baseline, the visualization leverages length as a visual channel, one of the most effective for quantitative comparison (Munzner, 2014). This layout minimizes perceptual distortion and enables accurate cross-group comparison, as supported by Talbot et al. (2014). The chart reveals national trends and potential shifts in ecological awareness influenced by game engagement. Using color hues to differentiate groups ensures visual clarity while avoiding redundancy, aligning with best practices in color theory and categorical comparison.

Data Source and Integration

This project integrates two complementary datasets to examine the relationship between virtual gaming experiences and climate perceptions. Dataset 1, the *Animal Crossing Survey Dataset* (Vuong et al., 2021), contains behavioral and attitudinal data from 640 global players. Dataset 2, the *People’s Climate Vote Global Survey* (UNDP & University of Oxford, 2021), includes climate opinion data from over 1.2 million respondents across 50 countries. To enable direct comparison, country names were standardized

(e.g., “Viet Nam” to “Vietnam”), and responses from Dataset 2 were scaled to match Dataset 1’s 1–5 Likert format. Only overlapping countries were retained.

Survey questions were grouped into five thematic categories—ranging from beliefs about overpopulation to technological optimism—enabling consistent cross-dataset analysis. Countries were further grouped by region to support broader pattern recognition. Combining these datasets allows us to compare *in-game behaviors* with *real-world climate attitudes* across both niche and general populations—insights not achievable with either dataset alone. Both datasets follow international data governance standards, with FAIR principles ensuring transparency and reuse, and CARE principles guiding ethical, community-sensitive analysis in global public opinion research.

Advanced Tools

The visualizations for this project leverage several advanced technologies to enhance interactivity and accessibility. Python in Google Colab was used for data processing, utilizing libraries like Pandas for cleaning and organizing data, and Matplotlib for generating static visualizations. To improve user engagement and interactivity, Streamlit was integrated, enabling the creation of a dynamic web app that allows users to interact with visualizations in real time. Streamlit’s integration ensures that even users without programming knowledge can engage with the content, and its deployment via Streamlit Community Cloud allows for easy online hosting.

Additionally, to improve accessibility, color-blind safe palettes from the Seaborn library were used, with adjustments checked using Coblis (Color Blindness Simulator) to ensure the visualizations are inclusive for a wider audience.

These technologies not only enhance user experience but also provide a robust platform for showcasing and interacting with the data. The combination of real-time interactivity, accessibility features, and cloud deployment exemplifies the integration of trending technologies into the project.

Result

By comparing behavioral data from Animal Crossing: New Horizons players with large-scale climate opinion data, this project aims to uncover whether virtual environmental engagement translates to real-world concern. We anticipate identifying patterns such as higher environmental concern among players who frequently engage with in-game ecological activities, and regional differences in alignment between game player sentiment and general population attitudes.

Initial results from the scatterplot analysis suggest low correlations between time spent playing and environmental opinion categories. For instance, the R^2 values range from 0.00 (Resource Limits and Overpopulation) to 0.13 (Human Superiority vs. Ecocentrism), indicating weak linear relationships across all categories. This suggests that playtime alone may not strongly predict environmental attitudes, prompting further exploration into other variables such as gameplay motivations or activity types.

From the grouped bar chart, we observed that a high percentage (66.2% and above) of both the general population and players express concern for the environment across countries. This implies a shared baseline of environmental concern and may indicate that games are reaching audiences already attuned to these issues. These early insights shape the direction of future analysis, including multivariate approaches or qualitative context, to better understand the nuances in virtual engagement and environmental perception.

Intellectual Merit and Practical Impact

Academic Contributions

This research advances the academic field of data visualization by integrating behavioral game data with global climate opinion datasets, enabling new insights through comparative, interactive visual design. By applying core principles from visualization theory—such as perceptual accuracy, color theory, and data abstraction—it showcases how visual analytics can support cross-disciplinary research at the intersection of game design, environmental psychology, and communication studies. The project also contributes a novel methodology for assessing the influence of virtual experiences on real-world attitudes, expanding current literature in both game studies and climate communication.

Practical Impacts

Practically, this project reveals how video games—especially those with ecological themes—may be harnessed as informal tools for climate engagement and education. Through interactive, publicly accessible visualizations, the research supports game developers in designing impactful narratives and helps communicators and educators use virtual environments to evoke emotional and behavioral responses. By highlighting the potential of immersive play to influence public opinion, the study contributes to broader societal efforts in climate awareness, especially among digital-native audiences.

Reflection on Growth and Learning

Hailee Cunningham

I learned many of the skills and information needed for the final project through self-study and research and through working with my partner. For the InfoVis redesign project, I did research using the textbook and other resources I found to learn more about good design practice, as well as implementing my prior knowledge. For technical skills, such as developing visualizations in python, I also used my prior programming knowledge as well as some online tutorials. While revising my InfoVis project due to feedback from the professor I spoke with at the symposium, I was pointed toward Streamlit by a fellow classmate. This ended up being very useful for the final project, as I used Streamlit to develop the project and access it online.

Gbemisayo Adelaja

The in-class activities provided me with practical knowledge of selecting the right visualizations for my target audience, helping me present data clearly and intuitively. The symposium allowed me to pitch ideas and receive valuable feedback from experts, which helped refine my InfoVis project. The field trip to the ZhouZhuang Life Mysterious Museum, however, left me dissatisfied with how data was visualized. This experience inspired me to think of alternative, more accessible ways to visualize data, which I applied in my final project. During the InfoVis project, I used simulated data due to the unavailability of the original dataset. This experience taught me the importance of ensuring that data is both accessible and transformed in a way that is easy for people to understand. Feedback from my professor helped me design an effective and clear poster for my project, which I applied to enhance the overall clarity of my final project.

Supplementary Materials

GitHub: <https://github.com/hollai465/FinalProject>

Streamlit: <https://finalproject-t4xubdn2cznyernjn2l4sj.streamlit.app/>

Acknowledgement

We would like to acknowledge Prof. Luyao Zhang, who gave us feedback on the initial steps of the project that led to this final submission. Nemuleen Togtbaatar and Yiqing Wang for peer reviewing our paper. The students from INFOSCI 301 course who gave insightful feedback for our project. We also

want to acknowledge the use of Github, Streamlit, Canva, Google collab as tools we use to achieve this project and report.

Disclaimer

This final project is for INFOSCI 301 Data Visualization and Information Aesthetics, instructed by Prof. Luyao Zhang at Duke Kunshan University in Spring 2025.

References

Bekoum Essokolo, V.-L., & Robinot, E. (2022). “Let’s Go Deep into the Game to Save Our Planet!” How an Immersive and Educational Video Game Reduces Psychological Distance and Raises Awareness. *Sustainability*, 14(10), 5774. <https://doi.org/10.3390/su14105774>

Carman, J., Psaros, M., Rosenthal, S., Marlon, J., Verner, M., Lee, S., Lu, D. (L.), Goldberg, M., Ballew, M., & Leiserowitz, A. (2024). *Geeks versus climate change: Understanding video game players’ engagement with global warming*. Climatic Change.
<https://climatecommunication.yale.edu/publications/video-gamers-article/>

Ouariachi, T., Olvera-Lobo, M. D., & Gutiérrez-Pérez, J. (2019). A Framework for Climate Change Engagement through Video Games. *Environmental Education Research*, 25(5), 701–716.
<https://doi.org/10.1080/13504622.2018.1564248>

Talbot, J., Setlur, V., & Anand, A. (2014). Four experiments on the perception of bar charts. *IEEE Transactions on Visualization and Computer Graphics*, 20(12), 2152–2160.
<https://doi.org/10.1109/TVCG.2014.2346320>

Vuong, Q.-H., et al. (2021). *Data Intelligence*, Animal Crossing Survey Dataset. Retrieved from [Sciengine](https://Sciengine.com).

United Nations Development Programme (UNDP) & University of Oxford. (2021). *People’s Climate Vote*. Retrieved from peoplesclimate.vote.

Flanagan, M., & Nissenbaum, H. (2014). *Values at Play in Digital Games*. MIT Press.

United Nations Development Programme (UNDP). (2021). *People's Climate Vote*.
<https://peoplesclimate.vote/country-results>

Anscombe, F. J. (1973). *Graphs in Statistical Analysis*. *The American Statistician*, 27(1), 17-21.
<https://doi.org/10.1080/00031305.1973.10478966>

Tufte, Edward R. *The Visual Display of Quantitative Information*. Cheshire, CT: Graphics Press, 1983.

Wilkinson, Leland. *The Grammar of Graphics*. 2nd ed. New York: Springer, 2005.

Ferguson, Christopher J., and Jackson, Sarah. 2022. "The Influence of Video Games on Environmental Attitudes: A Study of Animal Crossing: New Horizons." *Frontiers in Psychology* 13:800683. <https://doi.org/10.3389/fpsyg.2022.800683>.

Statista. 2025. "Animal Crossing: New Horizons Unit Sales Worldwide as of December 2024." Statista. Accessed May 2, 2025. <https://www.statista.com/statistics/1112631/animal-crossing-new-horizons-sales/>.