Supplementary Data

Contents

1 Formats

Article

Here, you find the article format: `https://thejeran.github.io/climate-article/`

Video

Here, you find the video format: `https://youtu.be/IHiv67VrQX4`

Datasets

`https://github.com/TheJeran/climate-article/tree/main/datasets`

2 Trends

This section includes demographic and other trends tested against the formats. None of them produced statistically significant results.

Additionally, we can see performance on the specific questsions between the formats and the initial and delayed quizzes.

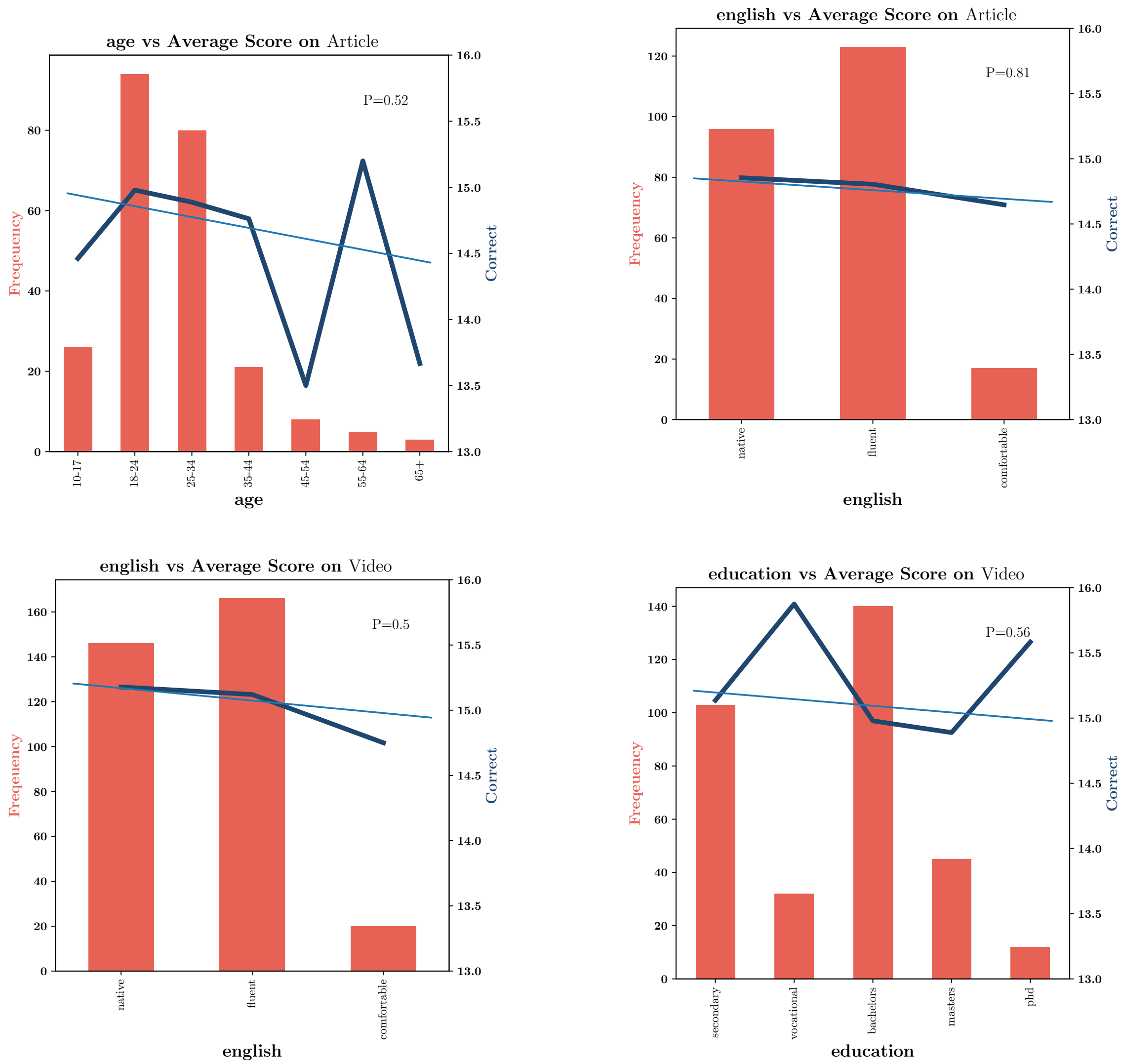

Figure 1: Trends of specific demographics on performance on specific formats

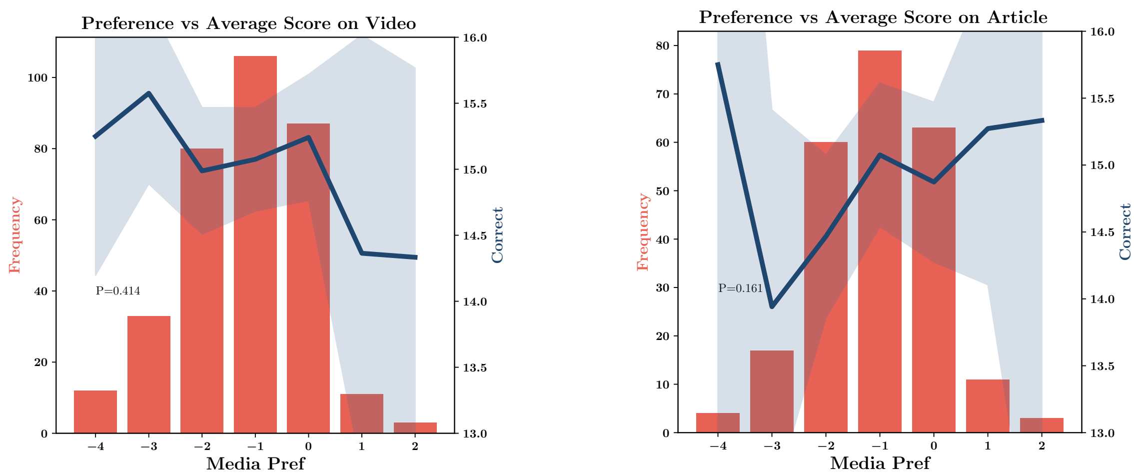

Figure 2: Trend of media preference and score with a format (Negative prefers video)

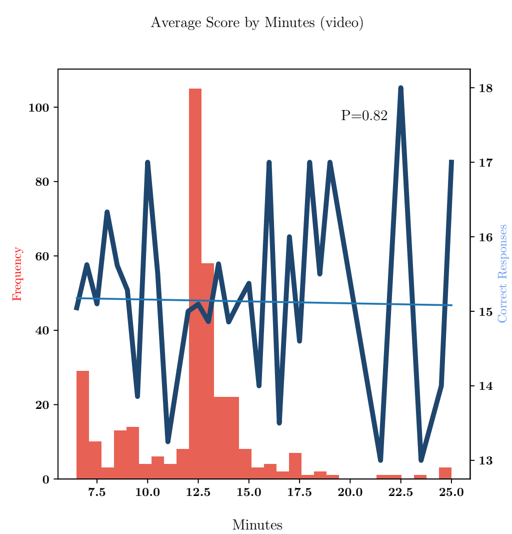

Figure 3: Trend of minutes on video vs average score

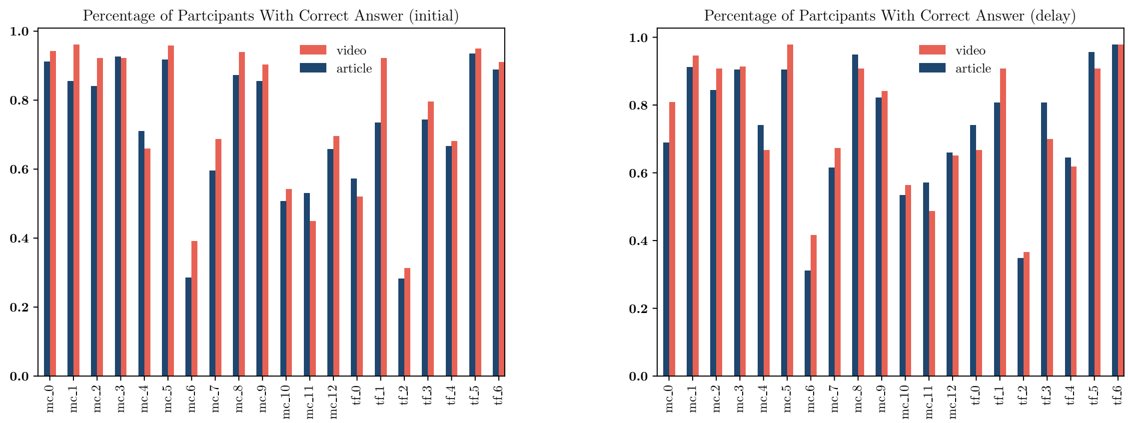

Figure 4: Percentage of participants that answered a questions correctly by format

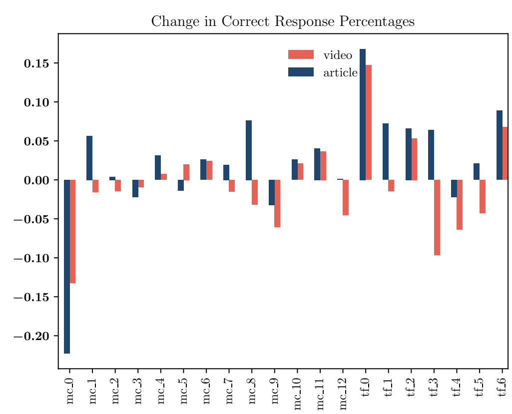

Figure 5: Change in percentage of participants who got correct in initial quiz vs after delay

3 Questions

3.1 First Quiz

Multiple Choice Questions

1. **What is one of the main challenges in making long-term climate predictions?**
   (a) Lack of historical data
   (b) Insufficient computing power
   (c) **Uncertainties in model projections**
   (d) Political interference

2. **What is the typical spatial resolution range for climate models?**
   (a) 1 km to 10 km
   (b) **25 km to 100 km**
   (c) 100 km to 500 km
   (d) 500 km to 1000 km

3. **What technique do climate models use to simulate processes that occur at scales smaller than the model resolution?**
   (a) Interpolation
   (b) Extrapolation
   (c) **Parameterization**
   (d) Standardization

4. **In the context of climate modeling, what does "resolution" primarily refer to?**
   (a) The clarity of satellite imagery used
   (b) The number of variables included in the model
   (c) The accuracy of weather predictions
   (d) **The size of the grid cells**

5. **What are the two primary ways researchers improve ESMs?**
   (a) Incorporate aerosol-climate interactions and Increase spatial resolution
   (b) Enhance data assimilation techniques and Refine parameterization schemes
   (c) Enhance representation of biogeochemical cycles and Improve modeling of land surface processes
   (d) **Increase the resolution of simulations and their complexity**

6. **What is the primary limitation of using a higher resolution in climate models?**
   (a) Decreased accuracy

(b) **Increased computational demands**
(c) Lack of data
(d) Model instability

7. **What is the primary purpose of Earth System Models (ESMs)?**
   (a) To predict short-term weather patterns and evolution
   (b) To predict the Earth's temperature in many years
   (c) **To simulate physical, chemical, and biological processes**
   (d) To investigate feedback loops within the Earth's various subsystems

8. **What is the main purpose of parameterization in climate models?**
   (a) **To simulate processes occurring at smaller scales**
   (b) To increase the model's resolution
   (c) To reduce computational time
   (d) To calibrate the model with historical data

9. **What are the main drivers for uncertainties in earth science models?**
   (a) Computational power and funding
   (b) **Data resolution and understanding of underlying mechanisms**
   (c) Precision of measurements and calibration of tools
   (d) Researcher bias and experimental design

10. **According to the narrative, how should machine learning be used in relation to Earth System Models?**
    (a) As a substitute for field observations and data collection
    (b) A replacement of ESMs for simulating simple processes
    (c) Preprocessing/gapfilling of data
    (d) **A complimentary tool for ESMs**

11. **In the context of scientific models, what do models in earth sciences primarily represent?**
    (a) Physical objects
    (b) Computer simulations
    (c) **Equations**
    (d) Theories

12. **What is a potential drawback of using machine learning in climate modeling?**
    (a) It may process data too slowly for timely predictions
    (b) It will require vast amounts of new high-quality input data

(c) **Its predictions may not align with known physical laws**
(d) The computational resources needed currently don't exist

13. **Why can't a double pendulum system be solved analytically?**
    (a) The equations don't converge and lack a real solution
    (b) Its motion is too slow and irregular to measure with sufficient accuracy
    (c) **The motion of one mass directly influences the motion of the other**
    (d) The Laplace transform of the equations results in non-integrable functions

True/False Questions

1. Analytical methods are more accurate than numerical methods
2. Incorporating the effect of air-resistance during free-fall is an example of parameterization
3. Earth System Models (ESMs) are created to predict how greenhouse gasses and solar radiation warm the earth
4. Machine Learning (ML) tools invariably increase the computational cost of high-resolution climate models
5. Increasing model resolution decreases model performance
6. The main drivers of uncertainties in earth science models are data resolution and understanding of underlying mechanisms
7. Higher resolution climate models are always more computationally demanding

3.2 After Quiz

Multiple Choice Questions

1. **What is one of the primary obstacles in generating accurate long-term climate forecasts?**
    (a) Insufficient historical records
    (b) Inadequate computational resources
    (c) **Uncertainties in model forecasts**
    (d) Government interference
2. **What is the common spatial resolution range for climate models?**
    (a) 1 km to 10 km
    (b) **25 km to 100 km**
    (c) 100 km to 500 km

(d) 500 km to 1000 km

3. **Which method do climate models employ to represent processes occurring at scales smaller than the model resolution?**
   (a) Interpolation
   (b) Extrapolation
   (c) **Parameterization**
   (d) Standardization

4. **In climate modeling, what does the term "resolution" primarily describe?**
   (a) The sharpness of satellite images used
   (b) The number of parameters included in the model
   (c) The precision of weather forecasts
   (d) **The size of the grid cells**

5. **What are the two main approaches researchers use to enhance ESMs?**
   (a) Incorporate aerosol-climate interactions and Increase spatial resolution
   (b) Enhance data assimilation techniques and Refine parameterization schemes
   (c) Improve representation of biogeochemical cycles and Enhance modeling of land surface processes
   (d) **Increase the resolution of simulations and Increase model complexity**

6. **What is the main constraint when using higher resolution in climate models?**
   (a) Reduced accuracy
   (b) **Greater computational requirements**
   (c) Scarcity of data
   (d) Model instability

7. **What is the fundamental goal of Earth System Models (ESMs)?**
   (a) To forecast short-term weather patterns and changes
   (b) To predict the Earth's temperature in the distant future
   (c) **To model physical, chemical, and biological processes**
   (d) To explore feedback mechanisms within the Earth's various subsystems

8. **What is the key purpose of parameterization in climate models?**
   (a) **To replicate processes occurring at smaller scales**
   (b) To enhance the model's resolution
   (c) To decrease computational time
   (d) To align the model with historical data

9. **What are the principal factors contributing to uncertainties in Earth System Models?**

   (a) Processing power and financial resources

   (b) **Data resolution and comprehension of underlying mechanisms**

   (c) Accuracy of measurements and instrument calibration

   (d) Scientist bias and experimental methodology

10. **According to the information provided, how should machine learning be utilized in conjunction with Earth System Models?**

   (a) As a replacement for field observations and data gathering

   (b) A substitute for ESMs in simulating basic processes

   (c) Preprocessing and filling gaps in data

   (d) **A supplementary tool for ESMs**

11. **In the realm of scientific modeling, what do models in earth sciences typically represent?**

   (a) Tangible objects

   (b) Digital simulations

   (c) **Mathematical formulas**

   (d) Scientific hypotheses

12. **What is a possible disadvantage of incorporating machine learning into climate modeling?**

   (a) It might process information too slowly for timely predictions

   (b) It will necessitate vast amounts of new high-quality input data

   (c) **Its forecasts may not be consistent with established physical laws**

   (d) The necessary computational power is currently unavailable

13. **Why is it impossible to solve a double pendulum system analytically?**

   (a) The equations do not converge and lack a real solution

   (b) Its movement is too gradual and erratic to measure precisely

   (c) **The motion of one mass directly affects the motion of the other**

   (d) The Laplace transform of the equations yields non-integrable functions

True/False Questions

1. Analytical approaches generally yield more precise results compared to numerical methods.
2. Including the influence of wind resistance during free-fall is an example of parameterization.
3. Earth System Models (ESMs) are designed to simulate how greenhouse gases and solar energy contribute to global warming.
4. Machine Learning (ML) tools always increase the computational requirements of high-resolution climate models.
5. Increasing model resolution decreases model performance.
6. The primary sources of uncertainty in earth science models are the resolution of data and comprehension of fundamental processes.
7. Climate models with higher resolution consistently demand more computational power.