**Income Inequality and Search Interest in Animal Welfare Products**

For this research, we aimed to investigate the association between income inequality and search interest in animal welfare products. Many companies track search interest as a measure of the top of their marketing funnels and the extent to which consumers are aware of and curious about their products or product category. Online search interest is particularly relevant to animal welfare products, as consumers wishing to research products free of animal ingredients, not tested on animals, or derived from humanely treated animals often conduct online searches. For example, a consumer might use Google to search “cruelty-free skincare brands” or “where to buy grass-fed beef,” signaling their interest and intent to purchase products aligned with animal welfare standards.

With significant income inequality, systems justification theory posits that people may be more inclined to defend and rationalize the existing social and economic systems. This psychological process can result in a reluctance to engage with information or ideas that challenge prevailing norms or threaten established market structures, as animal welfare products do. Consequently, people experiencing high levels of income inequality might be less inclined to search for information related to animal welfare products because doing so could expose them to alternatives that undermine their need to justify the system responsible for the inequality. Accordingly, we predicted the association between income inequality and search interest in animal welfare to be negative.

**Data**

We collected data from Google Trends and the American Community Survey (ACS) spanning from 2006 to 2022, the most recent year for which ACS data is available. We chose the United States for this study's geographical context because it offers extensive, longitudinal datasets for the dependent and independent variables, including the covariates. Additionally, the heterogeneity across states and time provides variation we can leverage to test the hypothesis that income inequality is negatively associated with search interest in animal welfare products. Although Google Trends has provided search data since 2004, the U.S. Census Bureau began reporting annual, state-level data from the ACS in 2006. Data from 2020 are excluded due to the U.S. Census Bureau's temporary halt of the ACS that year. Therefore, our dataset includes 51 states, encompassing Washington D.C., and 16 years for a total of 816 observations.

*Search interest in animal welfare products*. We procured the data for this variable from Google Trends, a tool that quantifies the relative popularity of search terms across geographical regions and over time. To gauge search interest, we compiled a relevant set of keywords that people frequently include in online searches about animal welfare products: i.e., vegan, vegetarian, dairy free, animal testing, cruelty free, grass fed, free range, and cage free. The Google Trends index we examine represents the popularity of these keywords in a state and year. Therefore, the proportion of a state’s searches in a year that included any of these keywords influences the state's index, offering a measure of the state's relative interest in animal welfare products.

Google Trends data are normalized on a 0 to 100 scale. For the interest-by-state data we analyze, a score of 100 is assigned to the state(s) with the most search interest in animal welfare for a given year, with all other states receiving scores relative to this maximum. For instance, Oregon had an index of 100 in 2019, marking it as the state with the highest search interest in animal welfare products. Pennsylvania, with an index of 59 in 2019, demonstrated approximately 59% as much search interest in animal welfare products as Oregon.

To gather the annual state-level search interest data, we queried Google Trends using the {trendyy} R package’s trendy() function for each year from 2006 to 2022, except for 2020 (Parry 2023). For example, we specified the request for 2006 as follows:

trendy(search\_terms = “vegan+vegetarian+‘dairy free’+‘animal testing’+‘cruelty free’+‘grass fed’+‘free range’+‘cage free’”, geo = “US”, from = “2006-01-01”, to = “2006-12-31”)

Adopting Stephens-Davidowitz’s (2020) approach, we pulled multiple samples from Google Trends, procuring ten state-level samples yearly. We used the rwg index to assess the agreement among these samples (James, Demaree, and Wolf 1984). The data showed strong consistency, with a minimum rwg index of 0.945 and an average of 0.995, reinforcing our plan to average these samples to derive a robust measure of search interest in animal welfare products. The dependent variable we study, therefore, represents the average search interest in animal welfare products across the ten samples for each state and year.

*Income inequality*. We assess income inequality using the Gini index, a widely accepted measure of economic disparity. We obtained the Gini index values for each state from 2006 to 2022, excluding 2020, using Social Explorer, a data resource that provides access to data from the ACS. The Gini index ranges from 1 to 100, with 1 representing perfect equality and 100 indicating maximal inequality.

*Covariates*. To enhance the robustness of our analysis, we incorporate six demographic and socioeconomic covariates we sourced from the one-year estimates of the American Community Survey (ACS) in the analysis. These covariates include *age* (the median age of a state’s inhabitants), *education* (the percentage of a state that holds a bachelor's degree or higher), *gender* (the percentage of a state that identifies as male), *race* (the percentage of a state that identifies as white), *income* (the average income of a state’s inhabitants, denoted in tens of thousands), and *population density* (the number of inhabitants in a state per square mile, denoted in hundreds).

Each of these variables could confound the relationship between income inequality and interest in animal welfare products. For instance, states with higher income inequality might also have higher average incomes, which could augment the demand for animal welfare products independently of income inequality. By including income as a separate variable in the analysis, we disentangle the effect of income inequality from absolute income levels. Incorporating these variables into the analysis allows us to isolate the specific effect of income inequality on interest in animal welfare products, enhancing the validity of the findings by minimizing the potential influences of confounding factors.

**Method**

Given the hierarchical structure of the data, as the observations are nested within states and years, we employed a linear mixed-effects model to analyze the relationship between income inequality and search interest in animal welfare products. This approach is designed to handle clustered data and account for the non-independence of observations within clusters, allowing us to use fixed effects to estimate the impact of income inequality and the control variables on search interest while controlling for random variation associated with the states and years. Equation 1 represents the linear mixed-effects model we estimated:

|  |  |
| --- | --- |
|  | (1) |

where is the search interest for state i in year j, is the overall intercept, and are the fixed effects coefficients for income inequality and the vector of control variables (i.e., age, education, gender, race, income, and population density), is the random effect for state i, is the random effect for year j, and is a random error term.

Following the approach recommended by Hamaker and Muthén (2020), we used cluster-mean centering for income inequality and the control variables. The within-state and within-year centered predictors represent deviations from the state and year averages, capturing the data's temporal fluctuations and spatial heterogeneity. This approach enables interpreting the model’s coefficients as within-cluster relationships between the predictors and the search interest in animal welfare products.

Table 1 presents the untransformed means and standard deviations of the variables, and the correlations among the cluster-mean centered versions of these variables, offering an overview of the primary characteristics and interrelationships of the variables involved in the analysis.

**Main Results**

The results of the analysis are presented in Table 2. Aligning with our prediction, Model 1 shows a significant negative association between income inequality and search interest in animal welfare products ( = -1.53, SE = 0.37, *p* = 3.96e-05). Model 2 illustrates that this relationship persisted and became more pronounced when we added the controls into the model ( = -1.43, SE = 0.37, p = 1.27e-04), suggesting that an increase in income inequality may indeed be correlated with a decrease in the public’s interest in animal welfare products.

Regarding the control variables, two demographic factors proved to be significant. Gender displayed a negative relationship with search interest ( = -8.27, SE = 1.31, *p* = 4.12e-10), suggesting that states with higher proportions of males have lower search interest in animal welfare products. By contrast, income was found to have a positive effect on search interest in animal welfare ( = 6.01, SE = 0.86, *p* = 7.95e-12).

In summary, the results lend empirical support to the proposition that income inequality may exert an independent influence on public interest in animal welfare products, even when accounting for pertinent demographic variables. This finding underscores the potential significance of socio-economic disparities in shaping consumer behaviors and attitudes toward animal welfare products.

**Supplementary Analysis**

To better understand the nuances of the relationship between income inequality and search interest in different animal welfare products, we segmented the Google Trends index from the main analysis into three product categories:

1. Animal welfare products without animal ingredients, represented by the keywords: vegan, vegetarian, dairy free.
2. Animal welfare products not tested on animals, represented by the keywords: animal testing, cruelty free.
3. Animal welfare products derived from humanely treated animals, represented by the keywords: grass fed, free range, cage free.

We collected Google Trends data for each subset of keywords and reconducted the analysis, maintaining the same methodology. This supplementary analysis allows for a more detailed understanding of how socio-economic disparities may influence public interest in the three categories of animal welfare products. We present the results of this supplementary analysis in Models 3 to 5 in Table 2.

For search interest in products without animal ingredients, Model 3 shows that income inequality had a significant negative effect ( = -1.34, SE = 0.37, *p* = 0.003). Similarly, for search interest in products not tested on animals, Model 4 shows that income inequality also had a significant negative effect ( = -1.90, SE = 0.72, *p* = 0.008). However, Model 5 shows that neither income inequality ( = -0.84, SE = 0.53, *p* = 0.11) nor the control variables significantly influenced search interest in products derived from humanely treated animals.

These results suggest that income inequality has a differential impact on search interest across the categories of animal welfare products. Notably, search interest in products that do not involve animal ingredients or are not tested on animals is negatively associated with income inequality, while search interest in products derived from humanely treated animals shows no significant relationship. These findings contribute to a more nuanced understanding of how income inequality may shape public interest in different aspects of animal welfare.

**Discussion**

This study is a first step toward unpacking the relationship between income inequality and interest in animal welfare products. Leveraging real-world data, we found a negative relationship between income inequality and search interest in animal welfare products, particularly for products not involving animal ingredients or animal testing, supporting predictions from systems justification theory.

The findings suggest that greater income inequality in a region may inhibit consumers’ curiosity about, and potentially consumption of, animal welfare products. This result aligns with systems justification theory, which posits that in regions of high inequality, people may be more inclined to defend and rationalize existing socio-economic systems. Here, this rationalization might manifest as resistance to engaging with concepts related to animal welfare products, which often challenge conventional consumption norms.

**Table 1: Summary Statistics and Correlation Table**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Mean** | **SD** | **Correlations** | | | | | | |
| Search Interest | 57.20 | 15.13 |  |  |  |  |  |  |  |
| Income Inequality | 46.09 | 2.24 | -.06 |  |  |  |  |  |  |
| Age | 37.96 | 2.42 | .02 | .21\*\*\* |  |  |  |  |  |
| Education | 30.06 | 6.57 | .09\* | -.30\*\*\* | -.21\*\*\* |  |  |  |  |
| Gender | 49.39 | .83 | -.07\* | -.14\*\*\* | -.48\*\*\* | .11\*\* |  |  |  |
| Race | 75.75 | 14.11 | -.02 | -.08\* | -.13\*\*\* | .14\*\*\* | .11\*\* |  |  |
| Income | 7.64 | 1.68 | .11\*\* | -.09\*\* | -.31\*\*\* | .58\*\*\* | .21\*\*\* | -.01\*\* |  |
| Population Density | 4.02 | 14.63 | .08\* | -.30\*\*\* | -.26\*\*\* | .55\*\*\* | .08\* | .19\*\*\* | .40\*\*\* |

Notes. \* p < .05, \*\* p < .01, \*\*\* p < .001.

**Table 2: Linear Mixed-Effects Model Estimates**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Search Interest in Animal Welfare Products** | | | | |
|  | **Main Analysis** | | **Without Animal Ingredients** | **Not Tested on Animals** | **From Humanely Treated Animals** |
| **Variable Names** | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 5** |
| Intercept | 57.20\*\*\*  (2.17) | 57.20\*\*\*  (2.17) | 55.63\*\*\* (2.25) | 58.64\*\*\*  (2.71) | 49.66\*\*\*  (2.28) |
| Income Inequality | -1.53\*\*\*  (0.37) | -1.43\*\*\*  (0.37) | -1.34\*\*\*  (0.37) | -1.90\*\*  (0.72) | -0.84  (0.53) |
| Age |  | 0.94  (0.51) | 0.88  (0.51) | 2.35\*  (0.98) | 1.83\*  (0.73) |
| Education |  | 0.18  (0.36) | 0.28  (0.37) | -1.91\*\*  (0.71) | -0.19  (0.53) |
| Gender |  | -8.27\*\*\*  (1.31) | -7.62\*\*\*  (1.32) | -10.44\*\*\*  (2.53) | 0.30  (1.88) |
| Race |  | -0.08  (0.09) | -0.04  (0.09) | -0.52\*\*  (0.18) | -0.28\*  (0.13) |
| Income |  | 6.01\*\*\*  (0.86) | 5.57\*\*\*  (0.87) | 12.69\*\*\*  (1.67) | 2.85\*  (1.25) |
| Population Density |  | 0.49  (0.25) | 0.51\*  (0.25) | 0.20  (0.48) | -0.65  (0.36) |
| Observations | 816 | 816 | 816 | 816 | 816 |
| Log likelihood | -2,725.16 | -2,657.39 | -2,668.38 | -3,148.06 | -2,920.05 |
| Akaike information criterion | 5,460.31 | 5,336.79 | 5,358.76 | 6,318.13 | 5,862.11 |
| Bayesian information criterion | 5,483.83 | 5,388.53 | 5,410.51 | 6,369.87 | 5,913.86 |

Notes. \* p < .05, \*\* p < .01, \*\*\* p < .001; Values are unstandardized coefficients, with standard errors in parentheses. The Google Trends indices are based on the following sets of keywords: main analysis (vegan, vegetarian, dairy free, animal testing, cruelty free, grass fed, free range, and cage free), without animal ingredients (vegan, vegetarian, and dairy free), not tested on animals (animal testing and cruelty free), from humanely treated animals (grass fed, free range, and cage free).

**References**

Hamaker, E. L. and B. Muthén (2020), “The Fixed Versus Random Effects Debate and How It Relates to Centering in Multilevel Modeling,” *Psychological Methods*, 25 (3), 365-379.

James, L. R., R. G. Demaree, and G. Wolf (1984), “Estimating Within-Group Interrater Reliability with and without Response Bias,” *Journal of Applied Psychology*, 69 (1), 85-98.

Parry, J. (2023), “trendyy,” *GitHub*, available at: https://github.com/JosiahParry/trendyy.

Stephens-Davidowitz, S. (2020), “Google Searches Can Help Us Find Emerging Covid-19 Outbreaks,” *NY Times*, available at: https://www.nytimes.com/2020/04/05/opinion/coronavirus-google-searches.html.