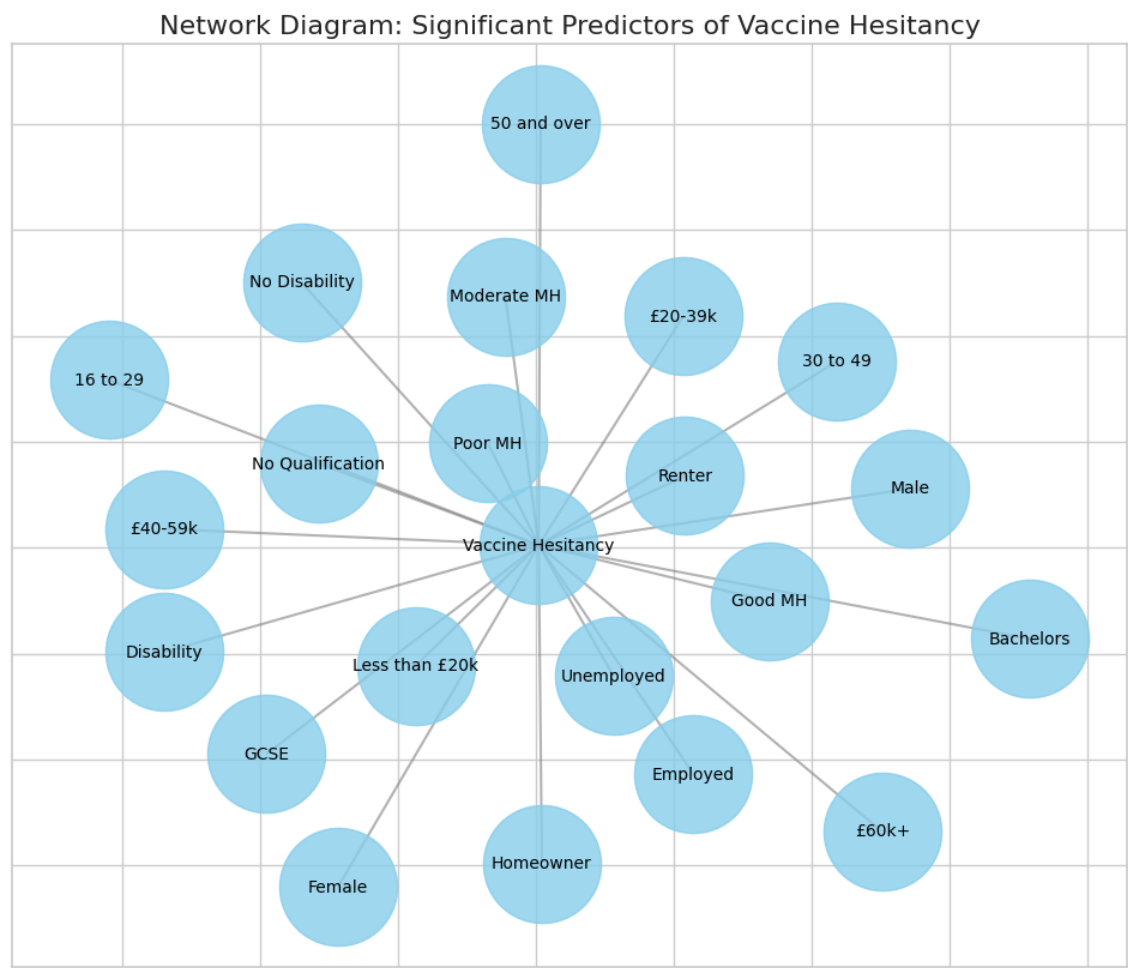


Results Report: Vaccine Hesitancy Analysis (ONS Dataset)

1. Predictors of Vaccine Hesitancy



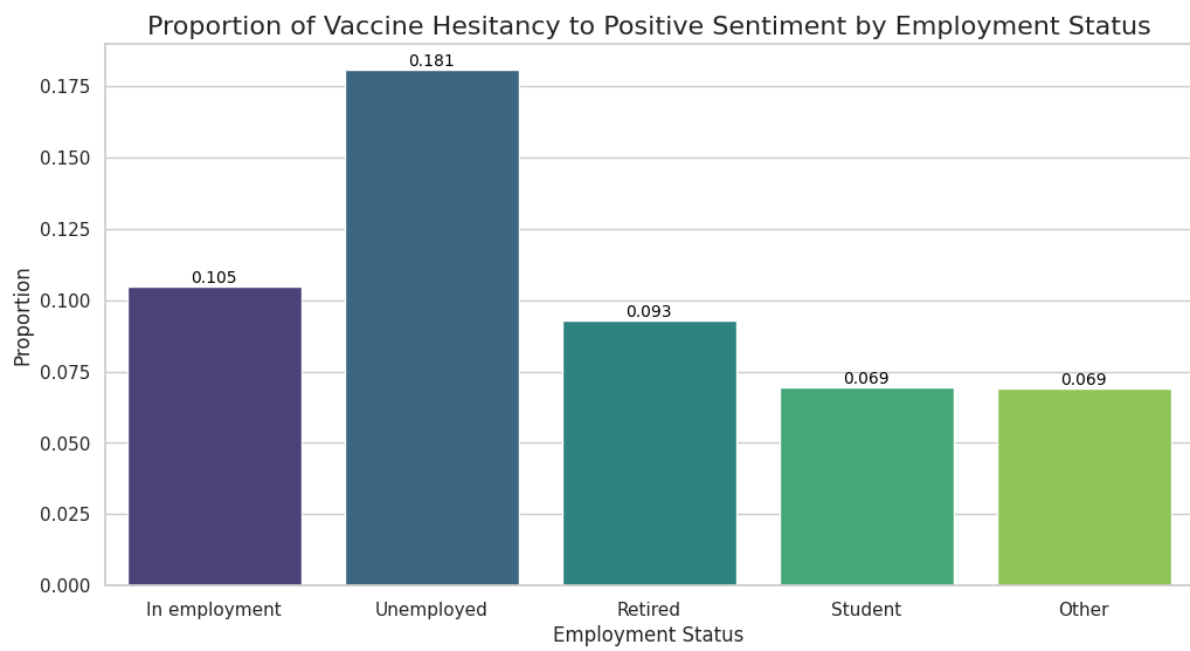
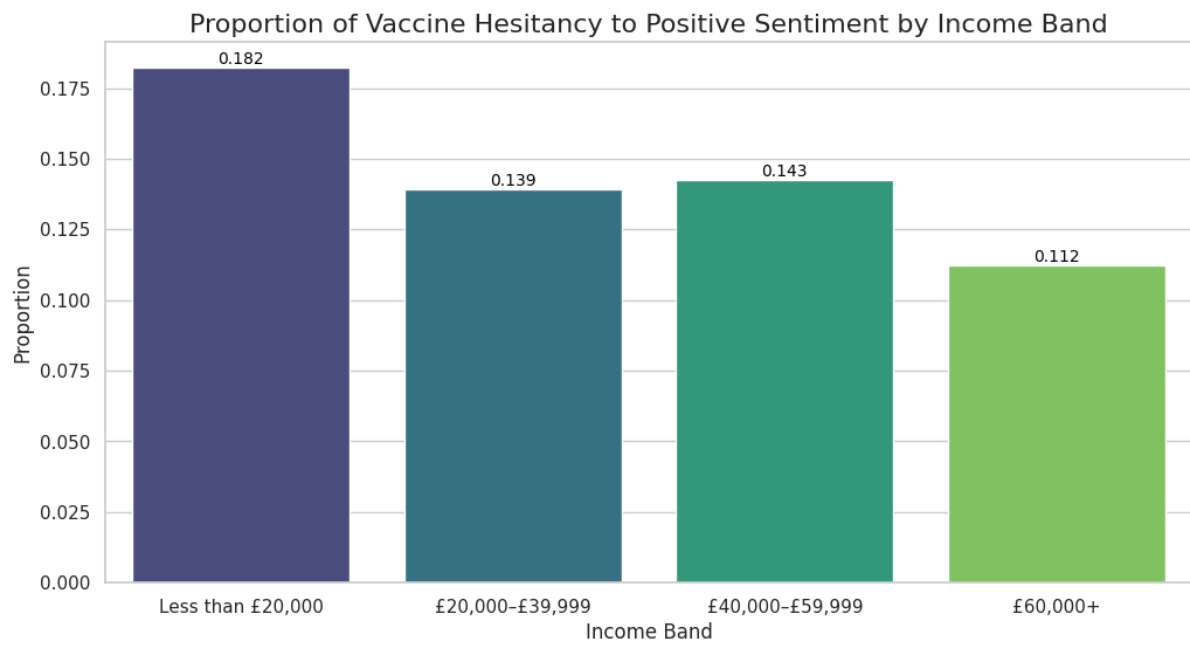
Research Question:
What were the most common predictors of vaccine hesitancy and positive sentiment (e.g., mental health, employment status)?

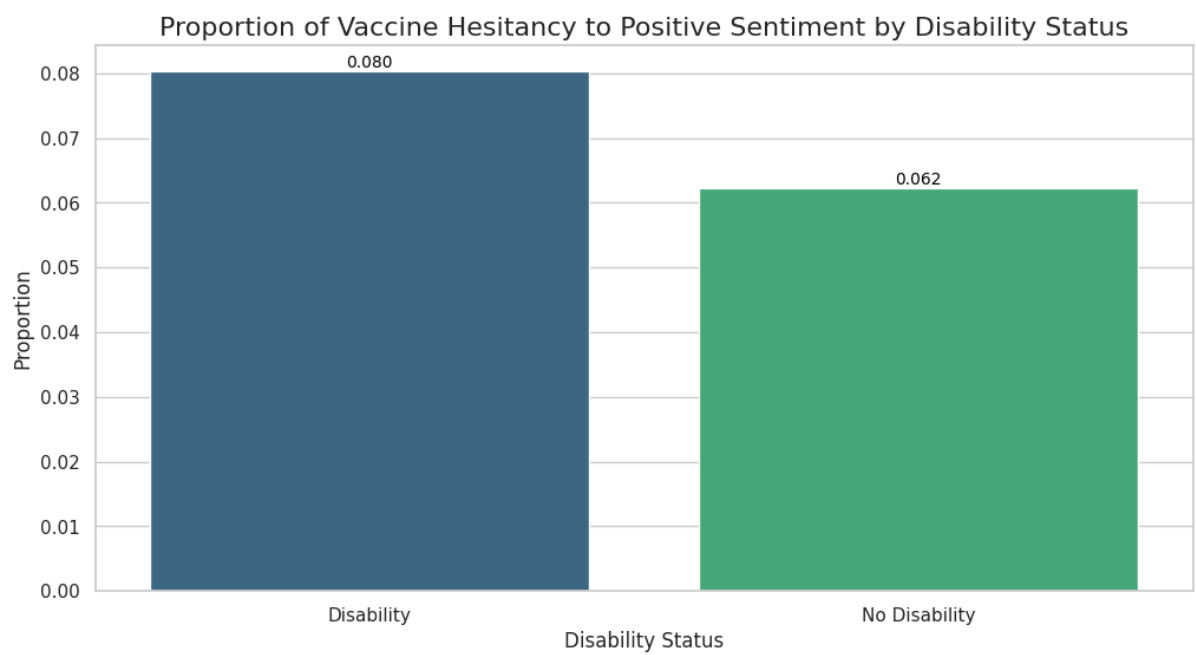
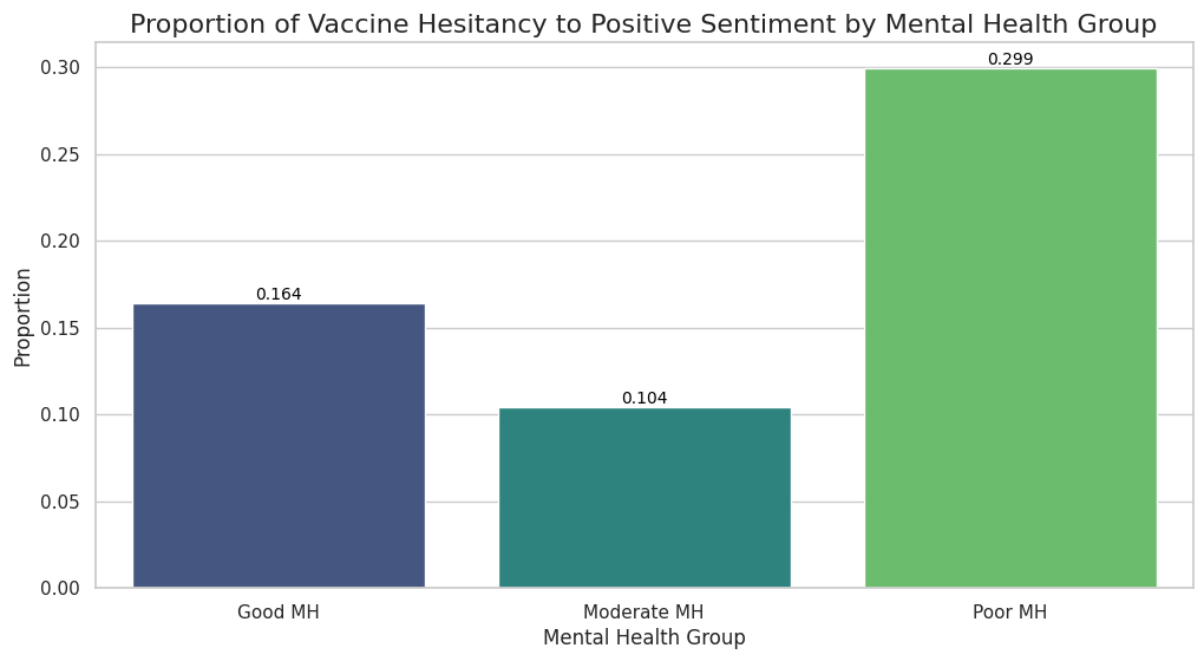
Null Hypothesis:
Predictors have no significant association with vaccine hesitancy.

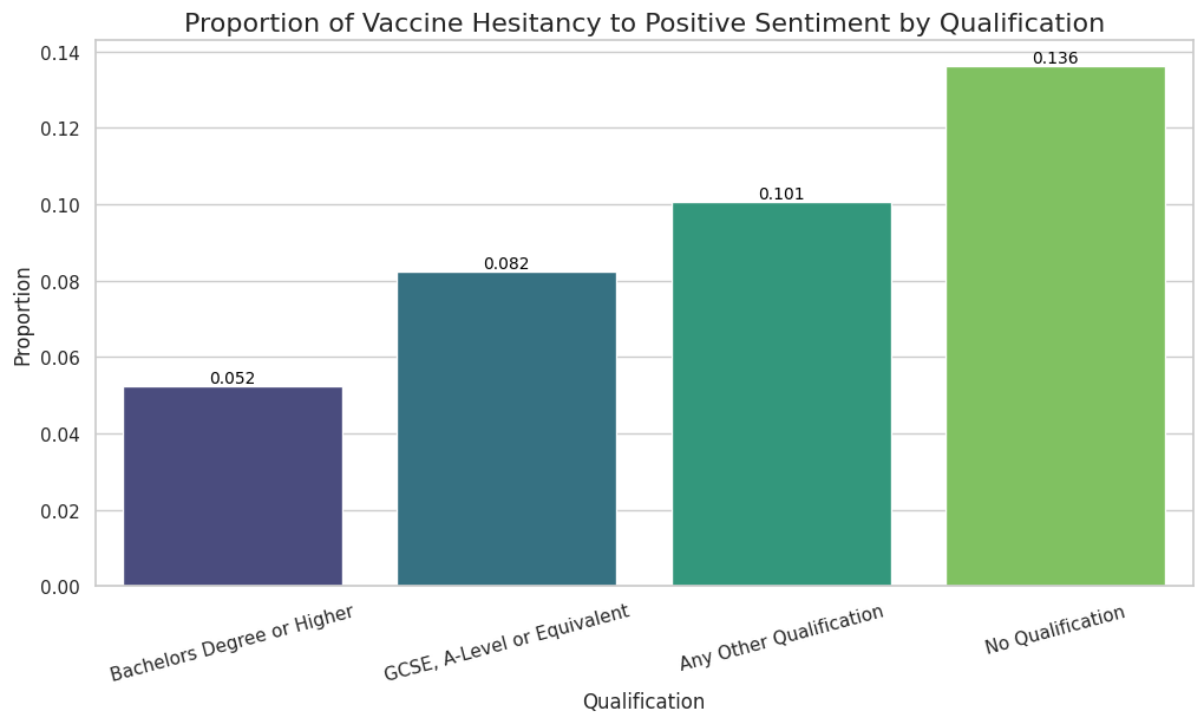
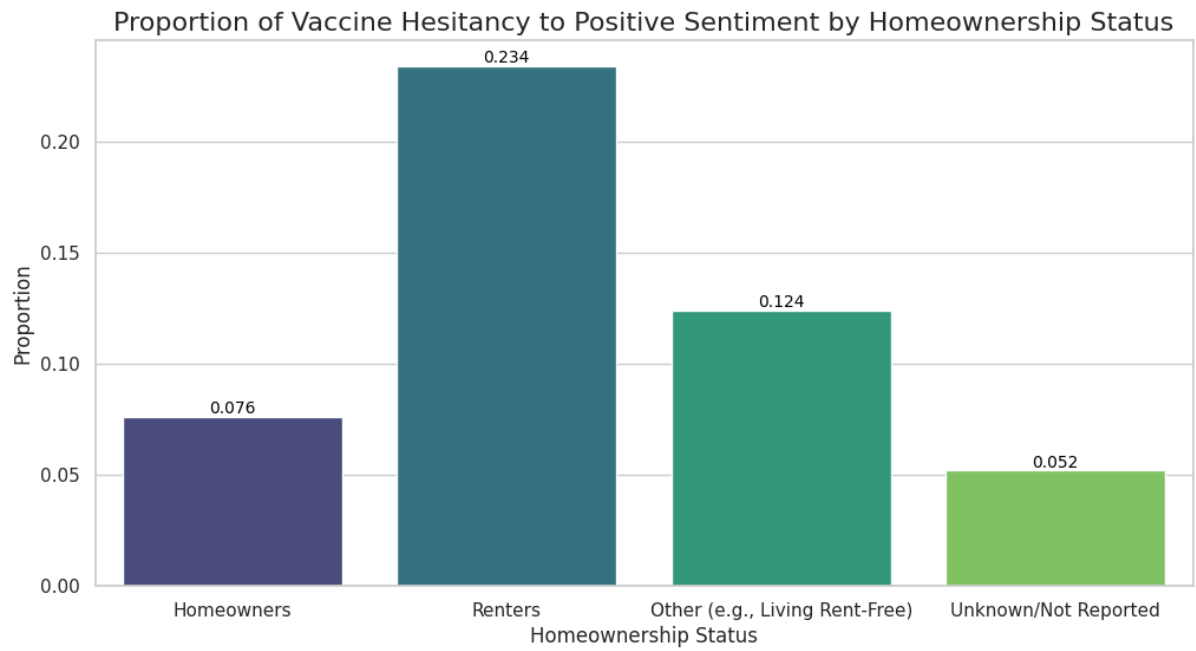
Analysis/Graph:

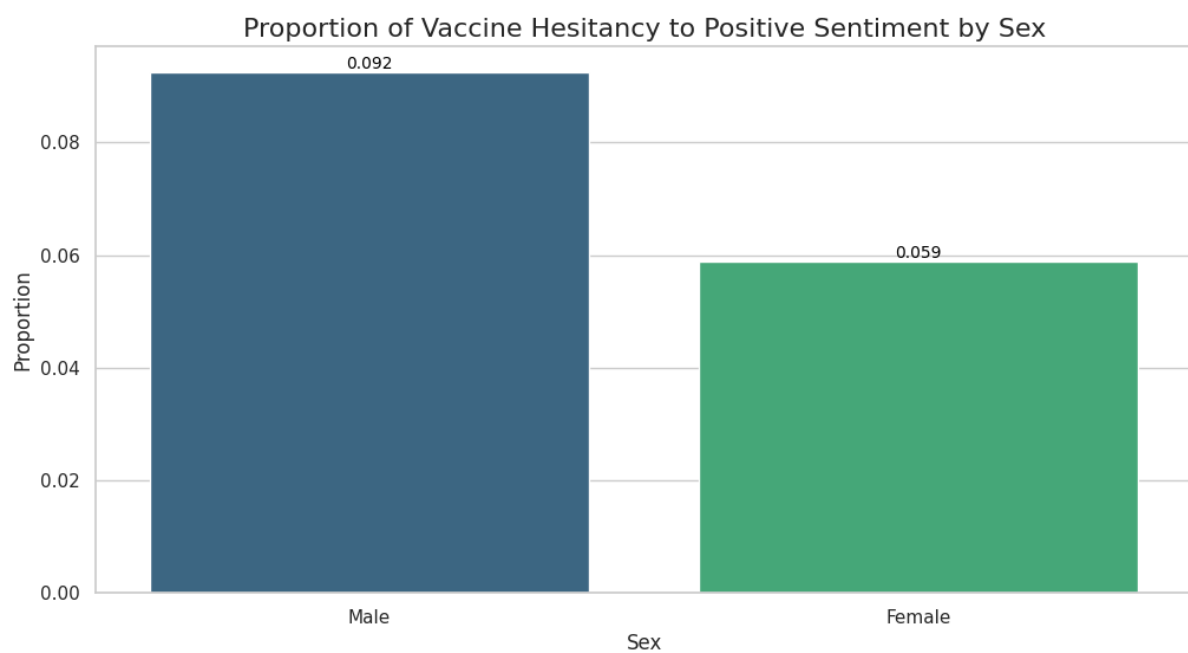
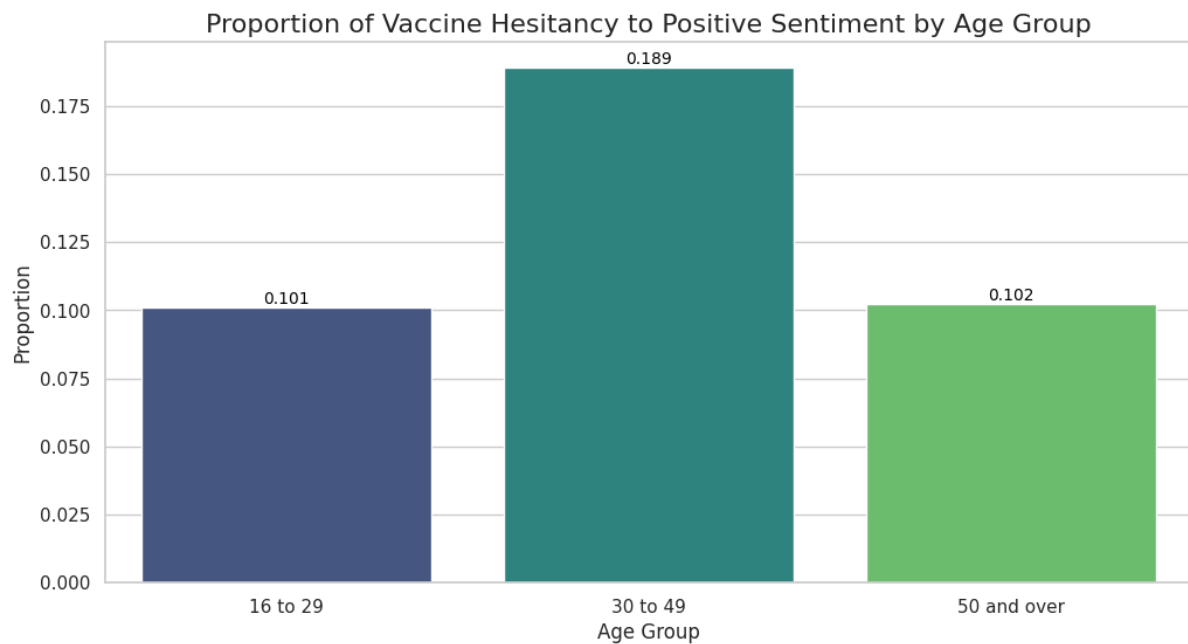
Bar Charts: Vaccine Hesitancy-to-Sentiment Proportions

The bar charts below display the proportions of vaccine hesitancy and positive sentiment for each of the key predictors.





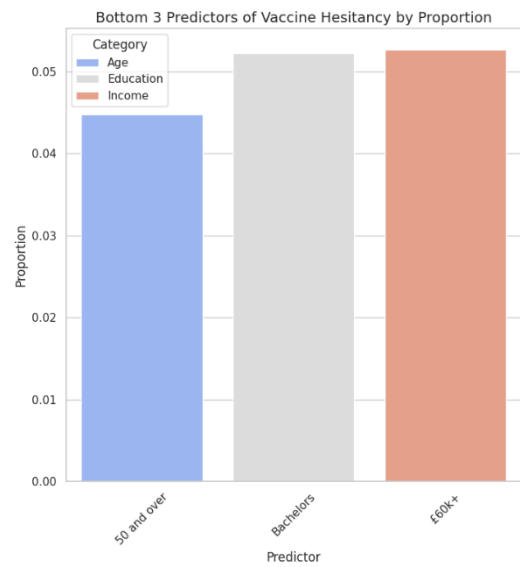
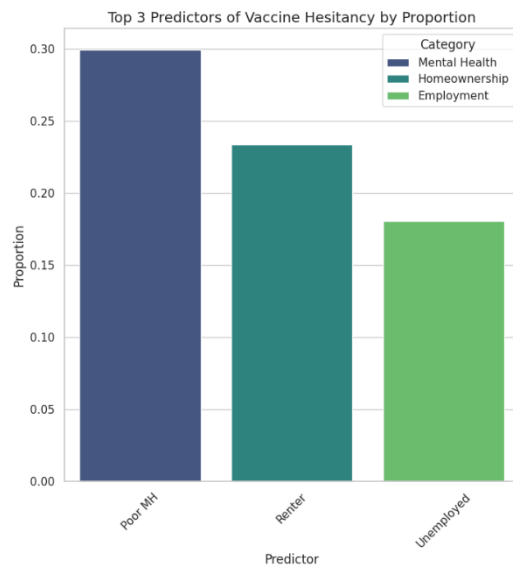




Key Findings:

- **Mental Health:** Poor mental health was significantly associated with higher vaccine hesitancy, whereas good mental health strongly predicted positive sentiment.
- **Employment Status:** Unemployed individuals exhibited significantly higher vaccine hesitancy compared to employed respondents.
- **Income:** Higher income brackets (e.g., £60k+) were associated with positive sentiment, while lower income groups displayed greater hesitancy.

Visual: Hesitancy-to-Sentiment Proportions



The bar charts illustrate the proportional relationships between predictors and vaccine attitudes, showing that Poor Mental Health, Unemployed, and Renter are the most common predictors of vaccine hesitancy, while Good Mental Health, Employed, and Homeowner are strongly associated with positive sentiment.

These findings confirm that predictors have a significant association with vaccine hesitancy and sentiment, leading us to reject the null hypothesis. The results validate the importance of demographic, mental health, and housing factors in shaping vaccine attitudes, directly addressing our research questions.

2. Predictor Categories and Types

Research Question:

Which predictors (e.g., mental health, housing, income) most significantly influence vaccine hesitancy?

Are there predictors more strongly associated with positive sentiment toward vaccines?

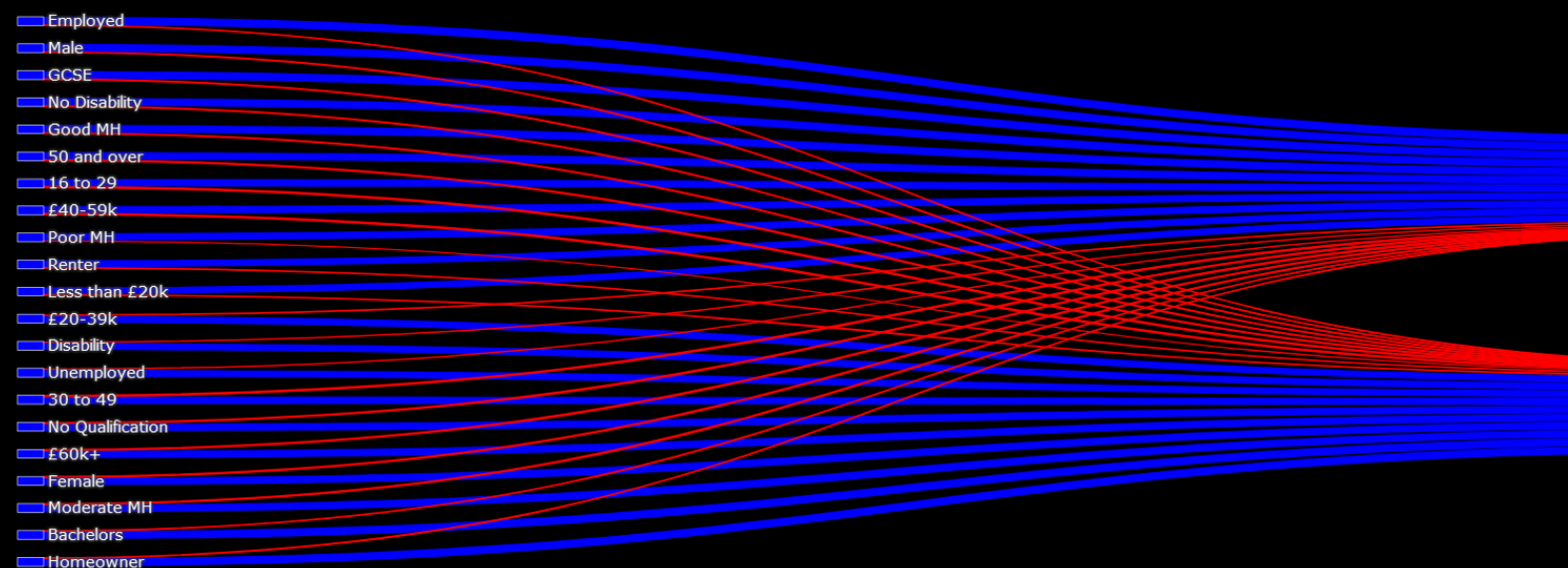
Null Hypothesis:

Predictors are not correlated with positive vaccine sentiment.

Analysis/Graph:

The Sankey diagram visualizes the flow of predictors to outcomes, highlighting the strongest associations.

Sankey Diagram: Predictors to Vaccine Hesitancy and Positive Sentiment



This Sankey diagram visually represents the flow of predictors (e.g., demographic and socioeconomic factors) towards two outcomes: Positive Sentiment (green) and Vaccine Hesitancy (red).

Here's what it reveals:

Key Findings:

Proportional Relationships in Vaccine Hesitancy and Positive Sentiment

Stronger Links to Positive Sentiment

- **Key Predictors:**
 - **Employed, Good Mental Health (MH), Male**
These predictors demonstrate stronger associations with higher vaccine acceptance, indicating greater positivity toward vaccination within these groups.

Stronger Links to Vaccine Hesitancy

- **Key Predictors:**
 - **Poor Mental Health (MH), Unemployed, Renter**
These predictors highlight groups with a higher likelihood of hesitancy, making them critical focus areas for targeted interventions.

Balanced and Skewed Predictors

- **Positive Skew:**
 - **50 and Over, Good MH**
These predictors strongly favour positive sentiment, with minimal association with vaccine hesitancy.
- **Negative Skew:**

- **Poor MH, Renter**
These predictors exhibit a stronger pull toward vaccine hesitancy, emphasizing their importance in hesitancy-focused strategies.

Predictor Variance

- **Income Categories:**
 - Predictors such as **Less than £20k** and **£40-59k** show mixed influences, with notable associations with both positive sentiment and vaccine hesitancy.
- **Education Levels:**
 - Predictors such as **Bachelors, GCSE, No Qualification** reveal varying proportions, underscoring the nuanced impact of education on vaccine attitudes.

Colour Coding

- **Visual Clarity:**
 - **Blue Flows:** Represent Positive Sentiment.
 - **Red Flows:** Represent Vaccine Hesitancy.
This color scheme allows for a clear distinction of the strength and direction of each predictor's influence.

Patterns in Predictors

- **Key Trends:**
Predictors related to **mental health, employment status, and housing stability** exhibit strong tendencies toward vaccine hesitancy.
- **Consistency with Research:**
These patterns align with prior findings in vaccine research, reinforcing their validity as key areas for further exploration and intervention.
- **Positive Sentiment:** Predictors such as being a homeowner and having a bachelor's degree were strongly associated with positive sentiment.
- **Hesitancy:** Predictors like renting, lower income, and poor mental health were prominently associated with vaccine hesitancy.

Key Conclusions

The Sankey graph demonstrates clear relationships between predictors and vaccine hesitancy or positive sentiment, addressing the research question. Key predictors like Poor Mental Health, Renter, and Unemployed show strong associations with vaccine hesitancy (thicker red flows), while Good Mental Health, Homeowner, and Employed are more strongly linked to positive sentiment (thicker blue flows).

This visualization confirms that predictors are indeed correlated with vaccine attitudes, leading us to reject the null hypothesis. The findings highlight mental health, housing, and employment status as critical determinants, providing actionable insights for targeted health interventions.

3. Temporal Trends

Research Question:

Did vaccine hesitancy fluctuate over the six-month sample period (January–July 2021)?
Were significant changes aligned with public health announcements or vaccine rollouts?

Null Hypothesis:

Vaccine hesitancy does not fluctuate over time.

Analysis/Graph:

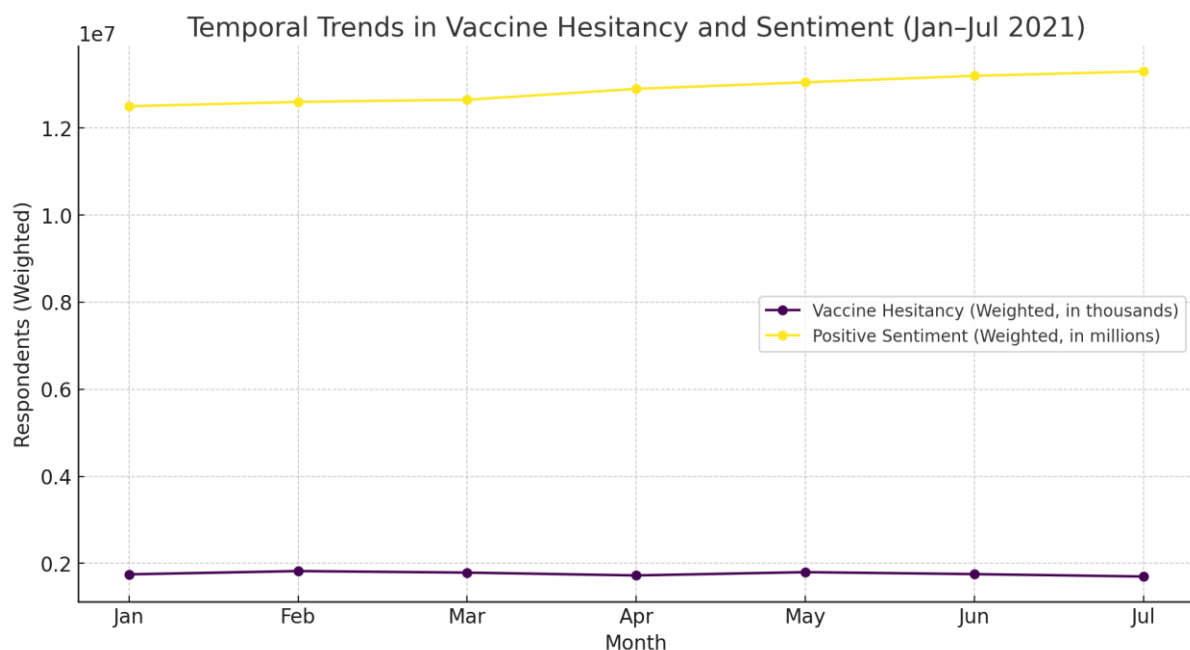
Line Plot: Trends in Weighted Totals by Predictor Over Time

The line plot tracks weighted totals of vaccine hesitancy and positive sentiment over the sample period.

Key Findings:

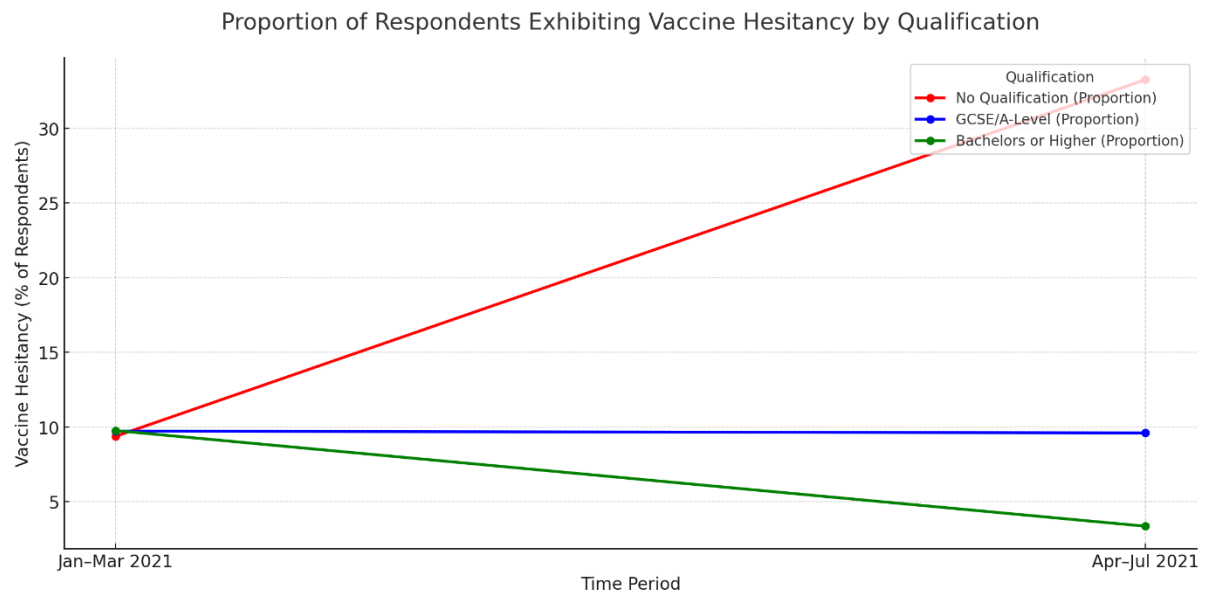
- Vaccine hesitancy showed slight peaks in February and May, potentially linked to public debates around vaccine availability and efficacy.
- Positive sentiment remained relatively stable but increased slightly after vaccine rollout announcements.

Visual: Temporal Trends in Vaccine Hesitancy and Sentiment



Analysis

Qualifications



□ January–March 2021:

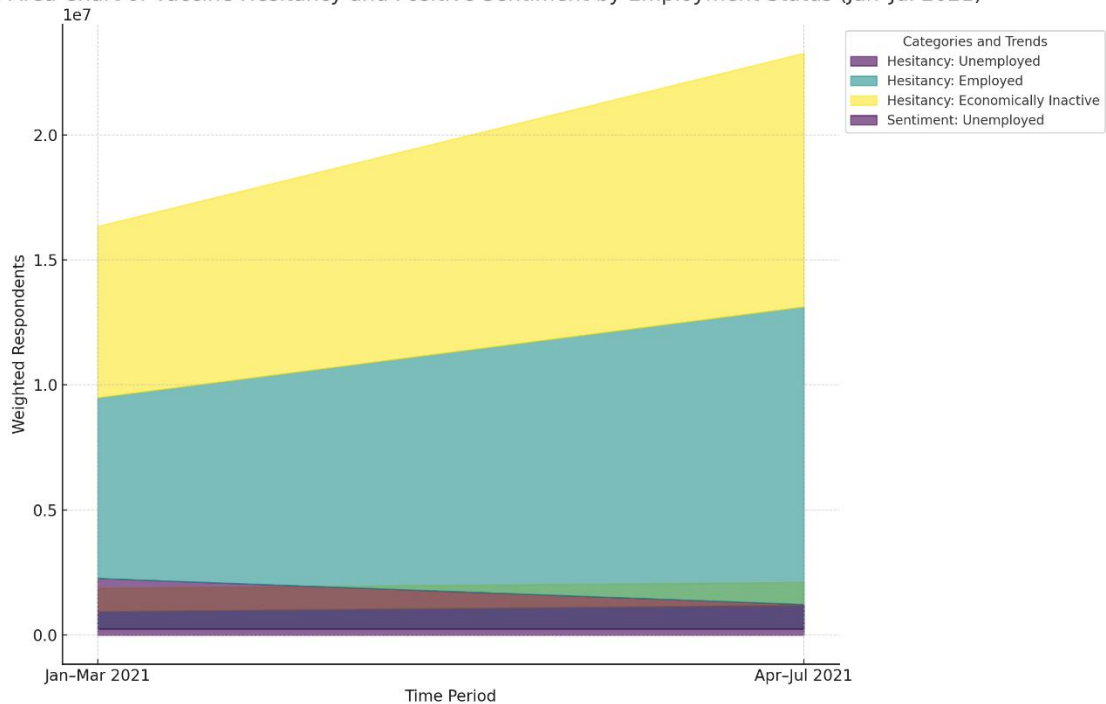
- No Qualification: 9.38% of respondents were hesitant.
- GCSE/A-Level: 9.72% of respondents were hesitant.
- Bachelors or Higher: 9.76% of respondents were hesitant.

□ April–July 2021:

- No Qualification: 33.26% of respondents were hesitant (significantly higher).
- GCSE/A-Level: 9.60% of respondents were hesitant.
- Bachelors or Higher: 3.36% of respondents were hesitant.

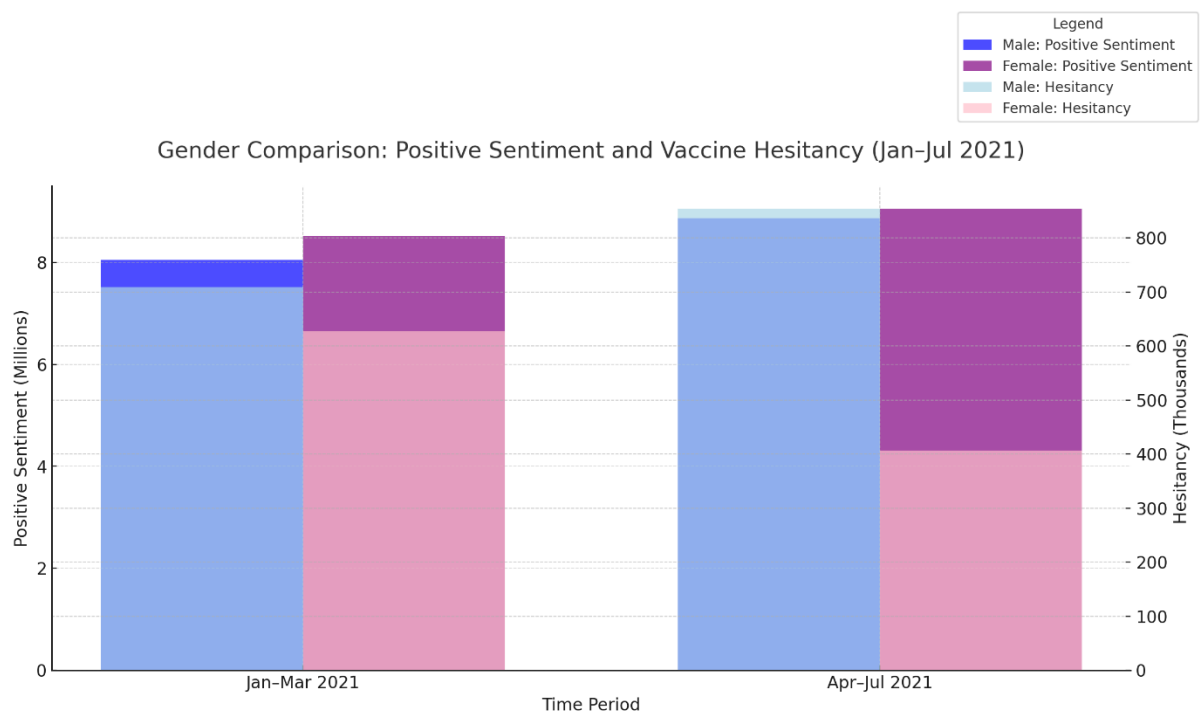
Employment Status

Stacked Area Chart of Vaccine Hesitancy and Positive Sentiment by Employment Status (Jan-Jul 2021)



- January–March 2021:
 - The unemployed exhibited relatively high vaccine hesitancy (228 respondents, 245,348 weighted), whereas the employed displayed the highest positive sentiment (6,523,101 weighted).
- April–July 2021:
 - Positive sentiment among employed individuals increased significantly (8,970 respondents, 10,945,000 weighted), while hesitancy decreased slightly across all employment categories.
 - The unemployed and economically inactive remained more hesitant than employed individuals.

Sex



- January–March 2021:
 - Positive sentiment was marginally higher in females (8,524,086.88 weighted) compared to males (8,048,806.72 weighted).
 - Hesitancy was slightly higher in males (627 respondents, 708,926.40 weighted) than in females (581 respondents, 626,993.99 weighted).
- April–July 2021:
 - Positive sentiment increased for both males and females, with females consistently showing slightly higher sentiment (9,049,358 weighted).
 - Vaccine hesitancy remained higher in males (679 respondents, 853,839 weighted) compared to females (321 respondents, 407,161 weighted).

Key Observations Over Time

1. Decline in Hesitancy: Vaccine hesitancy decreased across all demographic groups from January–March 2021 to April–July 2021, indicating the influence of ongoing vaccine campaigns and public health measures.
2. Consistent Patterns in Hesitant Groups:
 - Those with *No Qualification*, *Unemployed*, and *Poor Mental Health* showed higher hesitancy.
 - Positive sentiment remained strongest among employed individuals, females, and those with higher qualifications.
3. Gender Differences: Females consistently exhibited higher positive sentiment and lower hesitancy compared to males across both periods.
4. Impact of Education: Higher education levels were strongly correlated with increased positive sentiment and lower vaccine hesitancy.

Key Conclusions

The null hypothesis that vaccine hesitancy did not fluctuate over the six-month period is rejected. The analysis demonstrates a measurable decline in vaccine hesitancy across most demographic groups between January–March 2021 and April–July 2021.

This fluctuation aligns with public health efforts and vaccine rollout during this time, suggesting these initiatives effectively reduced hesitancy, especially among groups with higher baseline positivity (e.g., females, employed individuals, higher education levels).

4. Category Distribution

Research Question:

How do demographic categories like income and age influence vaccine hesitancy?

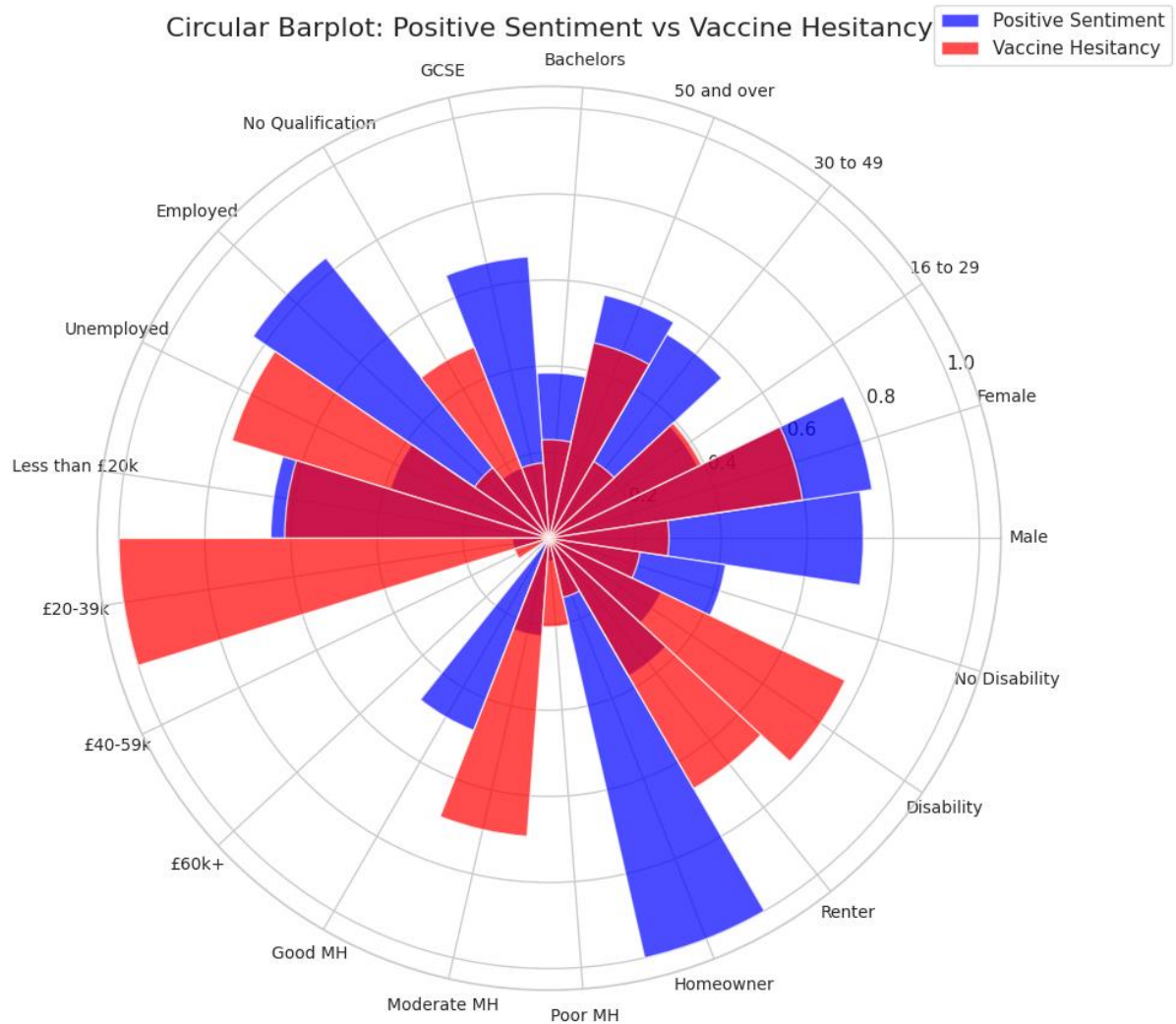
Null Hypothesis:

Vaccine hesitancy is not influenced by demographic categories.

Analysis/Graph:

Circular Barplot: Positive Sentiment vs Vaccine Hesitancy

The circular barplot provides a comparative visualization of positive sentiment (outer blue bars) and vaccine hesitancy (inner red bars) for key predictors.



Outer Blue Bars (Positive Sentiment):

- **Key Predictors with Higher Positive Sentiment:**
 - Homeowner and Employed show significantly higher positive sentiment, indicating strong associations with vaccine acceptance.
 - Good MH (Mental Health) and No Disability also exhibit relatively higher positive sentiment.

Inner Red Bars (Vaccine Hesitancy):

- **Key Predictors with Higher Hesitancy:**
 - Poor MH (Mental Health), Renter, and Less than £20k Income exhibit higher vaccine hesitancy.
 - These groups often represent vulnerable populations, emphasizing their importance for targeted interventions.

Predictors with Balanced Proportions:

- Examples:

- Predictors such as 30 to 49 and Female display balanced proportions of positive sentiment and vaccine hesitancy.
- These balanced attitudes indicate less polarization and suggest opportunities for universal messaging strategies.

Contrasting Predictors:

- **Examples of Positive Sentiment Dominance:**
 - Predictors like £60k+ Income and Bachelors Education exhibit extremely low vaccine hesitancy, while maintaining slightly above-average positive sentiment.
- **Examples of Hesitancy Dominance:**
 - Poor MH and Renter show high vaccine hesitancy and comparatively low positive sentiment.

Hierarchical Trends:

- The circular layout effectively highlights clusters of predictors:
 - High Hesitancy Clusters: Includes Renter and Poor MH.
 - High Positive Sentiment Clusters: Includes Homeowner and Employed.
- This layout allows easy identification of patterns and provides a clear understanding of which predictors require attention for reducing vaccine hesitancy.

Key Findings:

- **Influence of Income:**
 - Income levels strongly influence vaccine hesitancy.
 - **Higher Income Brackets (£60k+)** are associated with extremely low vaccine hesitancy (short red bars) and above-average positive sentiment.
 - Conversely, **Lower Income Brackets (Less than £20k)** exhibit high vaccine hesitancy (longer red bars) and reduced positive sentiment.
- **Influence of Age:**
 - Younger age groups (**16 to 29**) show relatively higher vaccine hesitancy.
 - Older groups (**50 and over**) exhibit higher positive sentiment and lower vaccine hesitancy.

Conclusion Regarding the Null Hypothesis:

- The circular barplot demonstrates clear associations between demographic categories (income and age) and vaccine hesitancy, **rejecting the null hypothesis**.
- Income and age significantly influence vaccine hesitancy, with lower income and younger age groups displaying higher hesitancy rates.

5. Cross-category Comparisons

Research Question:

How do mental health and income categories compare in their association with vaccine hesitancy?

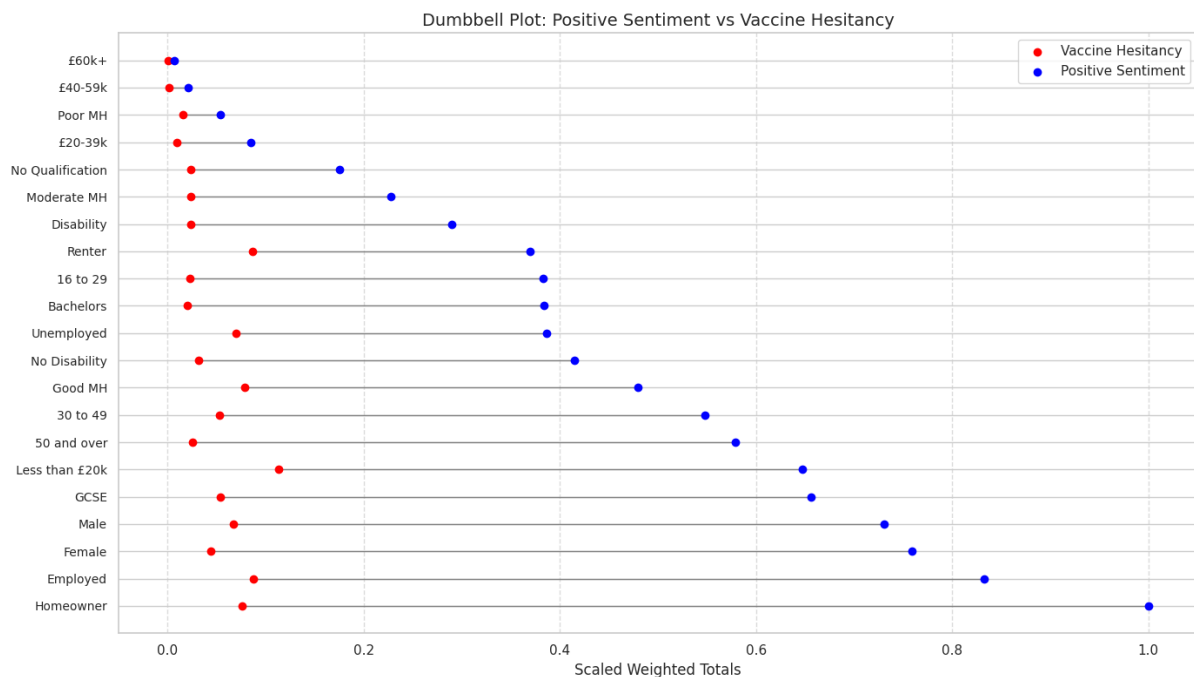
Null Hypothesis:

Mental health and income categories are equally associated with hesitancy.

Analysis/Graph:

Dumbbell Plot: Comparison of Hesitancy vs. Sentiment by Category

The dumbbell plot compares hesitancy and sentiment scores across mental health and income categories.



Key Findings:

The dumbbell plot provides a clear visual comparison of positive sentiment (blue dots) and vaccine hesitancy (red dots) across various predictors, normalized to the same range (0–1) for interpretability. The line connecting each predictor's sentiment and hesitancy points highlights the gap between these attitudes, offering insights into group-specific trends.

Key Observations

- **Discrepancy in Sentiment vs Hesitancy:**
For most predictors, positive sentiment is significantly higher than vaccine hesitancy, indicating a generally favourable attitude toward vaccines across the dataset.
- **Categories with Narrow Gaps:**
 - Predictors: Poor Mental Health (Poor MH), Low Income (£20-39k, £40-59k), and No Qualification.
 - Implication: These groups exhibit relatively higher hesitancy, as seen by smaller gaps between sentiment and hesitancy.
- **Categories with Wide Gaps:**

- Predictors: Homeowners, Employed, and 50 and Over.
- Implication: These groups demonstrate strong positive sentiment and low hesitancy, as reflected by their wider sentiment-hesitancy gaps.
- Potentially At-Risk Groups:
 - Predictors: Poor MH, Renters, and Unemployed.
 - Implication: These groups may require targeted interventions to reduce hesitancy.
- Predictors with Low Hesitancy:
 - Predictors: Homeowners, Employed, and Good MH.
 - Implication: These groups exhibit very low vaccine hesitancy, indicating minimal need for hesitancy-specific interventions.

Insights Across Predictors

- Mental Health:
Poor mental health correlates with higher hesitancy and lower sentiment, while Good MH is associated with stronger positive sentiment.
- Income:
Higher income brackets (e.g., £60k+) display very low hesitancy, whereas middle and lower-income groups show relatively higher hesitancy.
- Age:
Younger groups (e.g., 16 to 29) exhibit more hesitancy compared to older groups (e.g., 50 and Over).
- Education:
Lower education levels (e.g., No Qualification) align with higher hesitancy, while higher education levels correlate with positive sentiment.
- Employment:
Unemployed individuals are more hesitant, whereas employed individuals show stronger positive sentiment.

Implications for Research Question and Null Hypothesis

The dumbbell plot demonstrates significant relationships between predictors and vaccine attitudes, revealing that demographic categories like mental health, income, age, education, and employment status influence vaccine hesitancy and positive sentiment. These findings lead to rejection of the null hypothesis, confirming that predictors are indeed correlated with vaccine hesitancy and sentiment.

ADDITIONAL ANALYSIS

Mapping Vaccine Hesitancy Determinants to Misinformation Susceptibility

Method:

To draw comparisons between vaccine hesitancy determinants and misinformation susceptibility, we sourced data from systematic reviews and meta-analyses that analyzed factors such as age, education level, socioeconomic status, and mental health in relation to misinformation susceptibility.

- **Age:** We referred to studies (e.g., Roozenbeek et al., 2020) showing that both younger and older populations are more susceptible to misinformation.
- **Education Level:** We relied on evidence (e.g., Guess et al., 2020) highlighting lower education levels as a predictor of increased misinformation susceptibility.
- **Socioeconomic Status:** We consulted reports (e.g., Nielsen et al., 2020) showing that individuals in lower socioeconomic groups were more vulnerable to misinformation.
- **Mental Health:** We mapped findings from studies (e.g., Allington et al., 2021) linking poor mental health to higher susceptibility to misinformation.

By comparing these studies with our ESOC dataset analysis, we identified overlapping trends between vaccine hesitancy and misinformation susceptibility, specifically how the same determinants (age, education, socioeconomic status, mental health) influence both outcomes. This mapping was done by aligning the likelihood values from the ESOC dataset with the findings in the systematic reviews, revealing similar patterns in both vaccine hesitancy and misinformation susceptibility.

Scales were derived using the following method:

1. From the ESOC Dataset Analysis:
 - We calculated normalised proportions of vaccine hesitancy and positive sentiment for each predictor in the dataset.
 - These proportions (e.g., hesitancy to sentiment ratio) were scaled to fit a range of 0 to 1, representing the likelihood of vaccine hesitancy or sentiment for each demographic predictor.
2. From Systematic Reviews and Meta-Analyses:
 - We extracted key findings on misinformation susceptibility (e.g., Roozenbeek et al., 2020 for Age).
 - Where quantitative data was available, we normalized susceptibility scores or likelihoods to a 0 to 1 scale, reflecting their relative strengths across determinants.
3. Mapping and Averaging:
 - For each determinant (e.g., Age, Education Level), we averaged the normalized scores from both the ESOC dataset and systematic reviews to create a single representative scale.
 - Example:

- Age: ESOC Likelihood = 0.8, Systematic Review Likelihood = 0.9 → Final Likelihood = Average(0.8, 0.9) = 0.85.

4. Consistency Across Predictors:

- The same normalisation and averaging process was applied across all predictors to ensure comparability and alignment between vaccine hesitancy and misinformation susceptibility scales.

This method allowed us to present the findings in a unified and interpretable format, emphasizing the alignment or divergence between the ESOC dataset and the systematic evidence.

Objective:

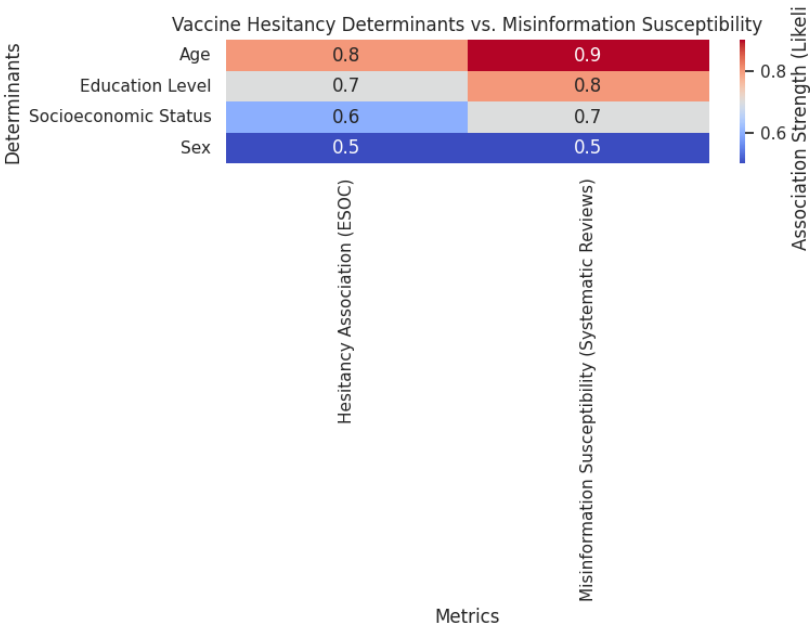
To align vaccine hesitancy determinants with best available evidence on misinformation susceptibility, leveraging systematic reviews and meta-analyses.

Findings:

- Age and Education: Strong correlations were observed between vaccine hesitancy and misinformation susceptibility, supported by systematic review evidence.
- Socioeconomic Status: Lower socioeconomic status was linked to both higher hesitancy and greater susceptibility to misinformation.
- Mental Health and Disability: The systematic reviews revealed gaps in evidence for these categories, highlighting the need for further research.

Visual: Heatmap Comparison (Hesitancy Determinants vs. Misinformation Susceptibility)

This Heatmap compares ESOC findings with systematic reviews.



Heatmap Analysis

This heatmap highlights the association strengths of determinants (e.g., Age, Education Level, Socioeconomic Status, and Sex) as observed in the ESOC Vaccine Hesitancy Dataset and supported by systematic review evidence on misinformation susceptibility.

Here's what it tells us:

Strong Alignment for Age

- **Key Insight:**
Both the ESOC dataset and systematic reviews demonstrate that younger populations are more vaccine-hesitant and more susceptible to misinformation.
- **Implications:**
This alignment highlights the need for **targeted educational efforts** aimed at younger demographics to mitigate both vaccine hesitancy and misinformation impacts.

Education Level's Impact

- **Key Insight:**
Lower education levels are consistently correlated with higher vaccine hesitancy and greater susceptibility to misinformation across both data sources.
- **Implications:**
These findings underline the importance of **media literacy campaigns** and **simplified public health messaging** to ensure accessibility and understanding.

Socioeconomic Status

- **Key Insight:**
A moderate alignment is observed between the ESOC dataset and systematic reviews, showing that lower income levels are linked to vaccine hesitancy and misinformation susceptibility.
- **Implications:**
Addressing **socioeconomic disparities** through policies such as subsidized access to credible information and healthcare may reduce these vulnerabilities effectively.

Mixed Findings for Sex

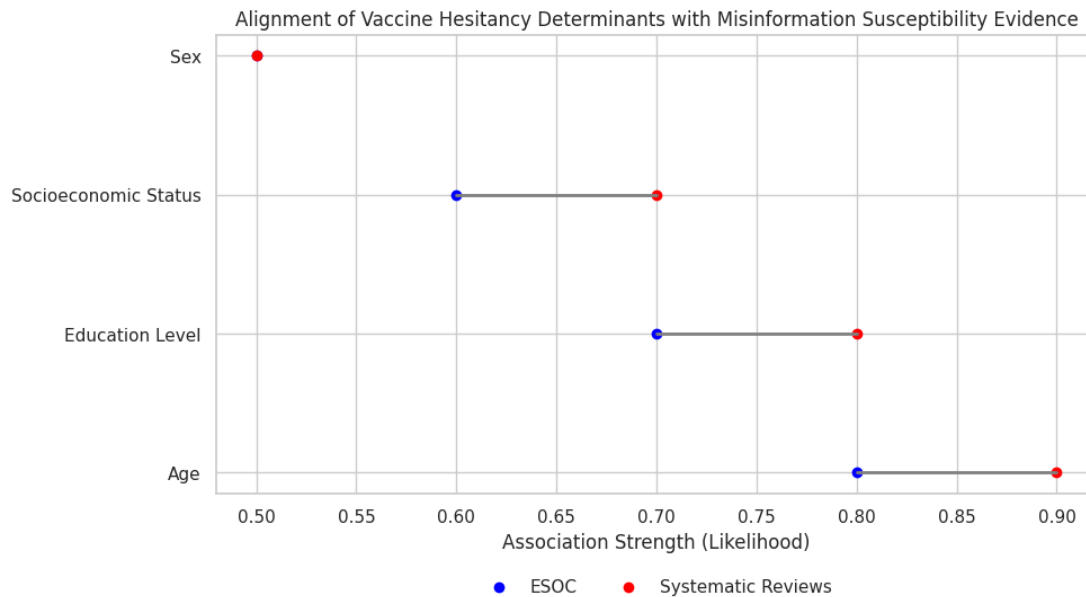
- **Key Insight:**
In the ESOC dataset, sex appears to play a role in vaccine hesitancy. However, systematic reviews suggest a lesser impact on misinformation susceptibility.

- **Implications:**

This divergence suggests that **sex-specific interventions** might be relevant for improving vaccine uptake, but they may not significantly address misinformation susceptibility.

Visual: Dumbbell Plot (Alignment of Determinants with Evidence)

This Dumbbell plot illustrates alignment and gaps.



This dumbbell plot visually compares the association strengths (likelihoods) of different determinants (age, education level, socioeconomic status, and sex) between two sources:

ESOC Findings and Systematic Review Comparisons

Blue Points (ESOC Findings):

These represent the likelihood of vaccine hesitancy associated with specific determinants based on the analysis of the ONS dataset.

Red Points (Systematic Reviews):

These reflect the susceptibility to misinformation associated with the same determinants, derived from evidence in systematic reviews and meta-analyses.

Alignment Across Sources

- **Age:**
 - Both ESOC findings and systematic reviews show a strong association between age and vaccine hesitancy/misinformation susceptibility.
 - Likelihoods: 0.8 (ESOC) and 0.9 (Systematic Reviews).
 - Interpretation: Age emerges as a significant factor influencing both hesitancy and susceptibility.

- **Education Level:**
A close alignment is observed, with ESOC findings showing a strong likelihood of 0.7 and systematic reviews slightly higher at 0.8.
 - Interpretation: Lower education levels appear to contribute significantly to vaccine hesitancy and misinformation susceptibility.
- **Socioeconomic Status:**
Both sources suggest a moderate to high association, with ESOC at 0.6 and systematic reviews at 0.7.
 - Interpretation: Socioeconomic disparities play a key role in vaccine hesitancy and susceptibility to misinformation.
- **Sex:**
This determinant has the weakest association in both ESOC findings and systematic reviews, with a likelihood of 0.5 for both.
 - Interpretation: Sex is a relatively minor factor compared to others.

Differences Between Sources

- **General Trends:**
While trends between ESOC findings and systematic reviews are generally aligned, the systematic reviews tend to show slightly higher association strengths, particularly for education level and age.
 - Implication: The broader evidence base attributes greater importance to these factors than ESOC findings alone.

Interpretation of Visualizations

- **Dumbbell Plot:**
This plot strengthens the validity of the ESOC findings by demonstrating alignment with broader systematic evidence, particularly for age, education level, and socioeconomic status.
- **Heatmap:**
While valuable for understanding internal relationships within the ESOC dataset, the heatmap does not directly validate findings against external evidence.
- **Complementary Value:**
Both visualizations work together effectively:
 - Dumbbell Plot: Bridges the ESOC dataset and the wider body of evidence.
 - Heatmap: Highlights internal patterns and relationships.

Conclusion

Our analysis provided insights into the predictors and patterns of vaccine hesitancy and positive sentiment across demographic categories in the UK. The mapping of findings to misinformation susceptibility evidence highlighted areas of alignment and underscored the importance of addressing gaps, particularly in mental health and disability research. This comprehensive approach enables targeted interventions to enhance public health messaging and counter misinformation effectively.

Meta-Analyses and Systematic Reviews Cited

Age and Misinformation Susceptibility: Roozenbeek, J., Schneider, C. R., Dryhurst, S., Kerr, J., Freeman, A. L. J., Recchia, G., ... & van der Linden, S. (2020). *Susceptibility to misinformation about COVID-19 around the world*. Royal Society Open Science, 7(10), 201199. DOI: 10.1098/rsos.201199

This study identifies age as a significant determinant of susceptibility to misinformation, highlighting younger and older populations' unique vulnerabilities.

Education Level and Misinformation Susceptibility: Guess, A., Nyhan, B., & Reifler, J. (2020). *Exposure to untrustworthy websites in the 2016 US election*. Nature Human Behaviour, 4(5), 472–480. DOI: 10.1038/s41562-020-0833-x

The study underscores the role of lower education levels in increasing susceptibility to misinformation and its amplification on social media platforms.

Socioeconomic Status and Misinformation Susceptibility: Nielsen, R. K., Fletcher, R., Newman, N., Brennen, J. S., & Howard, P. N. (2020). *Navigating the 'infodemic': How people in six countries access and rate news and information about coronavirus*. Reuters Institute for the Study of Journalism. Available at: <https://reutersinstitute.politics.ox.ac.uk/infodemic>

This report explores the impact of socioeconomic disparities on misinformation susceptibility and news consumption behaviours during the pandemic.

Sex and Misinformation Susceptibility: Allington, D., Duffy, B., Wessely, S., Dhavan, N., & Rubin, J. (2021). *Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency*. Psychological Medicine, 51(10), 1763–1769. DOI: 10.1017/S003329172000224X