AI and Human Enhancement:
Examining Attitudes on Neural Chips and Embryonic Gene Editing

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EPPS 6323
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Do attitudes towards chip implants or demographics impact attitudes towards embryonic gene editing?

Do attitudes towards neural implants or gene editing impact attitudes towards science?

1. Literature Review
2. Sentiment Analysis using Natural Language Processing
3. Explanatory Models using Linear Regression
4. Predictive Models using Decision Trees and Random Forest
5. Conclusion

Part 1: Literature Review

We reviewed a selection of academic articles analyzing public sentiment towards neural implants and embryonic editing.

Neural Implants:

- For serious conditions (e.g. ALS) respondents are typically supportive, for less serious conditions survey respondents are found to be indifferent or supportive of the application. There's less support for 'frivolous' applications.

Embryonic Editing:

- Public support is mixed, technology lacks safety assurances for broad application. Partial support for serious diseases (e.g. Alzheimers) but not 'less serious', such as ADHD. Concerns about treatment efficacy and equity.

Part 2: Sentiment Analysis

Objective: Analyzed sentiment of Reddit posts over a decade (2014-2024) to gauge public perception of genetic technologies.

Data Source: Extracted from Reddit via their API.

Data Volume: Analyzed 5,500 posts, bootstrapped from 12,031 observations.

Search Queries: Included terms related to genetic technologies like "dna_sequencing", "guide_rna", "genetic_modification", "crispr", etc.

Search Type: Used "Relevant" search setting for more accurate results compared to "Top", "Comments", and "New".

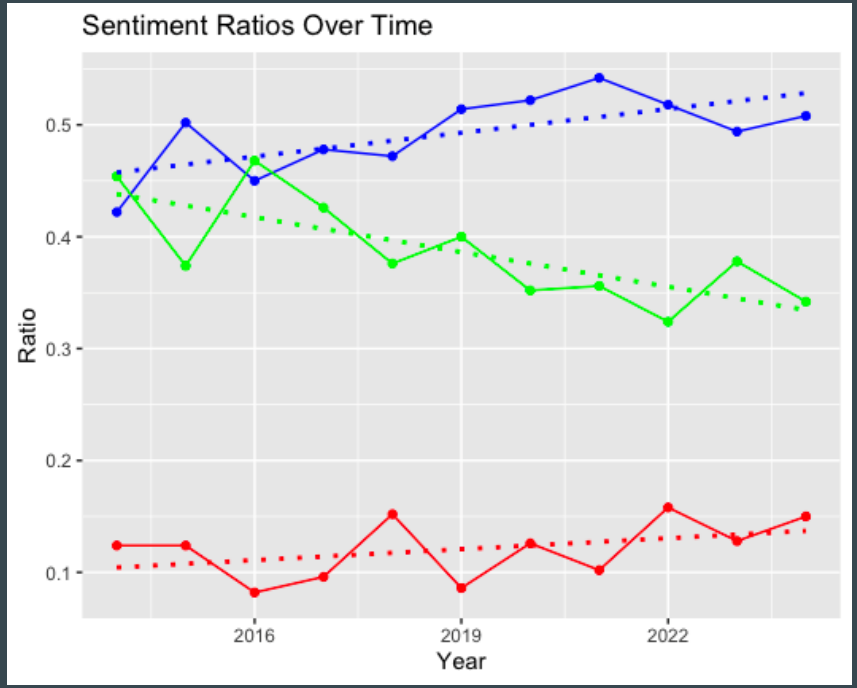
Sentiment Analysis Tool: Utilized textBlob.sentiment.polarity for classifying sentiments into negative, neutral, and positive based on the polarity score ranging from -1 to 1.

Statistical Approach: Employed linear regression to assess changes in sentiment over time.

Overall Interpretation

- The **negative sentiment ratio** does not show a significant trend with respect to year, suggesting stability or no clear pattern of change over the years within the dataset.
- The **positive sentiment ratio** shows a statistically significant decreasing trend over time
- The **neutral sentiment ratio** shows a significant upward trend

Sentiment	P-Value (Year)	Variability Explained
Negative	0.21	7.61%
Positive	0.00852	50.56%
Neutral	0.0229	39.38%



Part 3: Explanatory Models

We ran several linear regression models using gene editing responses as the dependent variable and neural implant responses as the independent variables.

Table 1: The Relationship of Respondents' Opinions on Chip Implants on Embryonic Gene Editing

	Dependent variable:				
	GENEV4a	GENEV4b	GENEV4c	GENEV4d	GENEV3
	(1)	(2)	(3)	(4)	(5)
BCHIP14a	0.001	0.177***	0.182***	−0.035*	
	(0.018)	(0.018)	(0.019)	(0.020)	
BCHIP14b	0.178***	0.145***	0.109***	0.156***	
	(0.021)	(0.021)	(0.022)	(0.023)	
BCHIP14c	−0.090***	0.090***	0.094***	−0.066***	
	(0.015)	(0.014)	(0.014)	(0.017)	
BCHIP14d	−0.004	0.082***	0.082***	−0.030*	
	(0.014)	(0.014)	(0.014)	(0.017)	
BCHIP3					0.368***
					(0.012)
Constant	2.124***	0.810***	0.931***	2.053***	0.839***
	(0.045)	(0.045)	(0.046)	(0.048)	(0.034)
Observations	4,765	3,992	4,106	3,975	3,879
Log Likelihood	−4,590.100	−3,353.568	−3,641.595	−4,001.396	−4,063.572
Akaike Inf. Crit.	9,190.199	6,717.136	7,293.191	8,012.791	8,131.144
Note:					*p<0.1; **p<0.05; ***p<0.01

- Opinions on potential risks of misuse are mixed.
- Respondents are supportive of gene editing to improve quality of life and for important medical advances if they are supportive of chip implants.
- Opinions on gene editing going too far are mixed
- Respondents who would want a neural chip implant are supportive of embryonic gene editing.

Part 4: Predictive Models

We decided to utilize decision trees and random forest models for our predictive models.

- Supervised learning – we have labeled data
- These models allow us to use categorical, non-normal data without creating dummy or transformed variables.
- Steps for our predictive models:
  - Exploratory Data Analysis
  - Created test and training sets of data (75%/25% split).
  - Ran a single decision tree and found misclass rate.
  - Ran a random forest of 5000 trees and found misclass rate.

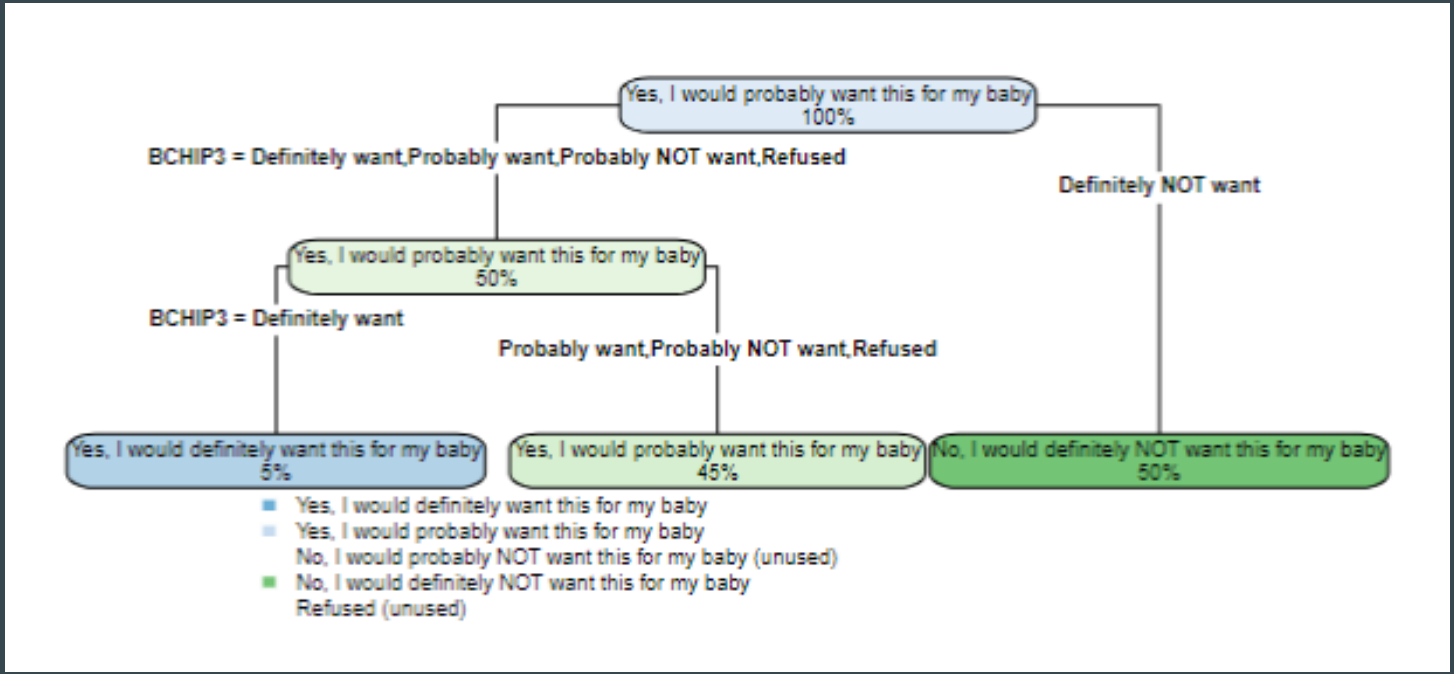
Did we see improvement?

GENE EDITING AND NEURAL IMPLANTS: PERSONAL IMPACT

- We selected GENEV3 and BCHIP3 as our first set of questions to analyze.
  - GENEV3 had a personal impact framing of gene editing
    - What would you choose for your child?
  - BCHIP3 asked participants about their desire to utilize a neural implant for increased cognition.
    - From the literature review, we know that medical AI intervention had strong support when it was perceived to be medically necessary, and less support when it was viewed as frivolous/unnecessary enhancement.

Decision Tree GENEV3

If gene editing to greatly reduce a baby's risk of developing serious diseases or health conditions over their lifetime were available, is this something you would want?



BCHIP3:
Would you personally want a computer chip implant in the brain, allowing you to far more quickly and accurately process information, if you had the opportunity?

GENEV3 and BCHIP3 Confusion Matrix Comparison

Decision Tree Misclass Rate: 0.559906

Table 4: Confusion Matrix GENEV3 and BCHIP3

	A	B	C	D	E
Yes, I would definitely want this for my baby	46	107	0	48	0
Yes, I would probably want this for my baby	21	271	0	156	0
No, I would probably NOT want this for my baby	3	128	0	176	0
No, I would definitely NOT want this for my baby	1	40	0	245	0
Refused	1	15	0	19	0

Note: A: Yes, I would definitely want this for my baby; B: Yes, I would probably want this for my baby; C: No, I would probably NOT want this for my baby; D: No, I would definitely NOT want this for my baby; E: Refused

Random Forest Misclass Rate: 0.5606891

Table 6: Confusion Matrix Random Forest GENEV3 and BCHIP3

	A	B	C	D	E
Yes, I would definitely want this for my baby	46	107	0	48	0
Yes, I would probably want this for my baby	21	268	0	156	3
No, I would probably NOT want this for my baby	3	124	0	176	4
No, I would definitely NOT want this for my baby	1	36	0	245	4
Refused	1	13	0	19	2

Note: A: Yes, I would definitely want this for my baby; B: Yes, I would probably want this for my baby; C: No, I would probably NOT want this for my baby; D: No, I would definitely NOT want this for my baby; E: Refused

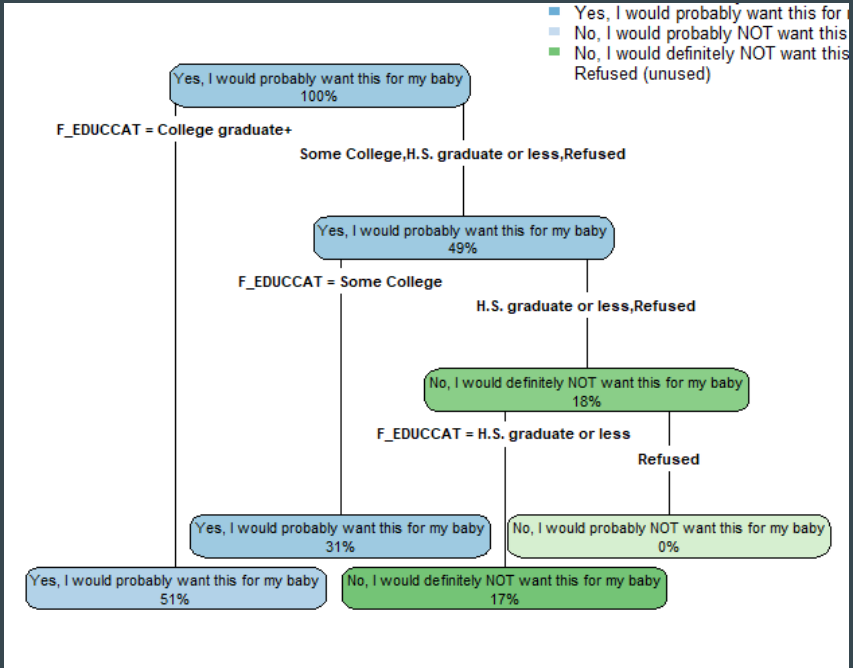
Why do we see a higher misclass rate for the random forest model?

- Too many trees/overfit data?
- We re-tuned the model and still had a higher misclass rate.
- Could be due to inherent variations in data and a restricted range of predictive and dependent variables.

GENE EDITING AND NEURAL IMPLANTS: MORALISTIC FRAMING

- We selected GENEV4 and BCHIP14 as our next set of questions to analyze.
  - GENEV4 had a moralistic framing of gene editing, and BCHIP14 had a variety of potential uses for the neural implants.
- Findings:
  - Random forest produced a lower misclass rate for all subquestions.
  - Even with the improvement of random forest, these models still had an average misclassification rate of 47%.
  - The random forest models each improved on the misclassification rate of negative sentiments only.

IMPACT OF DEMOGRAPHICS ON GENE EDITING ATTITUDES



Educational Attainment and GENEV3

We examined whether key demographic variables could predict respondent's stance on the use of gene editing to reduce the risk of developing serious diseases or health conditions (GENEV3)

Demographic variables:

- Importance of Religion
- Religious affiliation
- Level of educational attainment
- Gender
- Region of the US

Findings and Model Performance

Conclusion

Science attitudes: “personal use” questions did not show significance in our models, moralistic framework and potential applications did (strongest effects were the use of neural implants to treat age-related decline in mental abilities and the potential for gene editing techniques would help people live longer and better quality lives).

Positive sentiment to these questions translates in the likelihood to view science as having a positive impact on society.

Misclassification rate was quite low (~28 and ~29 respectively).

BCHIP was not a good predictor of an individual’s opinions for any of the GENEV questions.

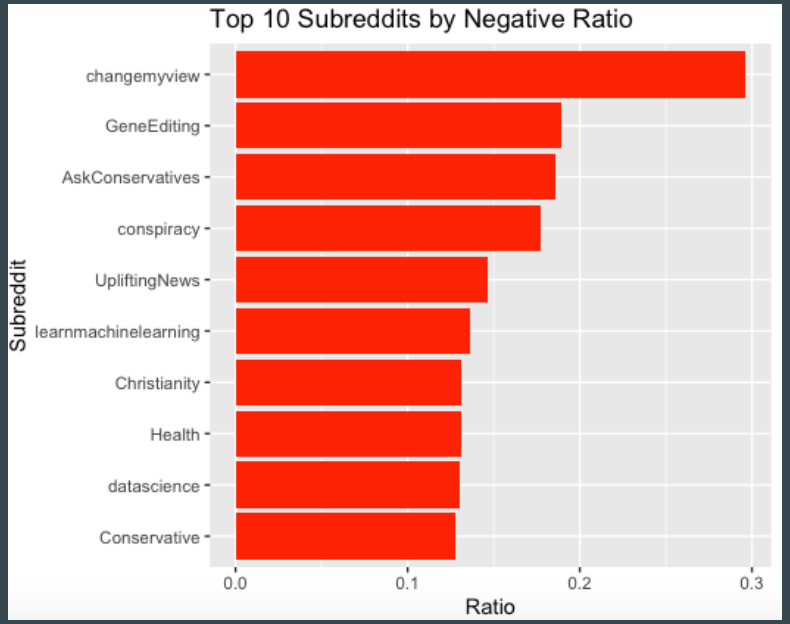
The comparison of explanatory models and predictive modeling showed inconsistencies - predictive modeling led to more nuanced findings.

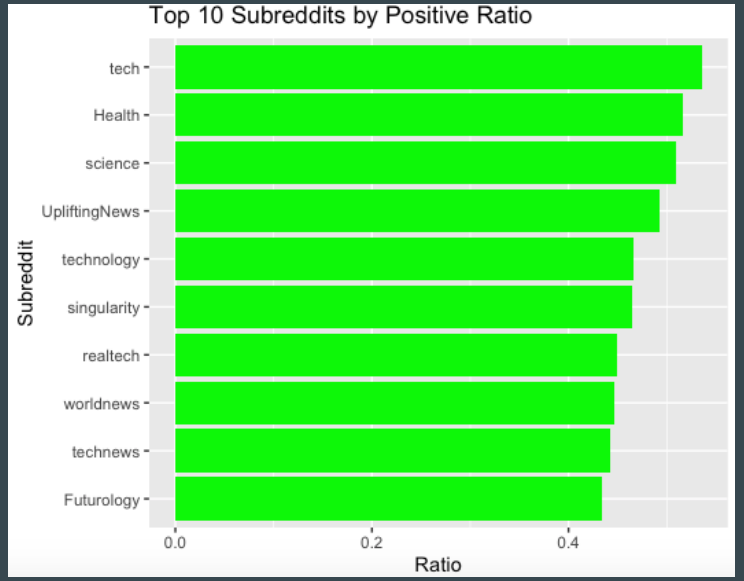
A positive view of neural implants and gene editing can predict a more positive view of scientific improvements in general.

Q&A

Top Subreddits

Look at uplifting news





ABILITY OF NEURAL IMPLANTS AND GENE EDITING TO PREDICT SCIENTIFIC ATTITUDES

For the dependent variable, we selected the question SC1 to gauge a respondent's attitude towards science:

- Overall, would you say science has had a mostly positive effect on our society or a mostly negative effect on our society?

We then performed decision trees using the previously selected BCHIP and GENEV questions as predictors for scientific attitudes.

- Neither BCHIP3 or GENEV3 yielded statistically significant results with a decision tree or random forest.
- BCHIP14 and GENEV4 both had statistically significant findings, and both models showed improvement in accuracy when we utilized random forest.