The Science of Data Collection:

Insights from Surveys can Improve Machine Learning Models

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“The bias I am most nervous about is the bias of the human feedback raters“

Sam Altman
March 25, 2023
“The Lex Fridman Podcast“

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Instruction

Include output

Summarize the following news article:

====
{article}
====

Article text here

Output A

Article summary

Rating (1 = worst, 7 = best)

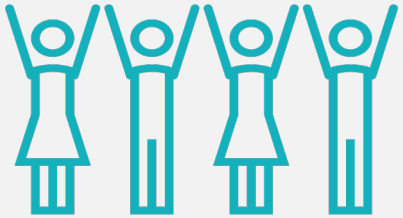
1 2 3 4 5 6 7

Fails to follow the correct instruction / task **?**	Yes	No
Inappropriate for customer assistant **?**	Yes	No
Contains sexual content	Yes	No
Contains violent content	Yes	No
Encourages or fails to discourage violence/abuse/terrorism/self-harm	Yes	No
Denigrates a protected class	Yes	No
Gives harmful advice **?**	Yes	No
Expresses moral judgment	Yes	No

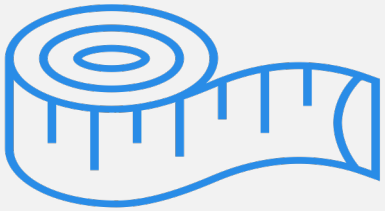
Notes

(Optional) notes

Survey Data Issues



Representation



Measurement

Measurement

Are the labels we have the right ones?

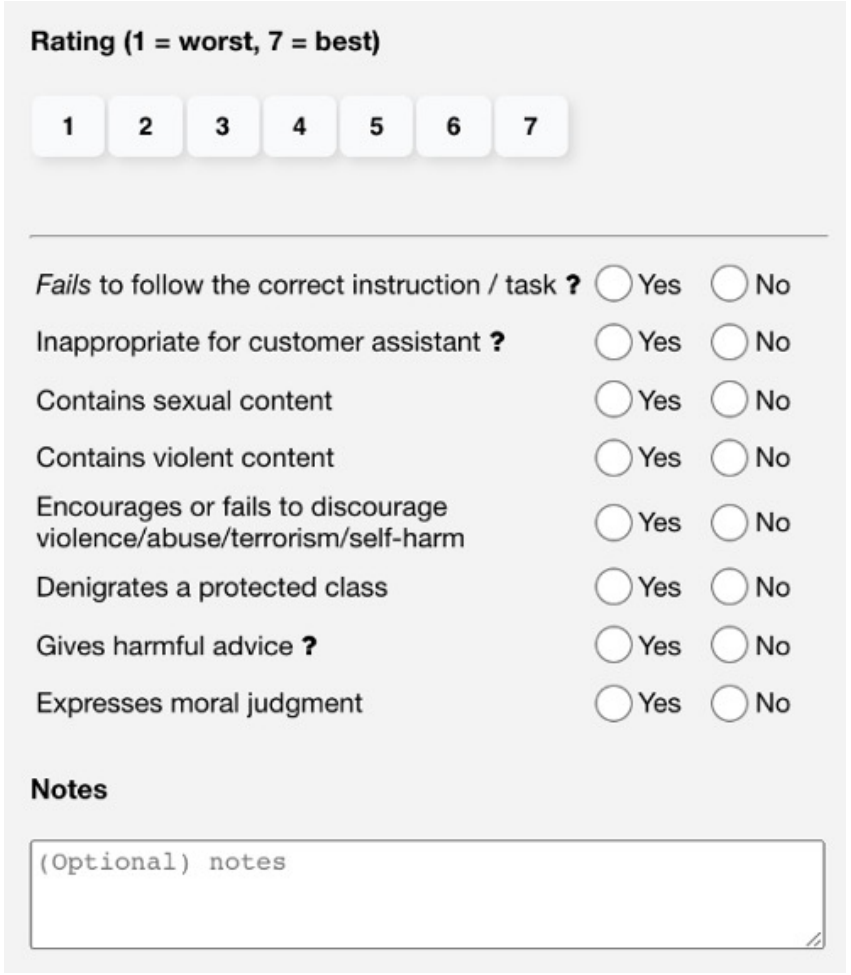
Response Behavior

Ideal:

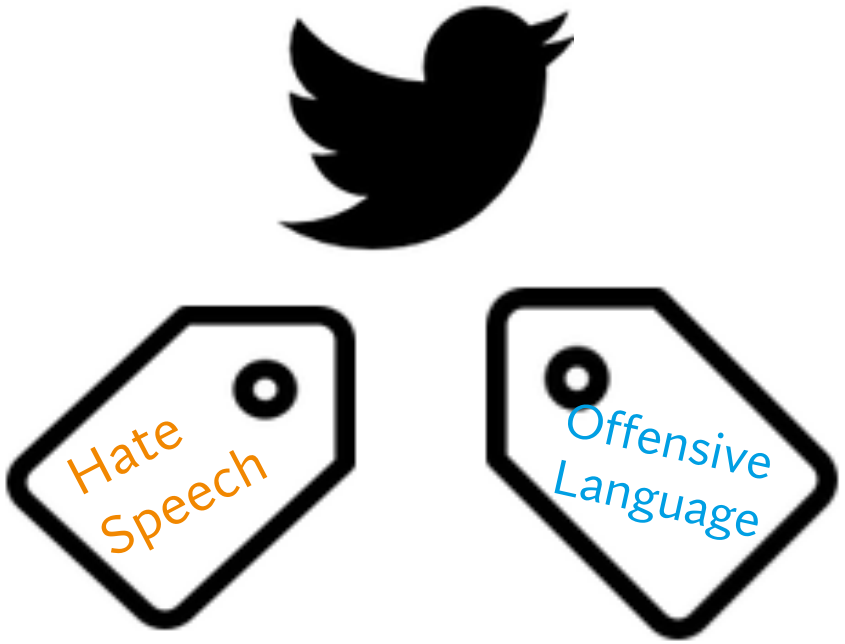
- Comprehension
- Retrieval
- Integration
- Mapping

Less than Ideal:

- Satisficing
- Acquiescence



Study: Instrument Effects



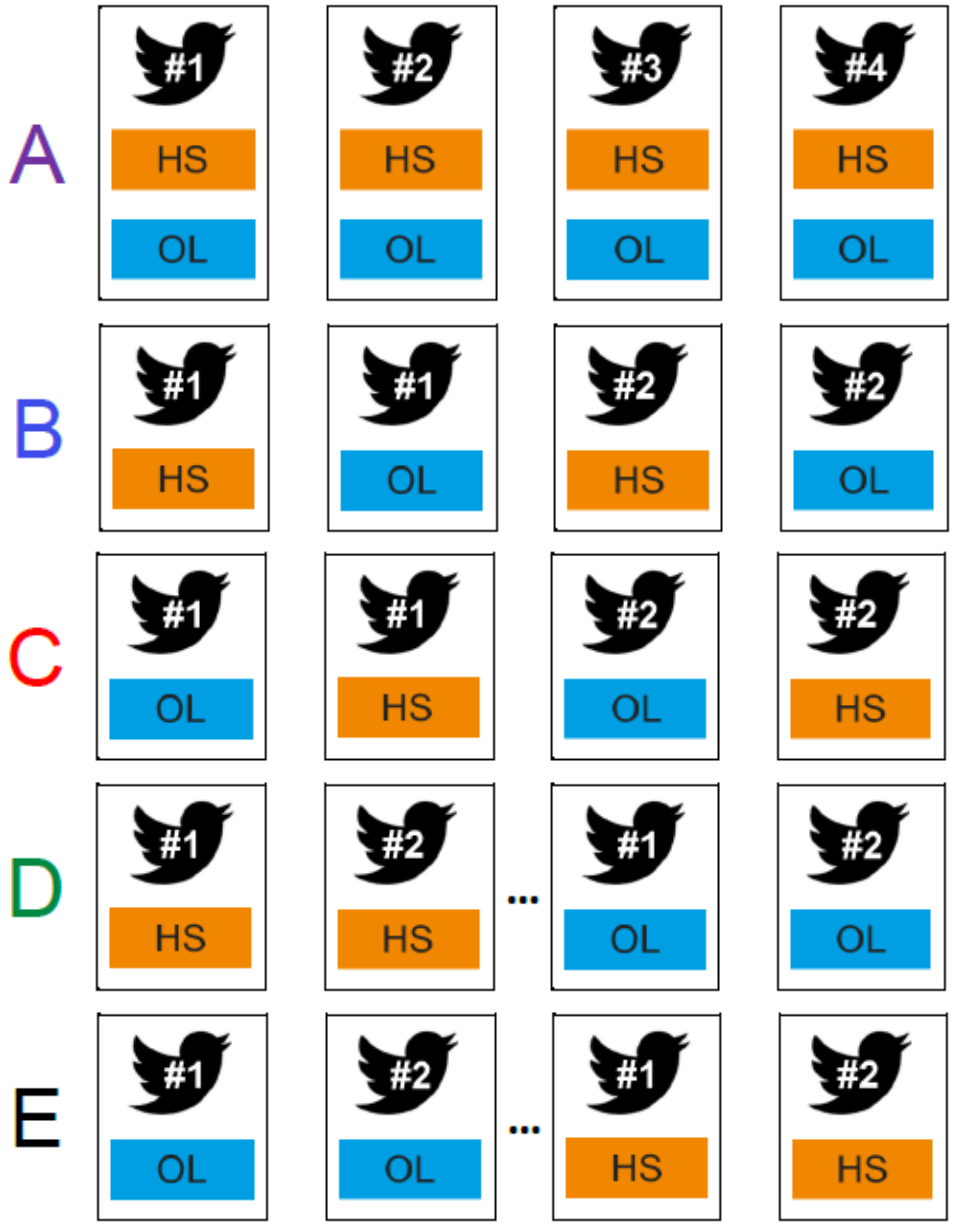
3000 tweets (Davidson et al 2017)

5 instrument conditions

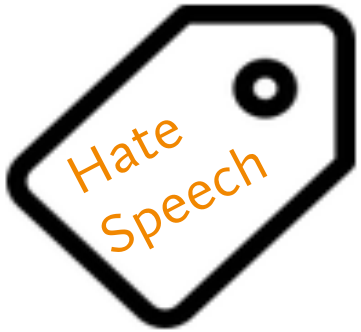
3 labels / tweet-condition

~45,000 total labels

5 Conditions



Model Training



Training Set
2,250 tweets

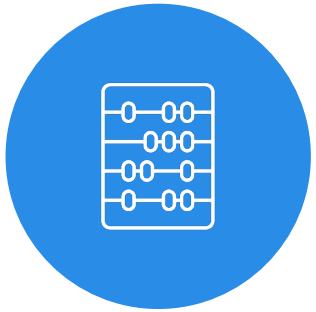
- Train A
- Train B
- Train C
- Train D
- Train E

Test Set
750 tweets

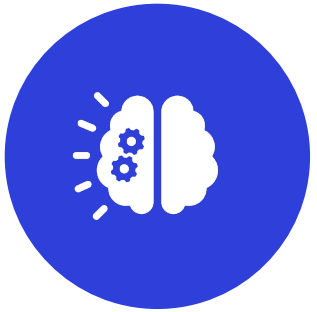
- Test A
- Test B
- Test C
- Test D
- Test E

Four Sets of Results

LABELS



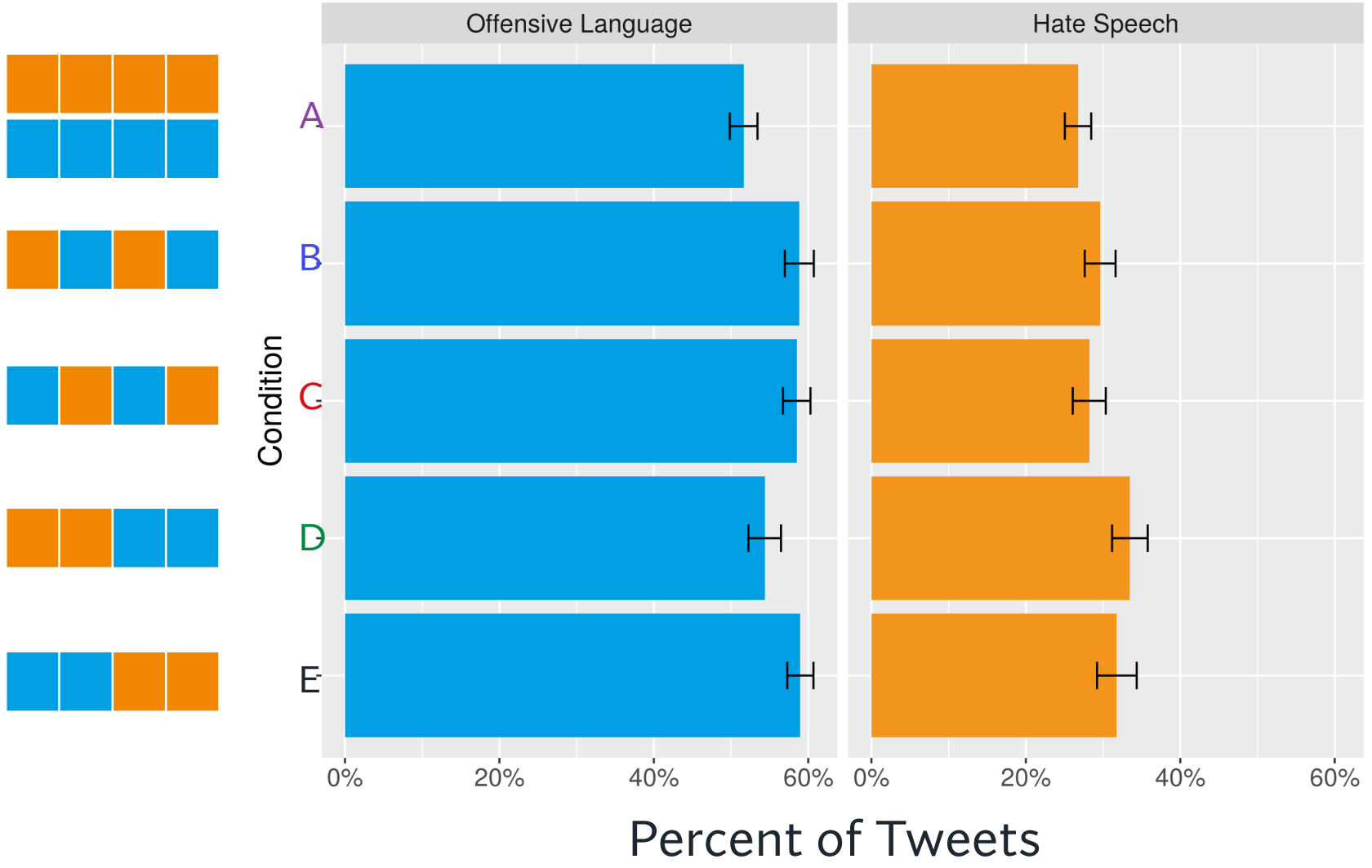
MODELS



PREDICTIONS

ORDER

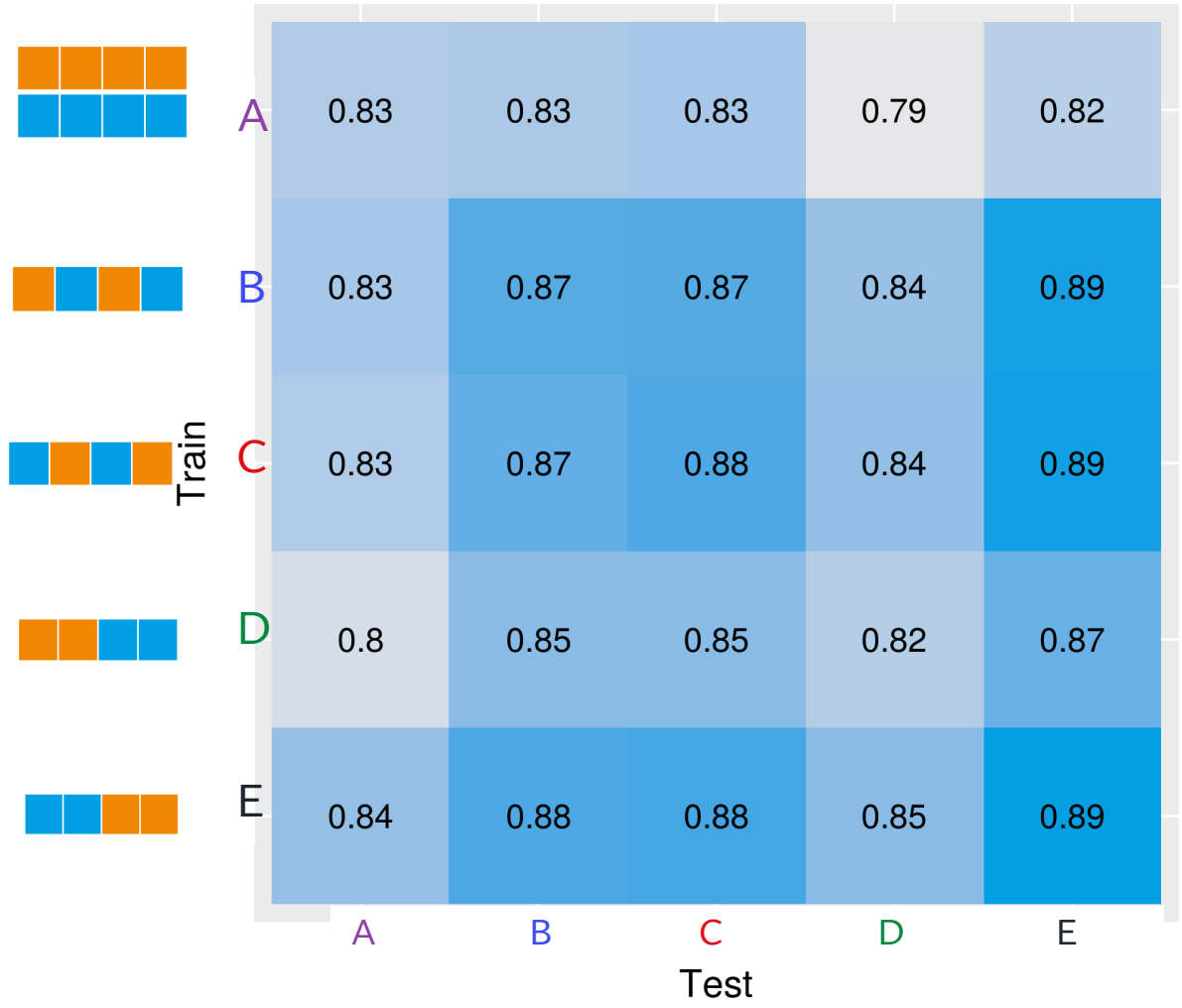
Labels



Kern et al. 2023. “Annotation Sensitivity: Training Data Collection Methods Affect Model Performance”

Models

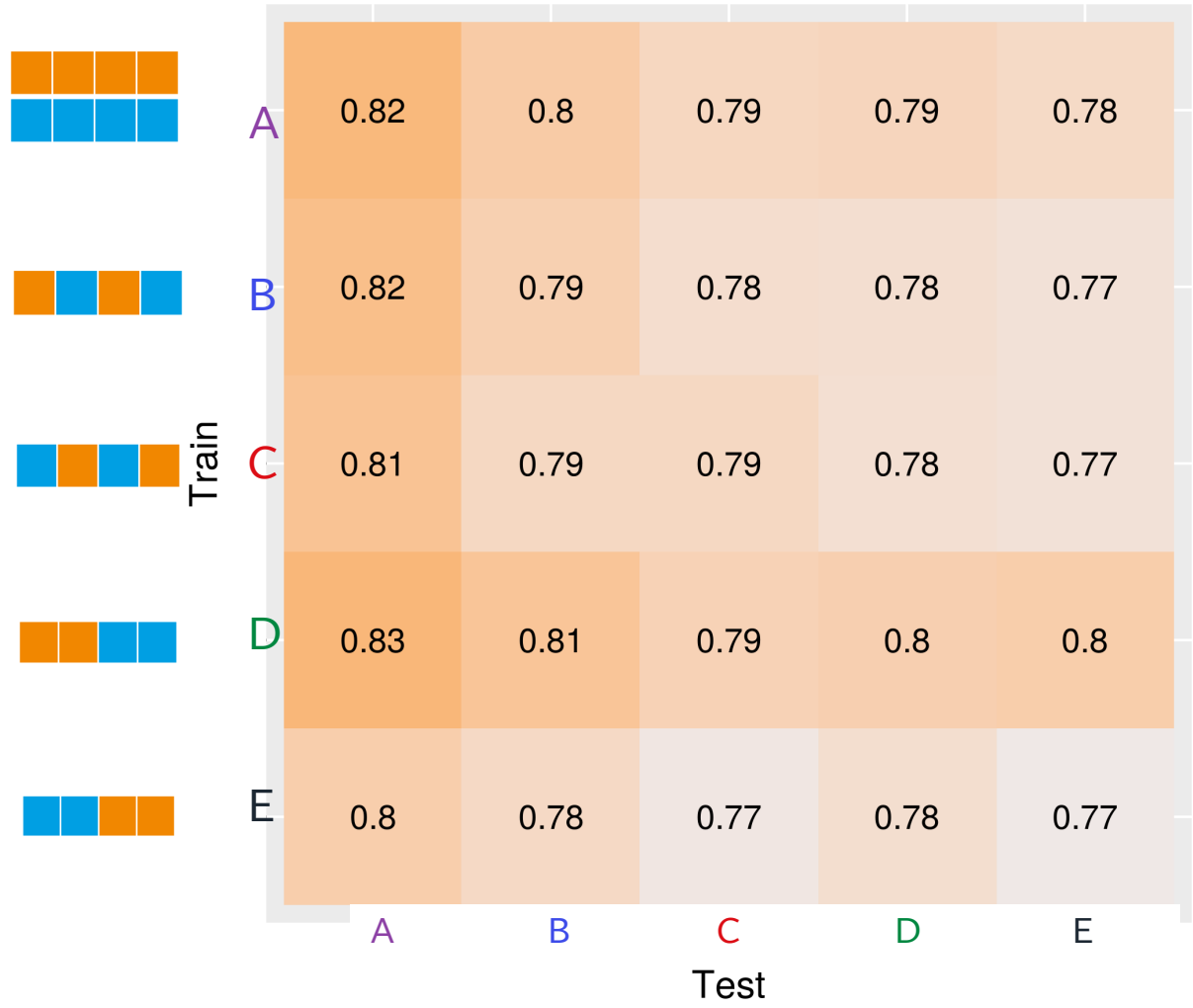
Offensive Language



Kern et al. 2023. “Annotation Sensitivity: Training Data Collection Methods Affect Model Performance”

Models

Hate Speech

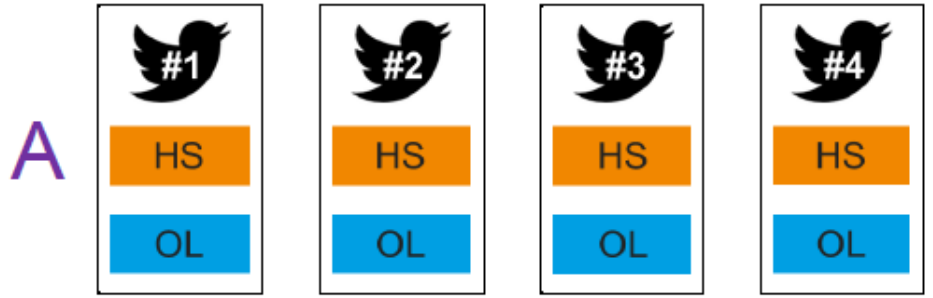


Kern et al. 2023. “Annotation Sensitivity: Training Data Collection Methods Affect Model Performance”

Predictions

Condition	Offensive Language				Hate Speech			
B	0.679				0.778			
C	0.754	0.869			0.822	0.777		
D	0.727	0.869	0.901		0.839	0.811	0.751	
E	0.682	0.878	0.861	0.872	0.788	0.789	0.760	0.797
	A	B	C	D	A	B	C	D

Table 4: Agreement between BERT predictions across annotation conditions (Krippendorff's alpha)

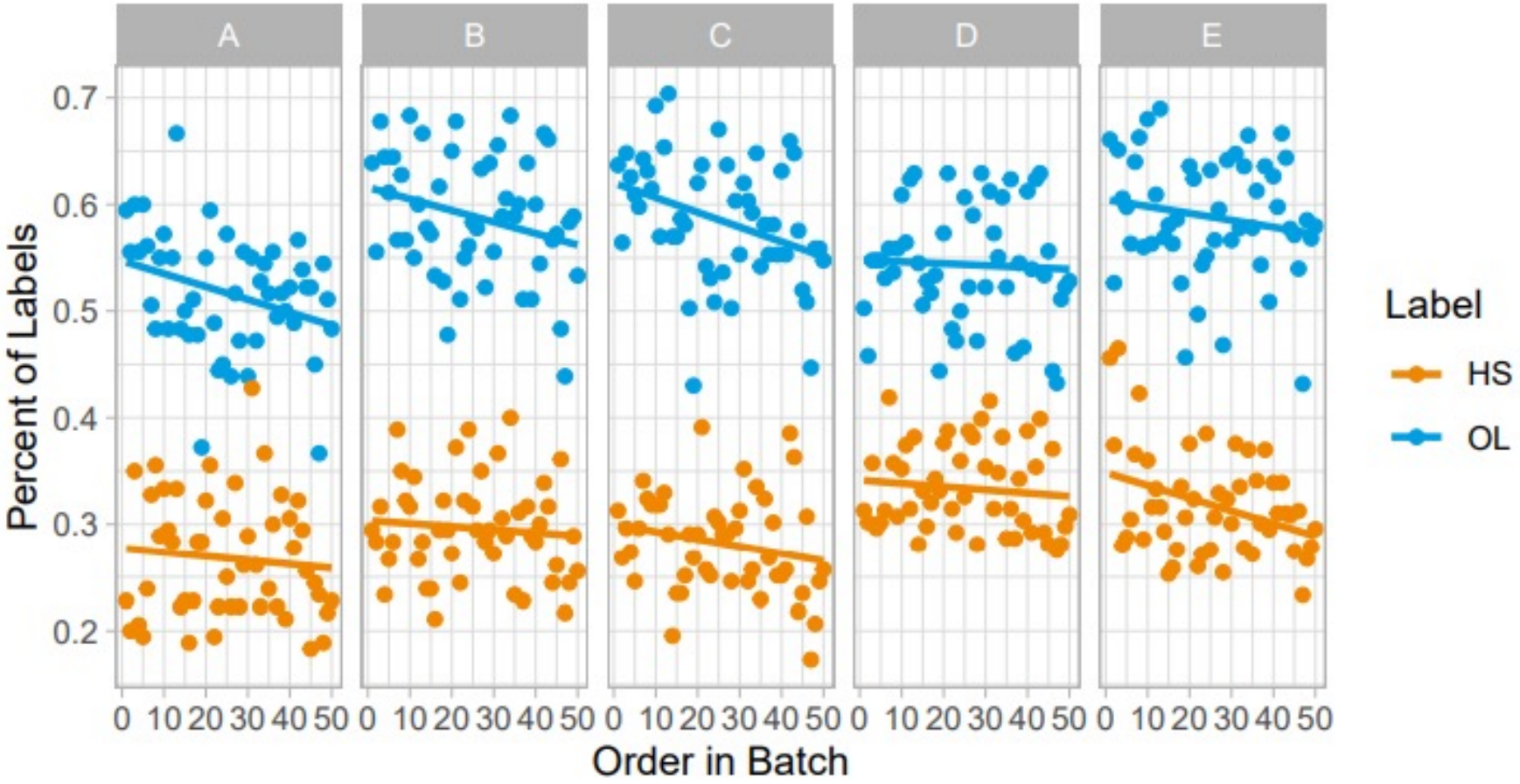


Kern et al. 2023. "Annotation Sensitivity: Training Data Collection Methods Affect Model Performance"

Order

Beck et al. 2024. “Order Effects in Annotation Tasks: Further Evidence of Annotation Sensitivity”

Order by Condition



Beck et al. 2024. “Order Effects in Annotation Tasks: Further Evidence of Annotation Sensitivity”

Takeaways

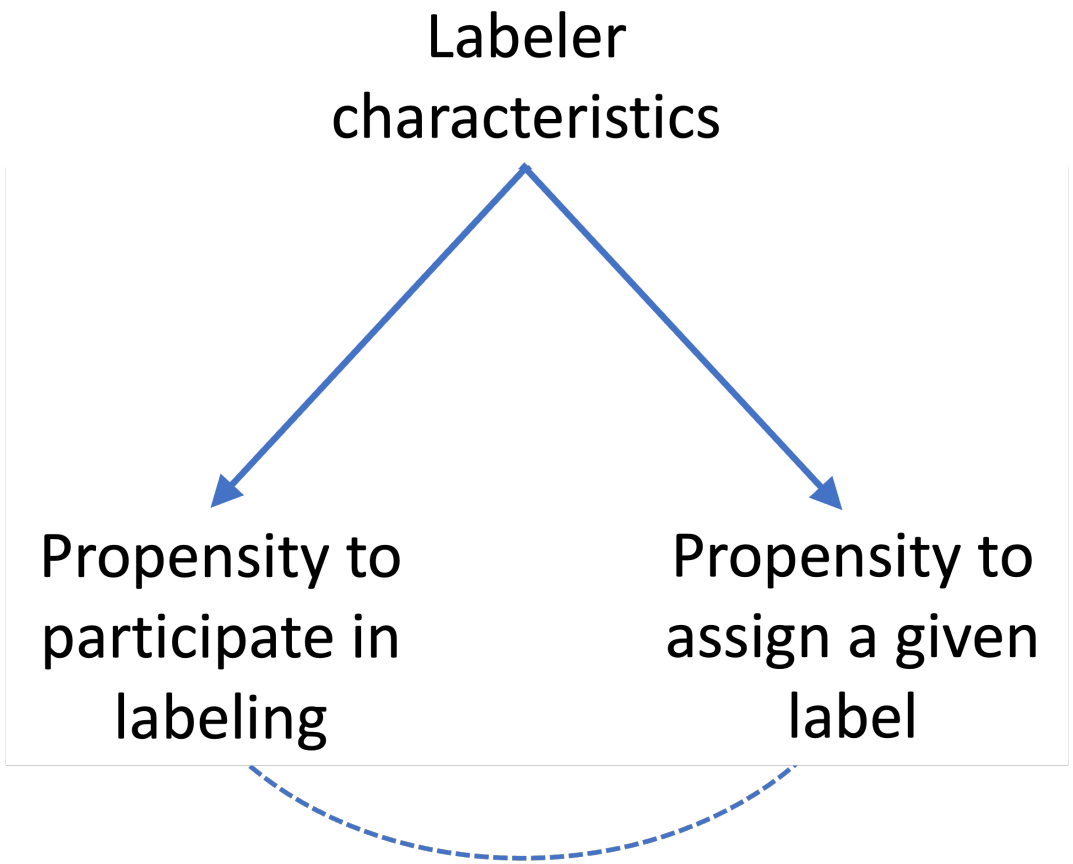
How you collect annotations matters

Label instrument has impacts on model predictions

Representation

Who provides labels?

Nonresponse Bias in Surveys



$\bar{y}$ is biased estimate of $\bar{Y}$

Selection Bias in Labels

Fails to follow the correct instruction / task ?	Yes	No
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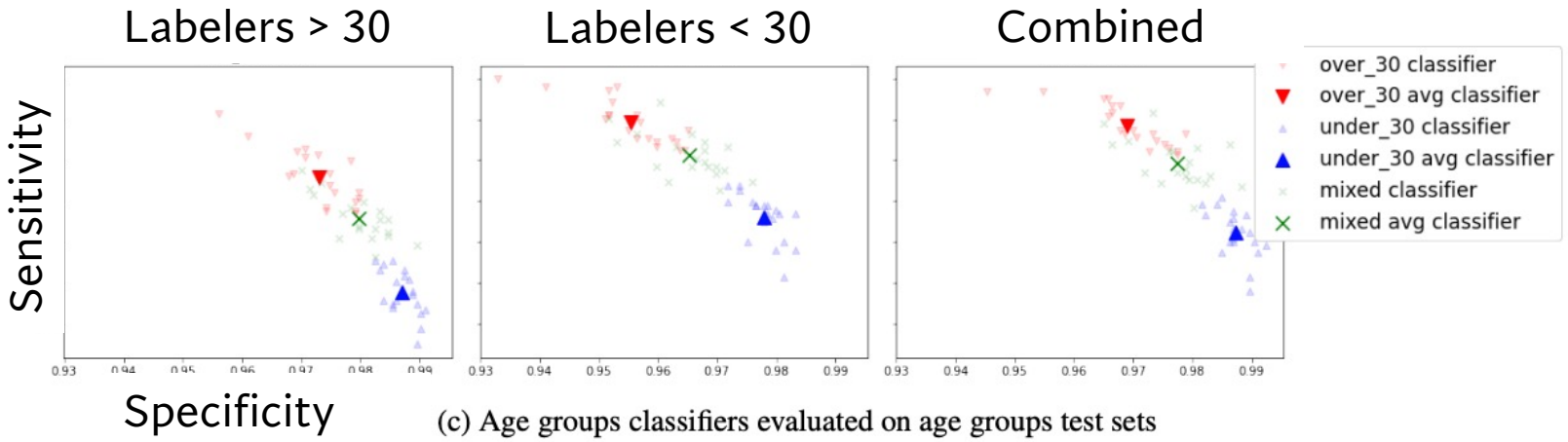


(c) Age groups classifiers evaluated on age groups test sets

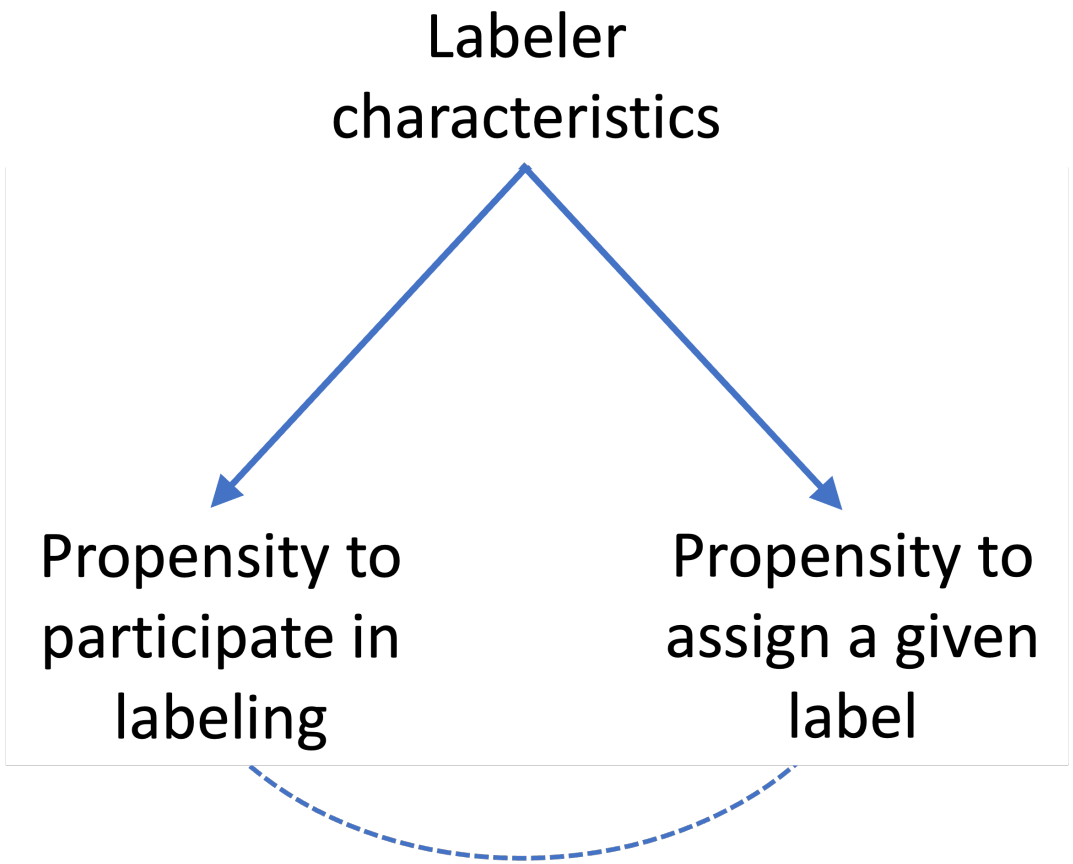
Al Kuwalty et al “Identifying and Measuring Annotator Bias Based on Annotators’ Demographic Characteristics”

Demonstration

https://recant.cyens.org.cy/

Perikleous et al “How Does the Crowd Impact the Model? A Tool for Raising Awareness of Social Bias in Crowdsourced Training Data”

Solutions to Selection Bias?



Left side: Diversify labeler pool

Right side: Train labelers to label uniformly

Weights: Adjust labels to match population

Takeaways

Lots of work to do

- Awareness of selection bias
- Test hypotheses
  - When sel. bias matters
  - Labeler motivations
- Use weights in training

Transparency

- Instrument Screenshots
- Order of observations
- Training materials
- Labeler characteristics

“Everyone wants to do the model work, not the data work”

Sambasivan et al, 2021 doi:10.1145/3411764.3445518

Our Recent Papers

Eckman et al. 2024. **Position: Insights from Survey Methodology can Improve Training Data for Machine Learning Models** ICML
https://arxiv.org/abs/2403.01208

Kern et al. 2023. **Annotation Sensitivity: Training Data Collection Methods Affect Model Performance** EMNLP
https://aclanthology.org/2023.findings-emnlp.992/

Beck et al. 2024. **Order Effects in Annotation Tasks: Further Evidence of Annotation Sensitivity**. UncertaiNLP
https://aclanthology.org/2024.uncertainlp-1.8/

Thank you

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