Improved Bayesian Ethnorace Prediction

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- Prediction accuracy affects all downstream empirical results in these studies!

Method

Method - overview

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- The ethnorace category with the highest posterior probability becomes the predicted ethnorace for the individual

Method - overview

Outputs:

- US Census categorizations
  - Asian American or Pacific Islander, American Indian and Alaska Native, Black/African American, Hispanic, Other/two or more races, White

Method - overview

Inputs:

- First Names
- Surnames
- Geolocations (state, county, place, ZIP, block)
- Party ID
- Age
- Gender
- Multi-unit Occupancy

Method - overview

Example:

- Given a profile of attributes: **First Name** BERT, **Surname** WILDEN, **ZIP Code** 92037
  - Asian = 0.03
  - Native American = 0.08
  - Hispanic = 0.004
  - Black = 0.08
  - White = 0.53
  - Other Race = 0.28
- Prediction: *White*

Method - details

Bayes' Rule

$$Pr(R = r|X) = \frac{Pr(X|R = r)Pr(R = r)}{Pr(X)} \quad (1)$$

Where

- $R =$ "true" ethnorace
- $r =$ predicted ethnorace
- $X =$ joint probability of having a particular profile of characteristics (first name, surname, geolocation, party ID, age, gender, and address type)

Method - details

Assuming conditional independence of ethnorace and attributes, Equation (1) becomes:

$$Pr(R = r|X) = \frac{Pr(R = r|x') \prod_{j=1}^{6} Pr(x_j|R = r)}{\sum_{i=1}^{6} Pr(R = r_i|x') \prod_{j=1}^{6} Pr(x_j|R = r_i)} \quad (2)$$

Conditional independence:

- Knowing both a particular attribute of an individual, and that individual's ethnorace, should give us no extra knowledge of any other attribute for that individual
  - Probably violated, but the maximum a posteriori predictions remain accurate

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- Imputed ethnorace predictions compared with individuals' self-reported ethnorace

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- Group specific:
  - **Precision**: proportion of correct predictions by group (i.e. what is the probability that an individual predicted to be White is White?)
  - **Recall**: proportion of group correctly predicted (i.e. what proportion of Whites were correctly classified?)

Validation - Accuracy

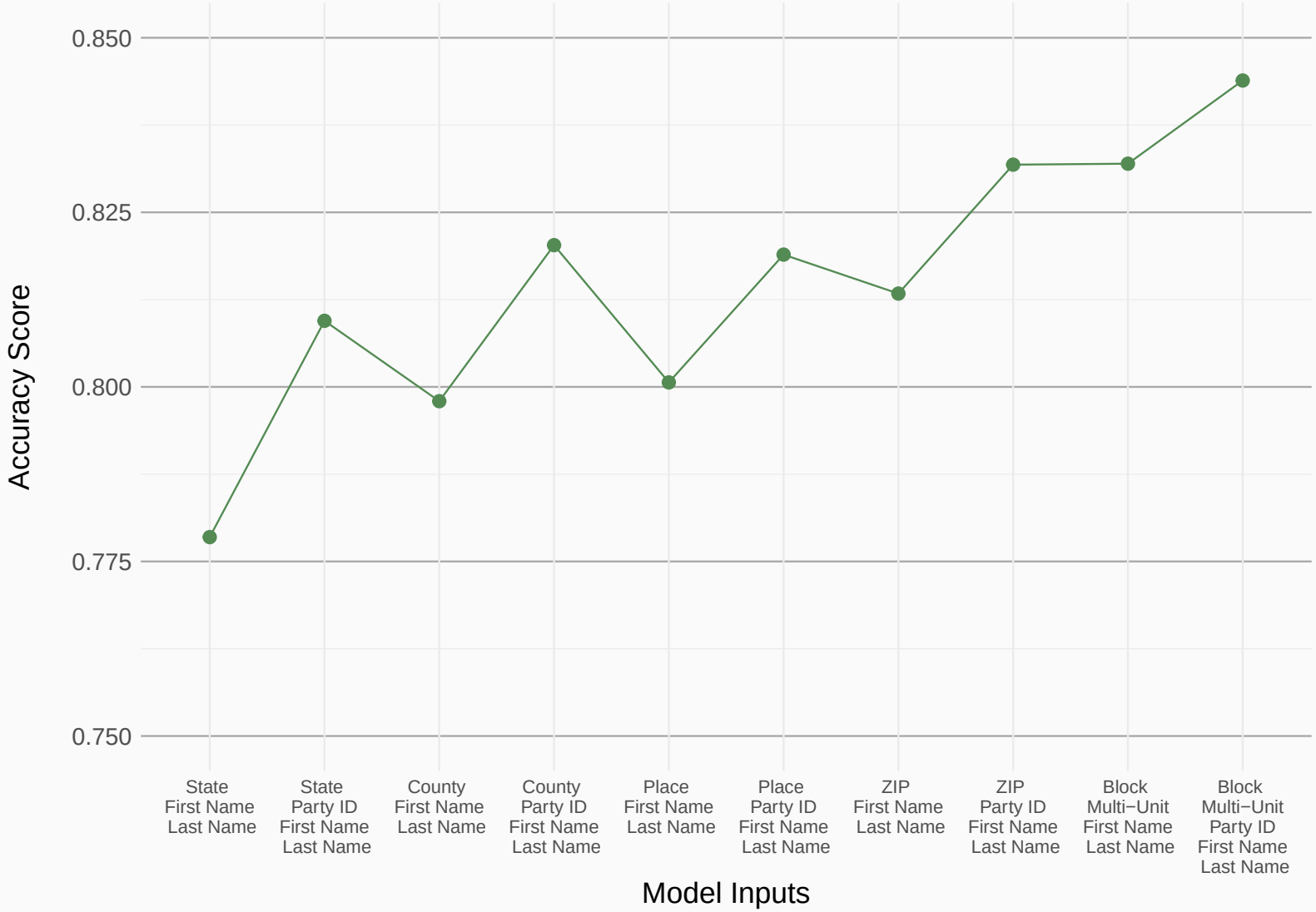

Figure 1: Accuracy Scores by Input Data

Validation - Precision and Recall

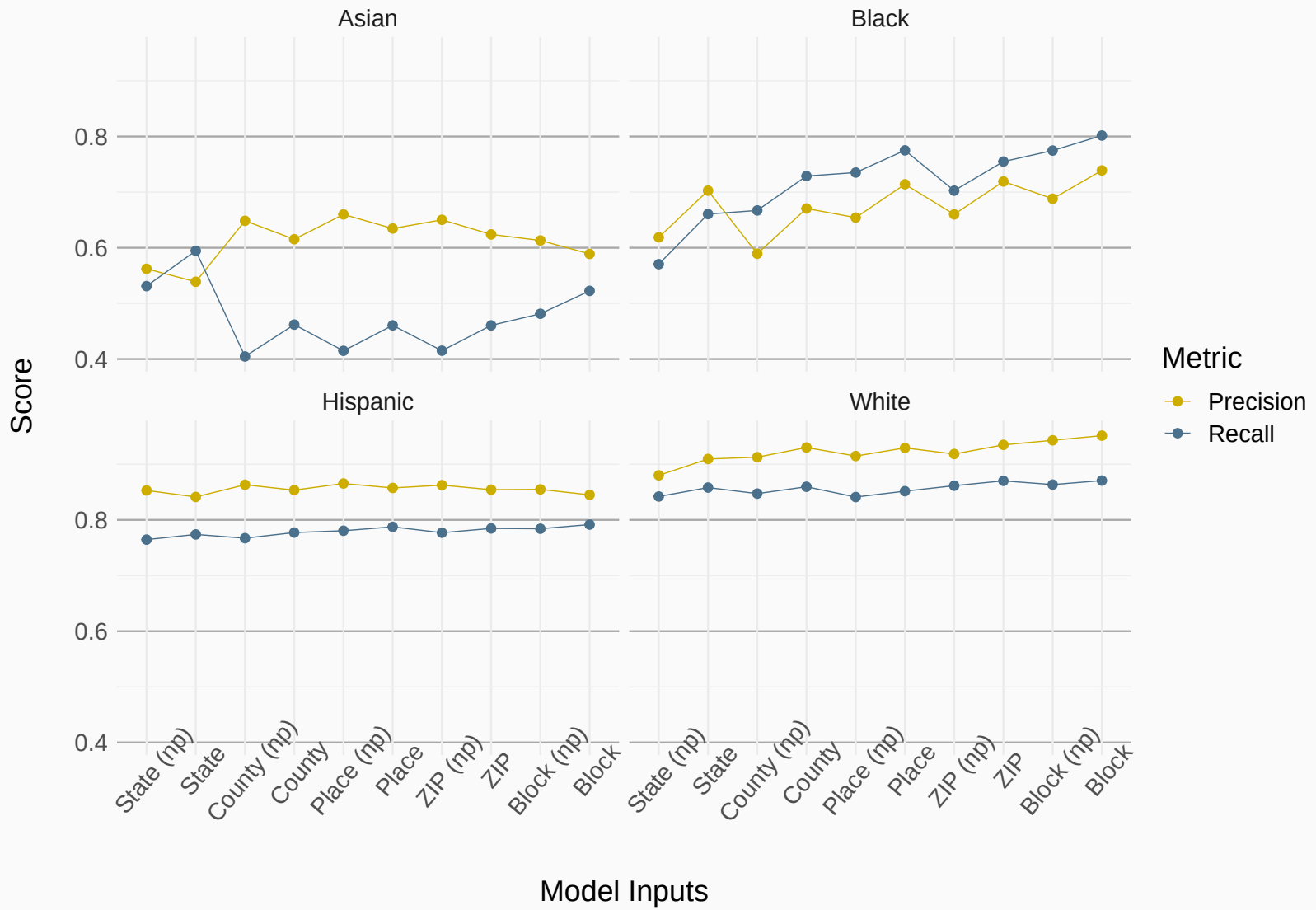

Figure 2: Precision/Recall Scores by Ethnorace and Input Data

Comparison to Existing Methods

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- Imai and Khanna (2016), R package **`wru`**

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    - State and ZIP Code options
    - American Indian and Alaska Native predictions
    - Faster/easier implementation

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Comparison - Accuracy

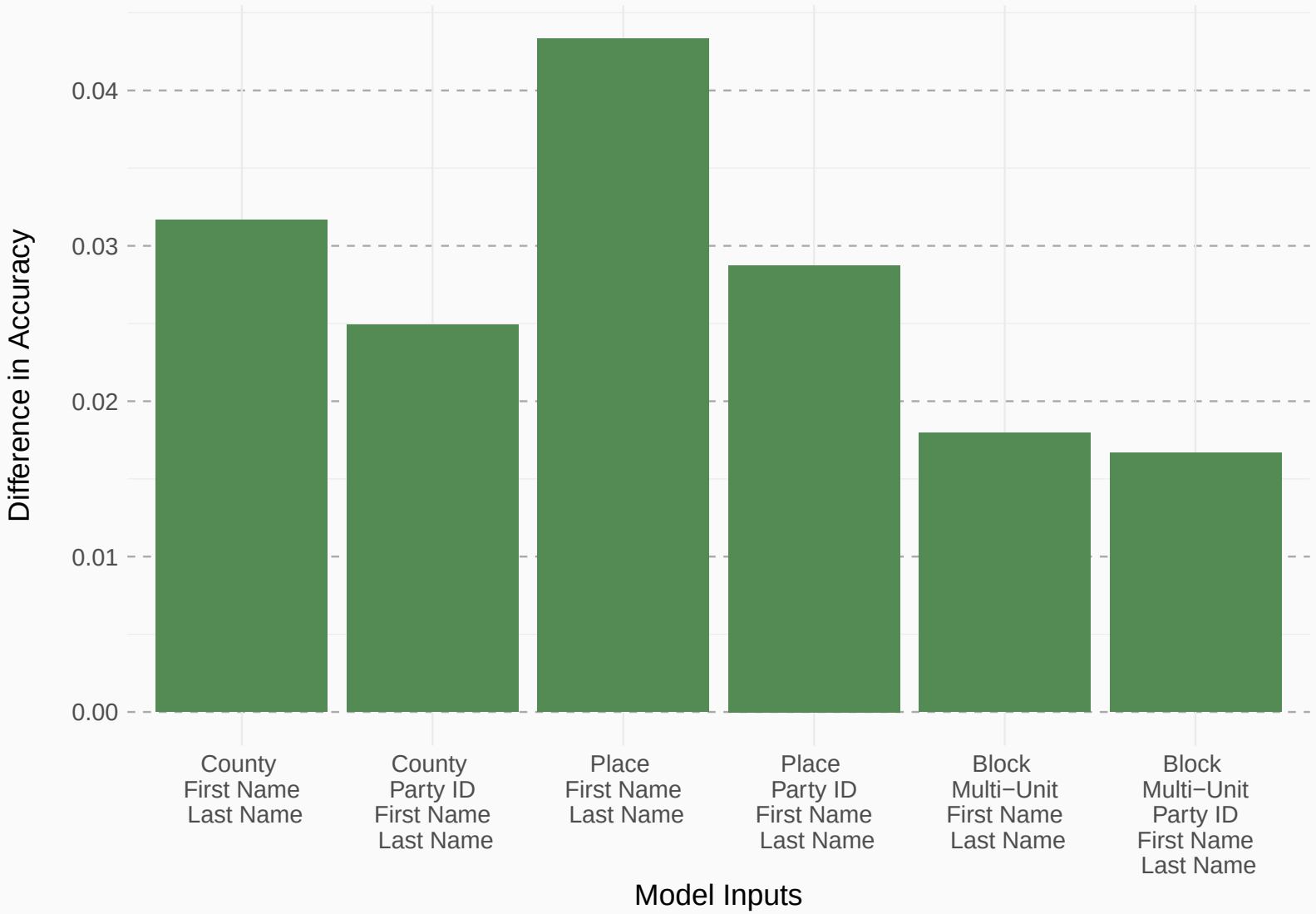

Figure 3: Accuracy Score Comparison to `wru`

Comparison - Precision/Recall Asian

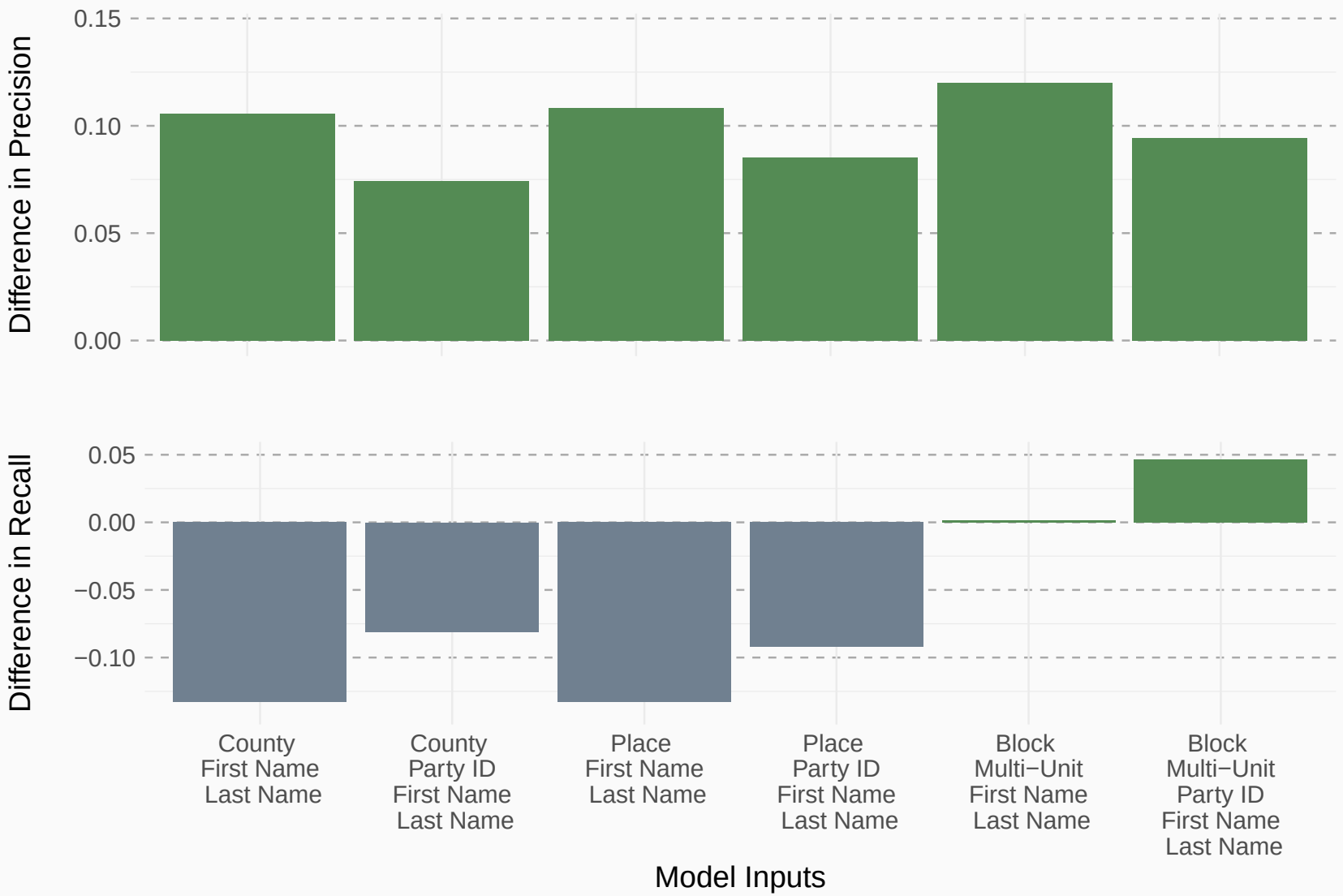

Figure 4: Precision and Recall Score Comparison to `wru`: Asian

Comparison - Precision/Recall Black

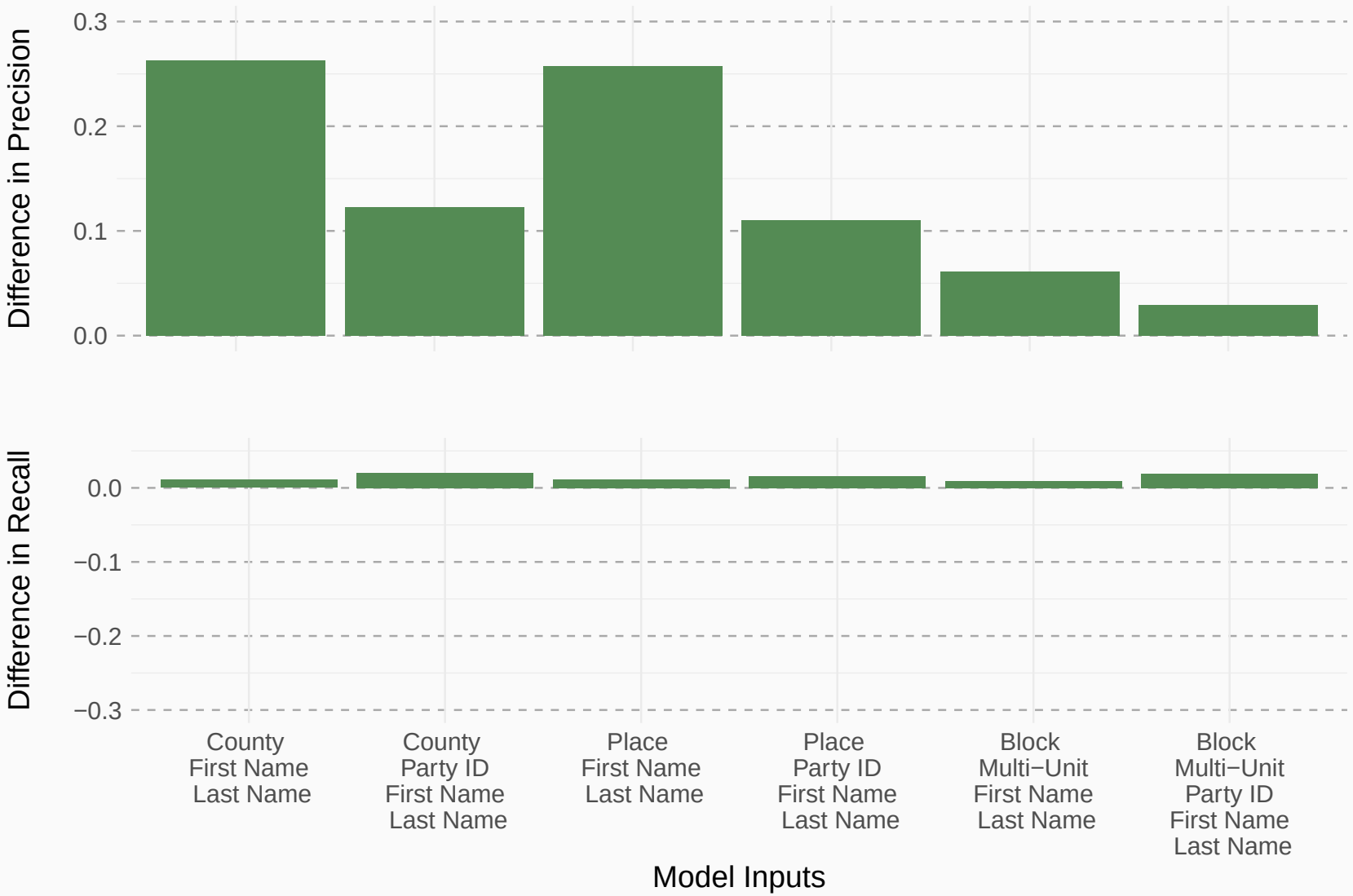

Figure 5: Precision and Recall Score Comparison to `wru`: Black

Comparison - Precision/Recall Hispanic

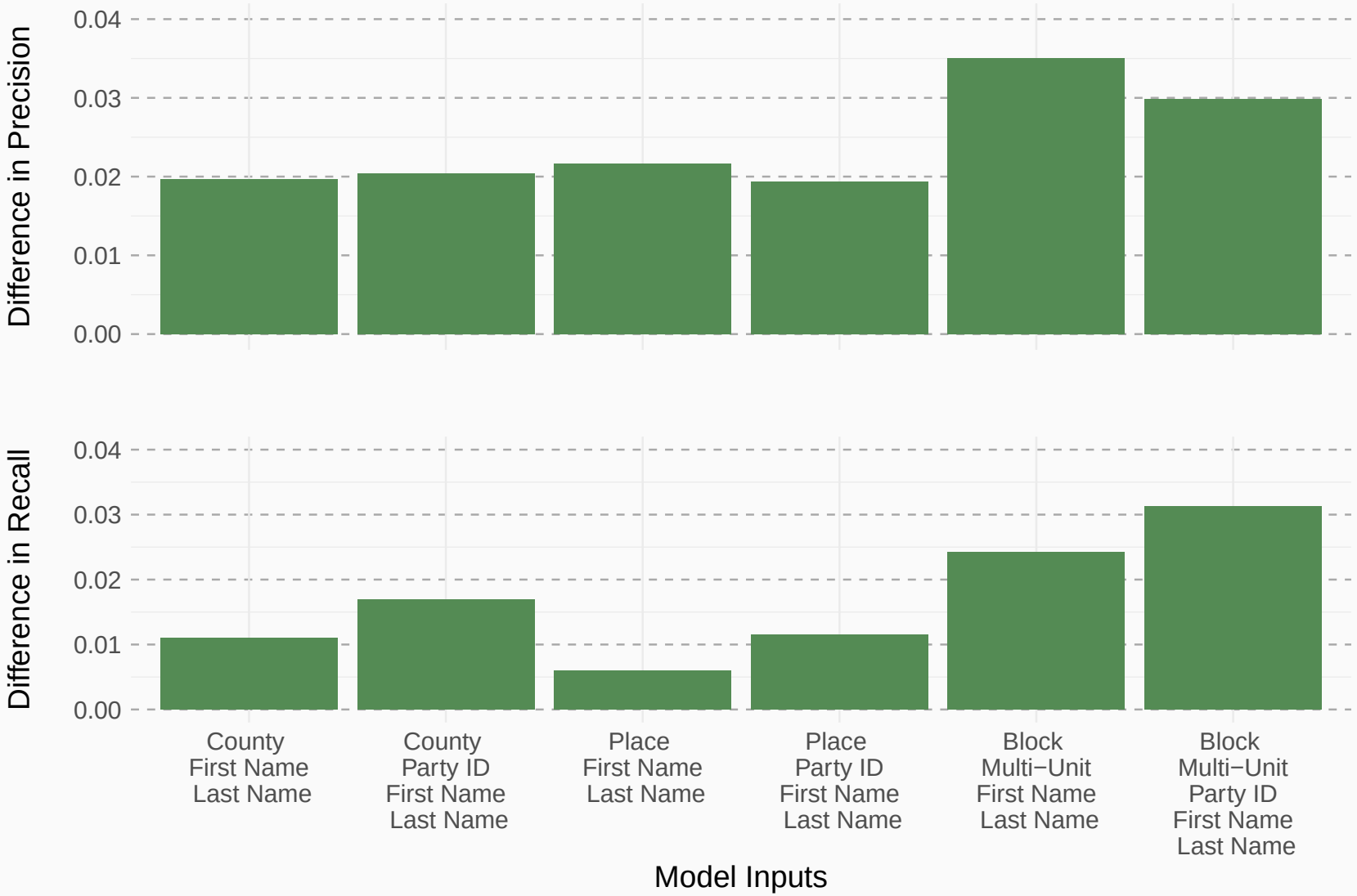

Figure 6: Precision and Recall Score Comparison to `wru`: Hispanic

Comparison - Precision/Recall White

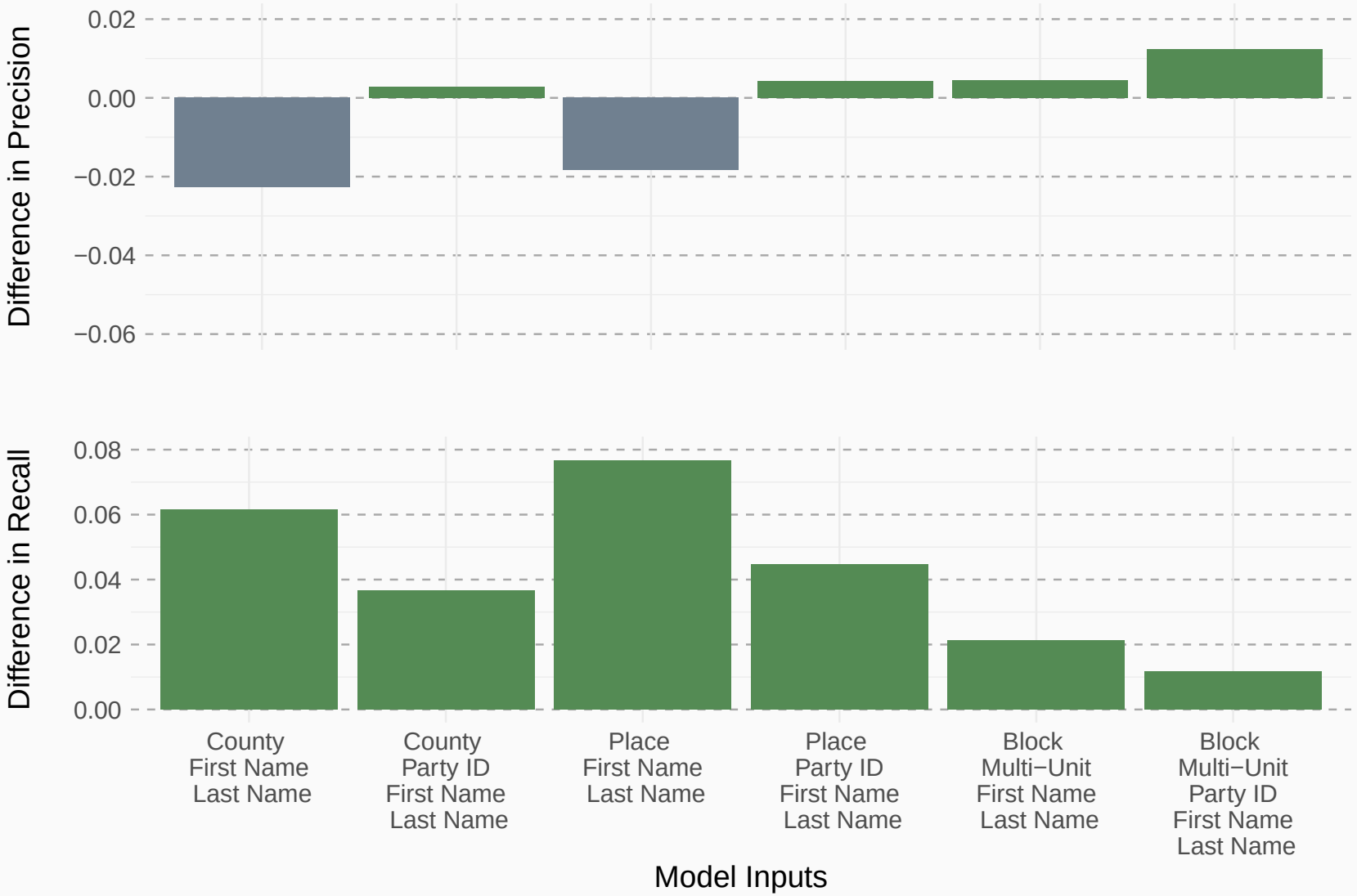

Figure 7: Precision and Recall Score Comparison to `wru`: White

Next Steps

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- Larger research agenda on ethics in AI/machine learning for the study of race
  - Where do mis-predictions happen?
- Replicate existing studies which use the old method

Thank you!

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