

## INTRODUCTION

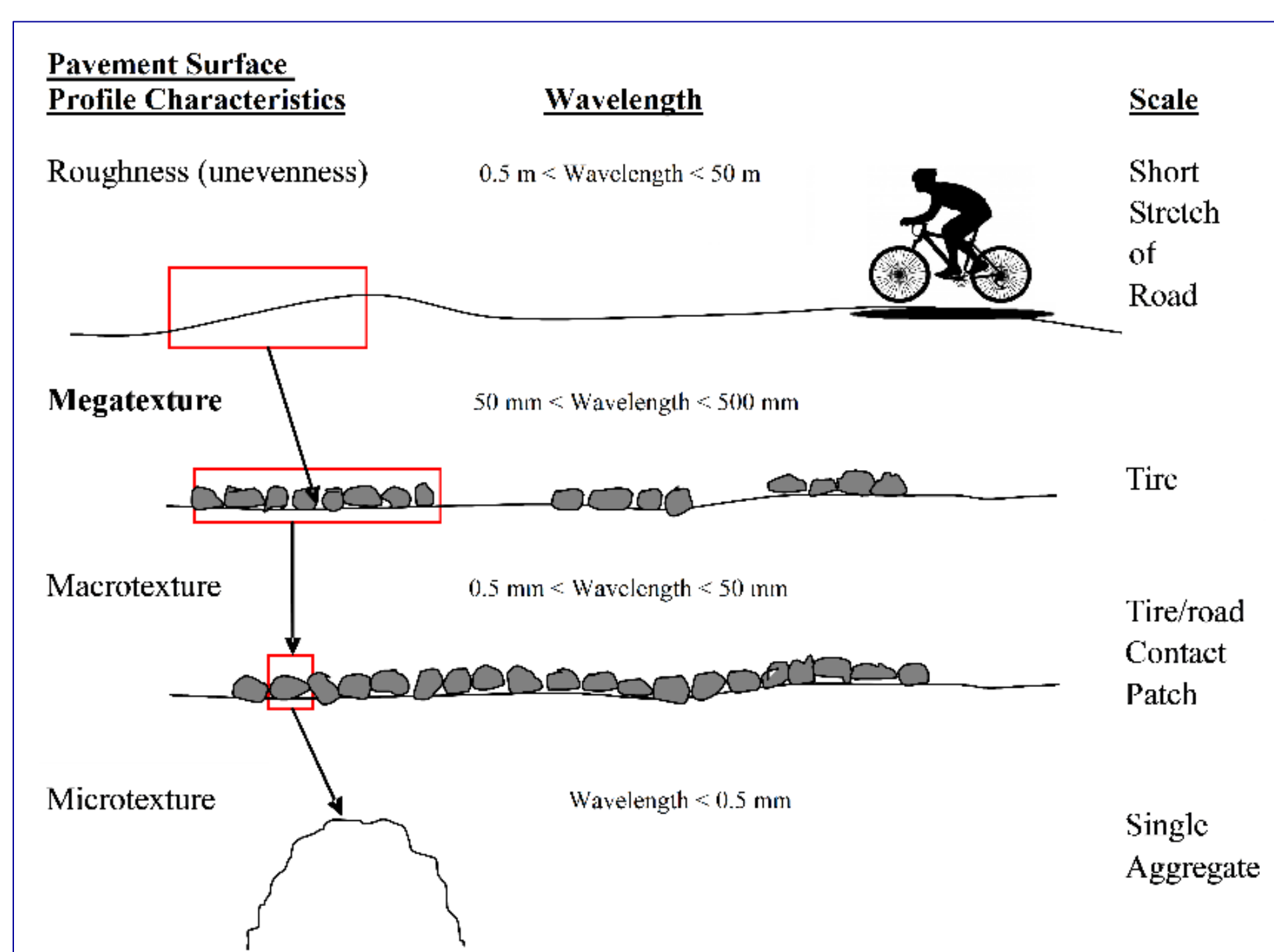
Many cities and states rely on aggregate seal coats (chip seals) to maintain roads. Chip seals provide an economical strategy as a lower volume road surface or for preservation treatments on asphalt roads, and the technology for increasing the lifespan of chip seals is continually improving. Chip seals often have higher macrotexture than asphalt or concrete surfaces, which provides high skid resistance for motor vehicles. However, bicycling is increasing in many parts of the country, both for recreation and commuting, and high macrotexture of chip seals has led bicyclists to protest that their use can decrease the comfort of their recreational rides.

With CalTrans sponsorship, we sought to better understand the relationship between *recreational bicyclist comfort* and *pavement surface macrotexture and roughness*.

## BACKGROUND

Pavement surface profile characteristics are known to influence motor vehicle ride quality, and we hypothesize that they also influence bicycle ride quality. There are four components of pavement surface texture that are defined based on the maximum dimension (*wavelength*) of their deviation from a true planar surface:

- **roughness** (between 0.5 and 50 m)
- **megatexture** (between 50mm and 500mm)
- **macrotexture** (between 0.5mm and 50 mm)
- **microtexture** (wavelengths less than 0.5mm)



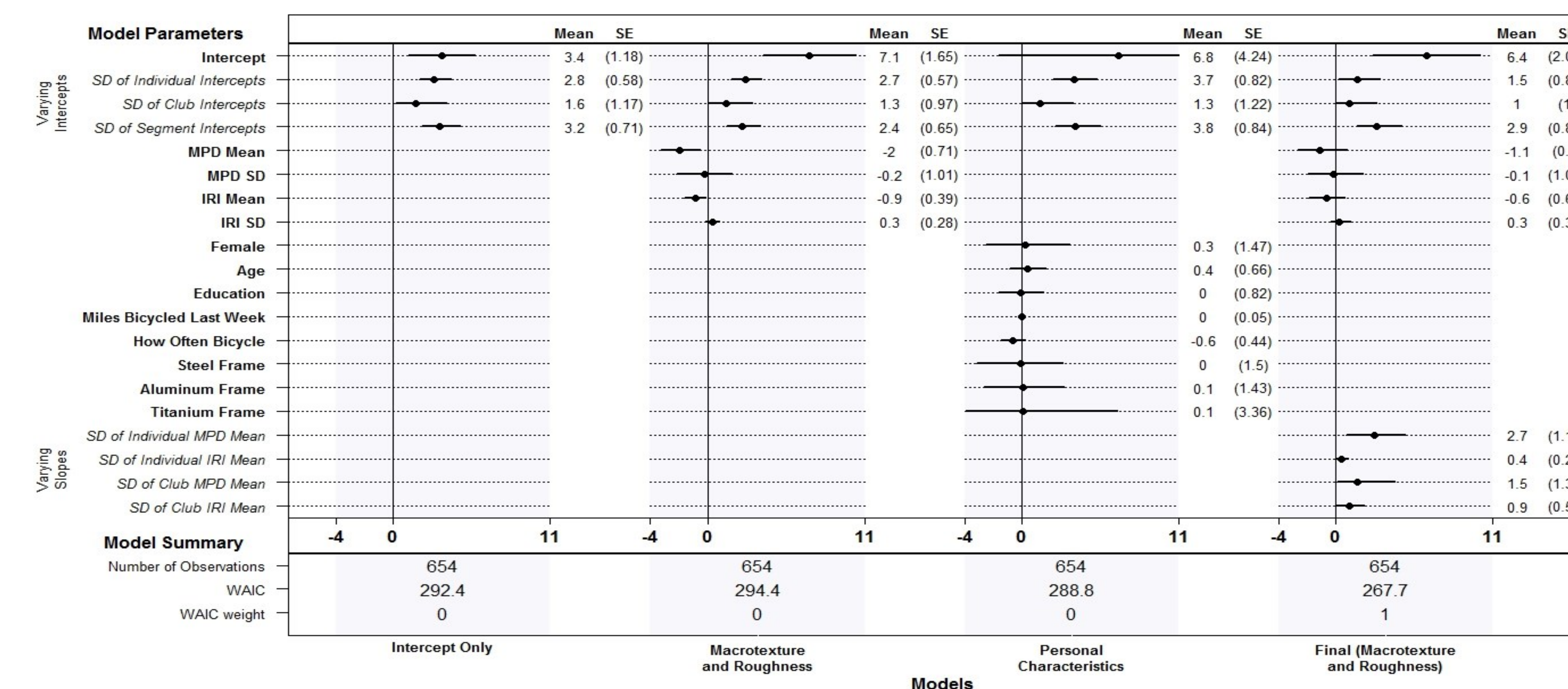
# Modeling the Impact of Pavement Roughness on Bicycle Ride Quality

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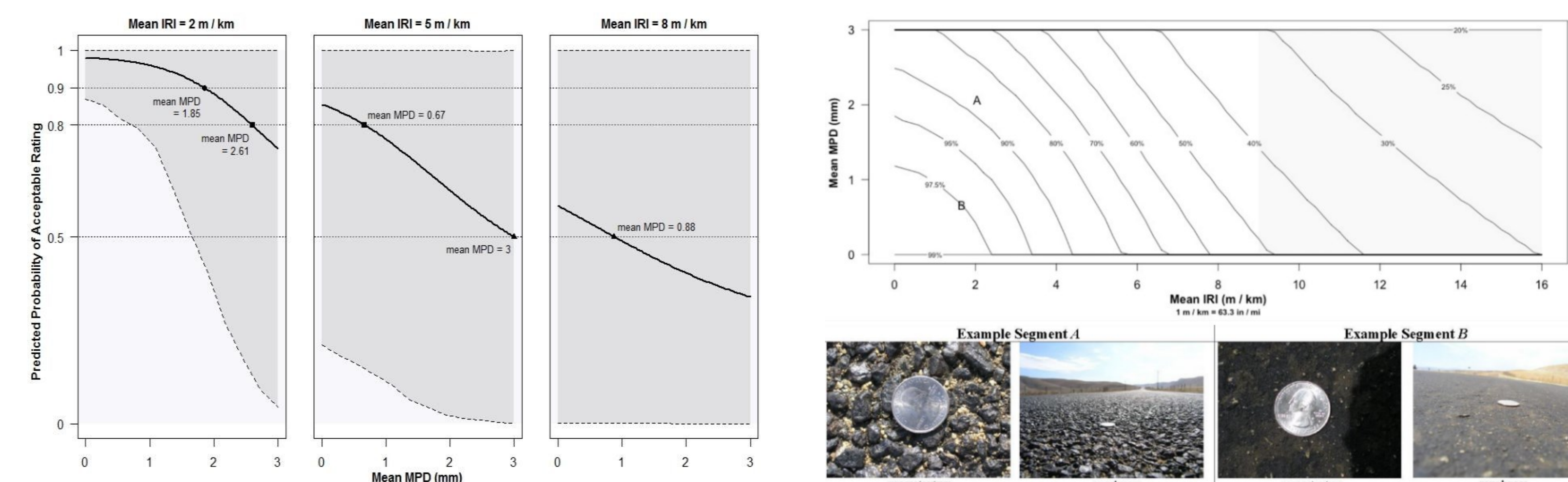
## METHODOLOGY

- **Setting:** 6 Northern California bicycling club's local routes
- **Design:** Repeated measures
- **Survey administration:** Paper self-administered survey distributed and collected during bicycle rides in July, August, and September 2013.
- **Sample:** 96 bicyclists on 39 road segments
- **Analysis:** Bayesian Multilevel Binomial Logistic Regression
  - **Dependent Variable:** Acceptable segment
  - **Explanatory Variables:**
    - Pavement Macrotexture and Roughness
    - Personal Characteristics

## MODEL COMPARISON



## PREDICTED PROBABILITY OF ACCEPTABLE RATING



## DISCUSSION

The multilevel binomial pavement acceptability model presented in this paper allows us to more precisely understand the roughness and macrotexture conditions that lead to an acceptably comfortable bicycle ride. This model could be used to develop a maximum threshold of macrotexture and roughness, which could then be implemented by state and local road agencies to proactively choose pavement treatments that exceed the threshold and have the highest probability of an acceptable rating.

## FUTURE RESEARCH

This model could be further improved and modified through:

- additional survey efforts to increase the sample size
- sampling commuters, children, more young adults (it was difficult to get them to stop and take the survey on organized rides), and more women
- sampling in urban areas
- sampling more bicycle tire and frame types, especially lower tire pressure commuter bikes
- sampling more types of treatments
- development of relationships between macrotexture and treatment specifications to aid pavement engineers in identify appropriate treatments without first building them
- development of new roughness and macrotexture measurements

## ACKNOWLEDGEMENTS

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