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PLUG-IN HYBRID & ELECTRIC VEHICLE RESEARCH CENTER

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On-Road Ecodriving Experiment: Preliminary Results

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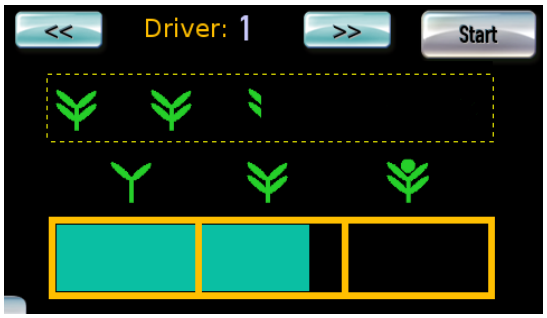
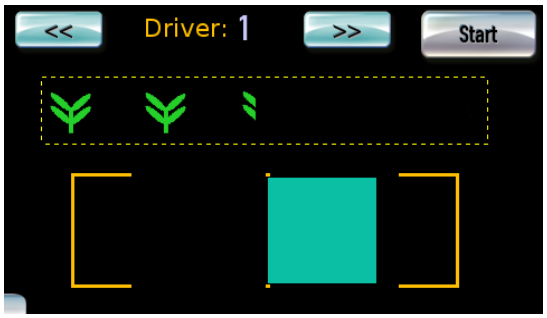
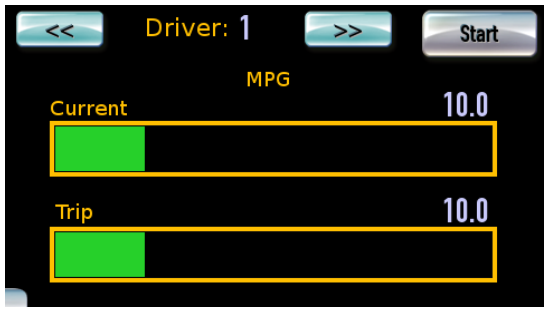
17 January 2013
Annual Meeting of the Transportation Research Board

Summary

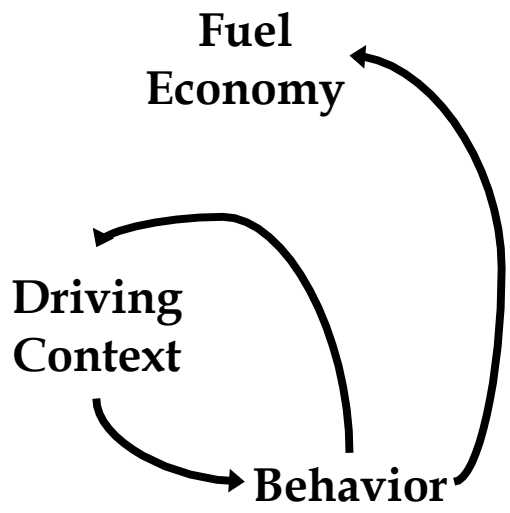
- Three driver feedback screens
  - One-month off/on periods; 60 drivers to date.
- Preliminary Results
  - Average 10% higher on-road fuel economy going from feedback off to feedback on: 23.1 to 25.5 mpg.
  - 3% improvement attributable to eco-driving behaviors.
  - Range of 2 to 5% improvement by screen type .







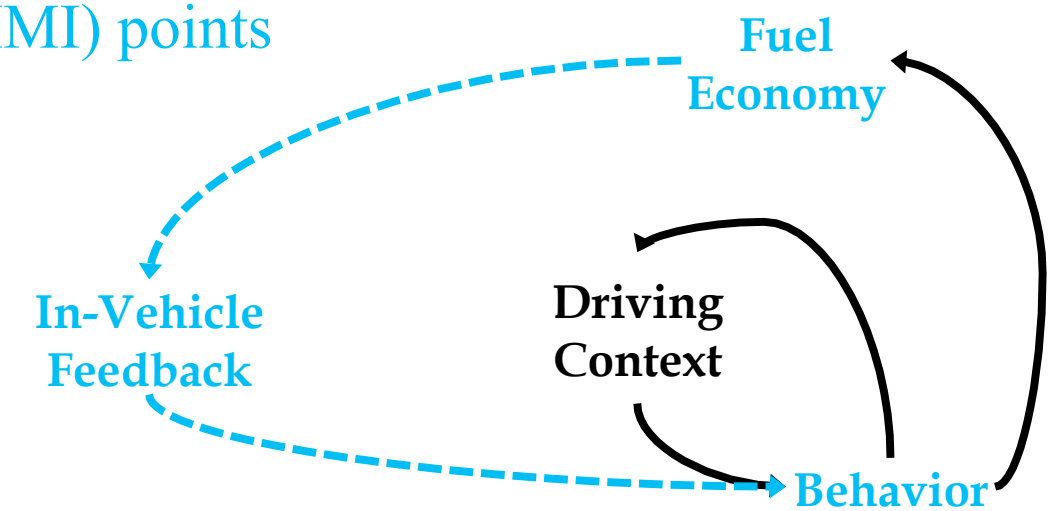
A Broken Feedback Loop



Complete Feedback Loop

❶ Context

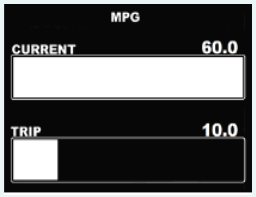
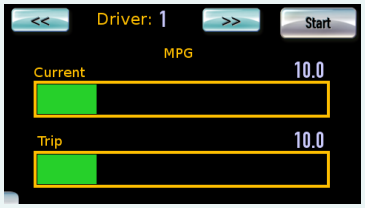
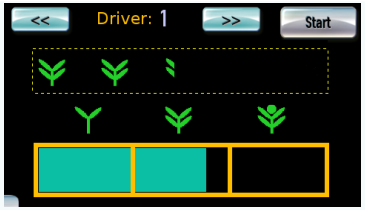
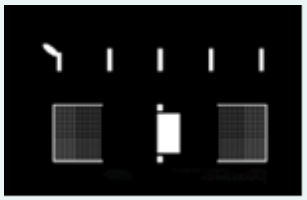
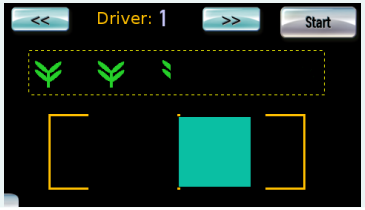
❷ Human Machine Interface (HMI) points of influence



h_0 : In-Vehicle Feedback ≠ Fuel Economy improvement

Ecodrive I-80 Study

- Household drivers along the San Francisco-Reno Interstate-80 Corridor
  - Today's results: ***n*** = 60 drivers; 90,000 miles; 3,000 hours
  - Final ***n*** will be 150 drivers
  - Comparison of three feedback metrics developed by NHTSA

Direct Fuel Economy Value, "Numbers"		
Symbolic "Shrub" representation		
Acceleration level		

Experimental design

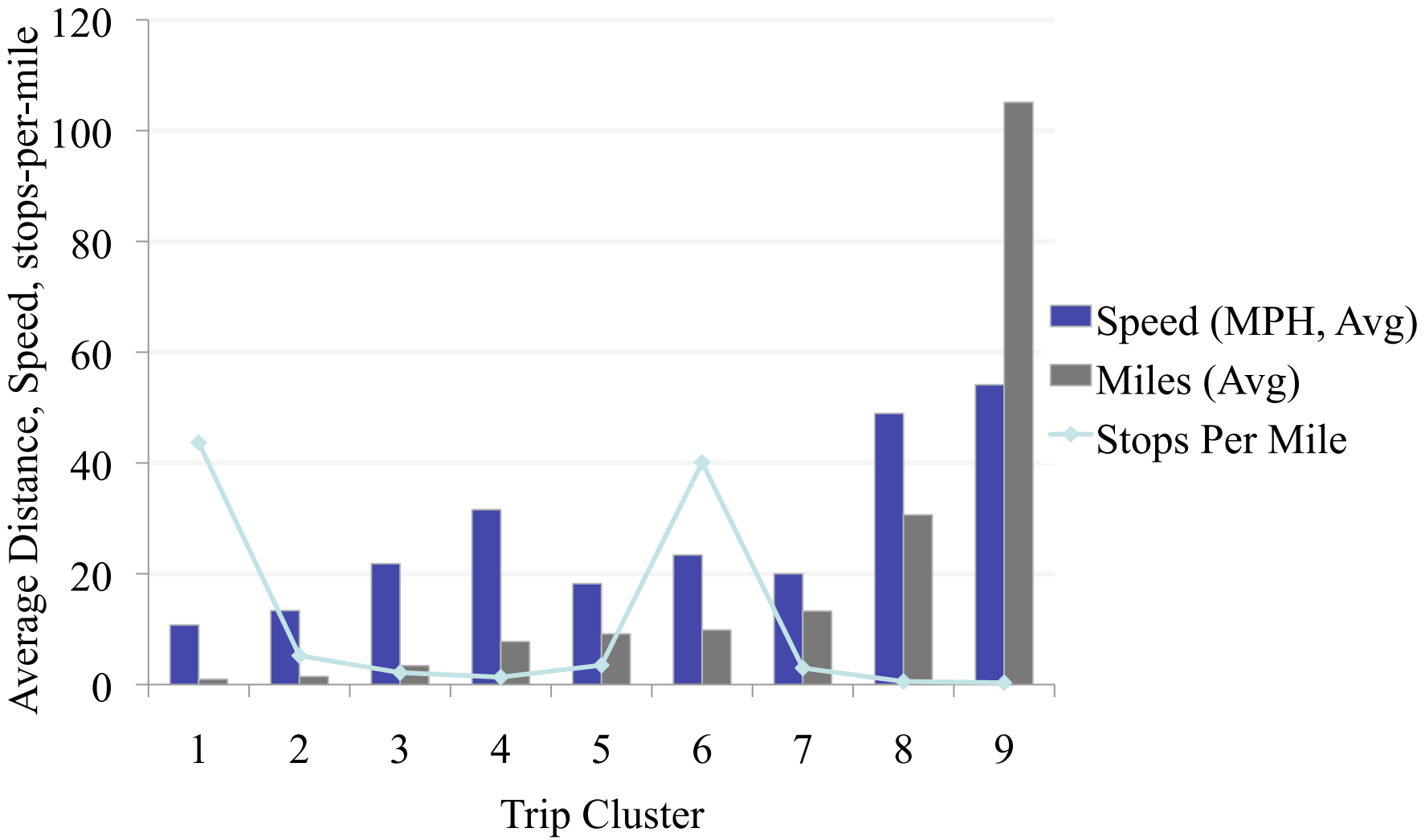
- "Natural" driving
  - on-road, drivers own vehicle, going places they go
- Avoid social biases
  - no training or coaching by researchers
- Randomization
  - feedback treatment
- Supplement vehicle data with surveys and interviews
  - Attitude, personality, drivers' own descriptions
- Multiple driving contexts
  - Small cities with rural hinterlands
  - Large urbanized areas (still to come)

Model-based Analysis

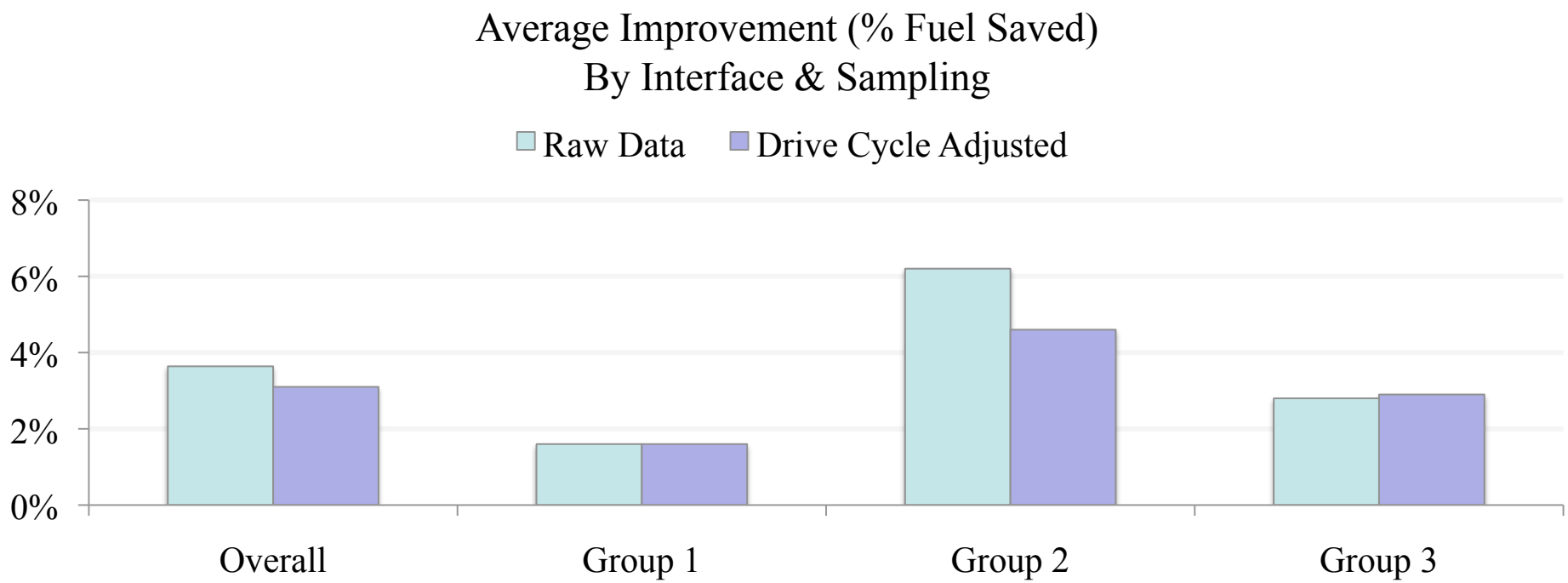
- Trip-types assumed constant across periods: looks for changes within trip types
- Mixed-effects model makes driver-level estimates: trips as repeated observations
- Model trained on without-feedback driving predicts outcome for with-feedback driving based on trip-specific factors
  - Prediction residual = feedback effect + error

Trip-types

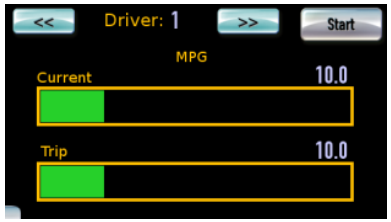
Drive-cycle cluster descriptions



Results By Interface Design

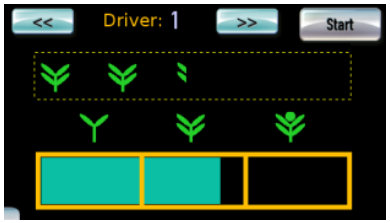


"Numbers"

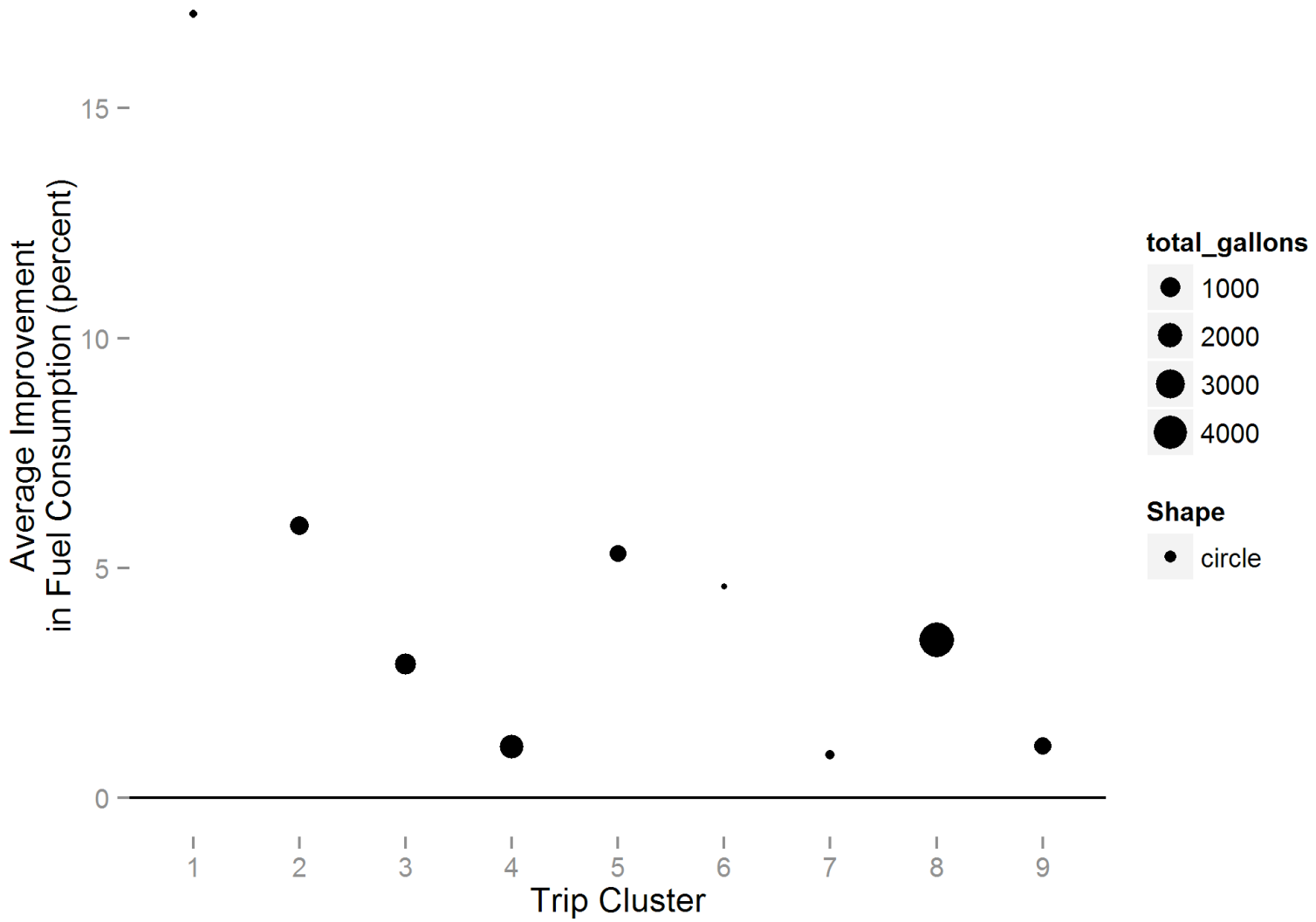


"Accelerator"

"Shrubbery"

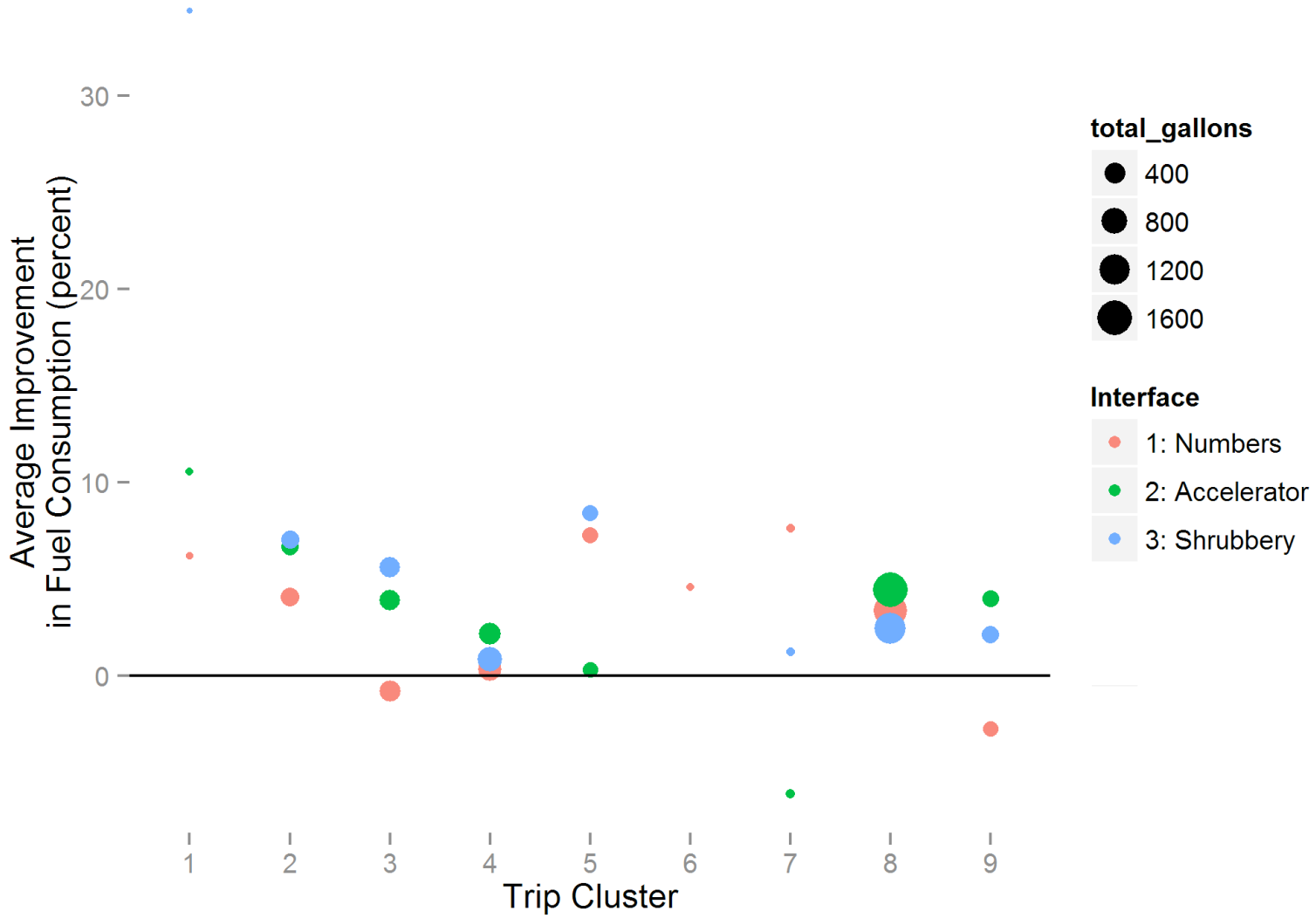


Results by Drive-cycle



Increasing Distance and Average Speed

Results by Drive-cycle and Interface



Increasing Distance and Average Speed

Conclusions, subject to refinement

- Reject h_0: In-vehicle feedback ≠ Fuel economy improvement
- Rather, In-vehicle feedback is positively correlated with higher on-road fuel economy
  - Variation by trip-type (drive-cycle)
  - Variation by interface design from 2% to 5%
    - Accelerator design most effective on average
  - Mean reduction: 10% overall between feedback off and on.
  - Mean reduction: estimate 3% due to on-road driving behavior.
    - Balance of the reduction may be due to changing trip patterns including vehicle substitution or avoidance of short trips, or omitted variables.

Acknowledgement:
USDOE/Oak Ridge National Lab
UC Sustainable Transportation Center

Thank you.
Questions?

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