Exploring Driver Adaptation to L2 System Features: An Investigation of Vehicle Speed and Secondary Task Engagement

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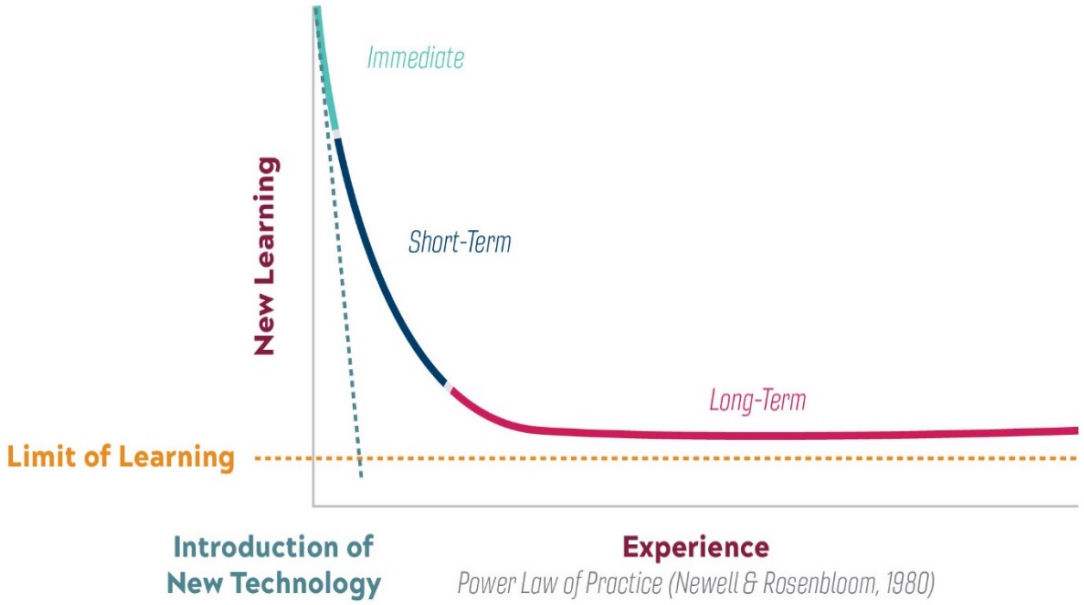
Overview

- Background on Driver Adaptation
- Method – Description of NDS
- Results
  - Vehicle Speed
    - Experience with L2 Systems
    - Driver Age
  - Secondary task engagement
- Conclusions

Background

- The present study is concerned with driver adaptation to Level 2 (L2) system features, as defined by SAE International
- Used existing naturalistic driving datasets where vehicles were equipped with L2 automated features
- Two NDS's were used:
  - Initial four weeks of exposure to L2 system features
  - Long term exposure to L2 system features
- Primarily interested in immediate exposure, short-term exposure and long-term exposure

Driver Adaptation: Learning Curve



- Phase 1: Under 3 hours of L2 experience,
- Phase 2: Between 3 and 8 hours of L2 experience, and
- Phase 3: Over 8 hours of L2 system experience.

Method – Comparison of L2 System Feature by Driver Experience

- L2 NDS
  - 82 participants
  - Mean age: 40.1 years
  - Initial 4 weeks of L2 feature use
  - Washington, DC
  - Vehicles were ‘on loan’ to participants
- Virginia Connected Corridor Elite 50 NDS
  - 33 participants
    - Mean age: 47.6 years
  - Data collection for 12 months
  - Washington, DC
  - Vehicles were owned by participants and VTTI instrumented for data collection

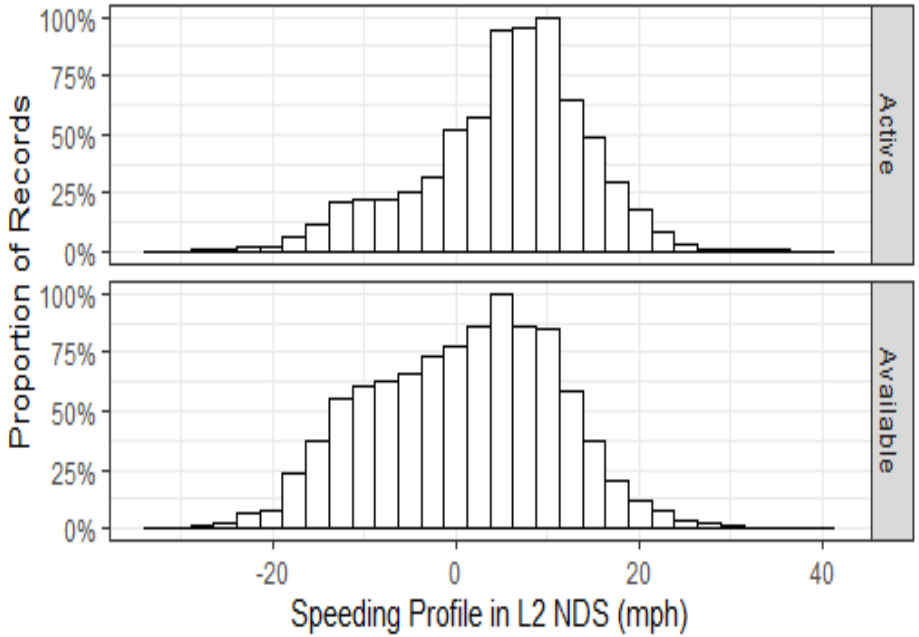
Method – Comparison of L2 Feature Initial Use by Driver Age

- L2 NDS
  - 82 participants
    - Between 25 and 54 years of age
  - Initial 4 weeks of L2 feature use
  - Washington, DC
  - Vehicles were ‘on loan’ to participants
- Older Driver NDS
  - 18 participants
    - Between 70 and 79 years of age
  - Initial 6 weeks of L2 feature use
  - Southwest Virginia
  - Vehicles were ‘on-loan’ to participants

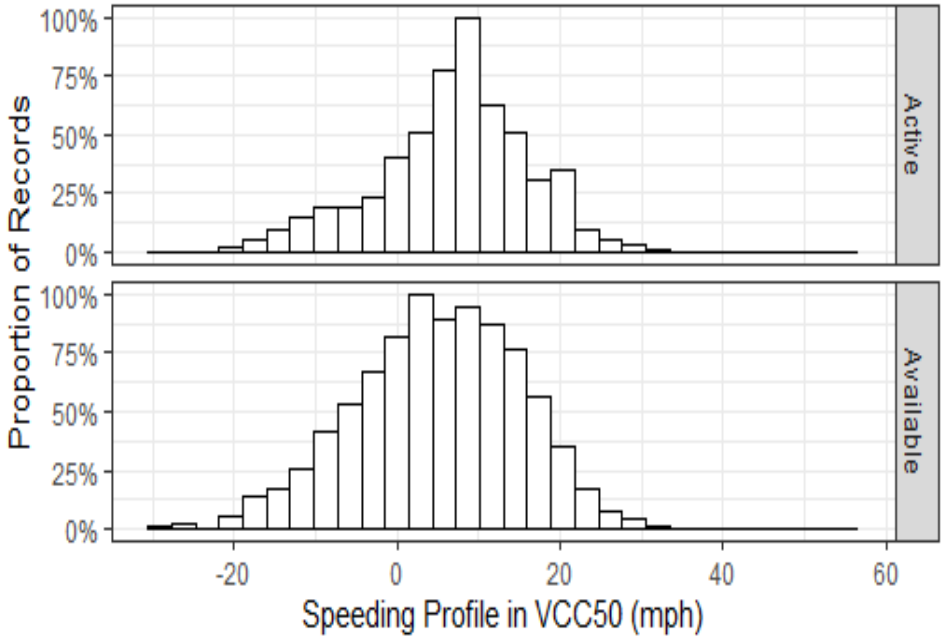
Dependent Variables

- Vehicle Speed Analysis
  - Vehicle speed at onset of L2 system features being activated
  - Vehicle speed for matched sample when L2 systems were available but inactive
- Secondary task engagement
  - Matched sample of cases (L2 systems active) and controls (L2 systems available but inactive)
  - Reviewed by trained coders and secondary task engagement was recorded
  - Evaluated by what we know to be “High Risk” for legacy vehicles versus “Low Risk” or No Distraction present

Vehicle Speed: L2 Features by Experience



1. Speeding = Actual speed - speed limit
2.Records represents 1Hz time-series kinematic data



1. Speeding = Actual speed - speed limit
2.Records represents 1Hz time-series kinematic data

Vehicle Speed for Shorter/Longer L2 Activation (L2 NDS)

- Participants with Less L2 Active Time (Phase 1 vs. Phase 2)
  - Higher speeds were selected when L2 systems were active than when available but inactive
  - Speed selection increased when L2 systems were active between Phases 1 and 2 but not when systems were available but inactive
- Participants with More L2 Active Time (Phase 1/2 vs. Phase 3)
  - Higher speeds were selected when L2 systems were active than when available but inactive
  - Speed selection increased when L2 systems were active between Phases 1 and 2 but NOT between Phases 2 and 3

Results – Vehicle Speed by Age

1. Speeding = Actual speed - speed limit
2.Records represents 1Hz time-series kinematic data

High Risk Secondary Task Engagement

- L2 NDS
  - No significant main effects for either L2 Status or Phase
  - Significant interaction of L2 Status and Phase
    - Increase in high risk secondary tasks across phase only when L2 Systems were active

- VCC50 NDS
  - Significant main effect of L2 systems with higher high risk secondary task engagement when L2 systems are active compared to when inactive

Conclusions

- Evidence of driver adaptation to L2 system features in that we see increases in speed selection at the moment of L2 activation over time.
  - This pattern of selecting higher speeds when L2 systems are active continues for experienced drivers
  - Similar patterns were also observed for older drivers at similar rates to the L2 NDS participants
- This analysis corroborates previous analyses suggesting that secondary task engagement increases when L2 systems are active
- The speed analysis suggests that drivers are willing to accept faster speeds when L2 systems are active
- The secondary task analysis suggests that drivers are more willing to engage in visual –manual tasks more frequently when L2 systems are active

Limitations

- The vehicle speed analysis was data to assess what speed drivers were willing to accept when they first initiated L2 system features
  - This does not reflect the speed that the vehicle actually traveled
  - Comparison to available but inactive may be highly contingent on traffic conditions.

- “High Risk” secondary task was based upon what has been found in the literature for legacy vehicles.
  - This analysis was NOT a risk analysis and we are not certain that these same tasks yield the same risk levels when L2 system features are active

Contact Info

Thank you!!

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Questions??