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 represent 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??