DRIVER ATTENTION INSIGHTS USING HYBRID NATURALISTIC-CONTROLLED RESEARCH

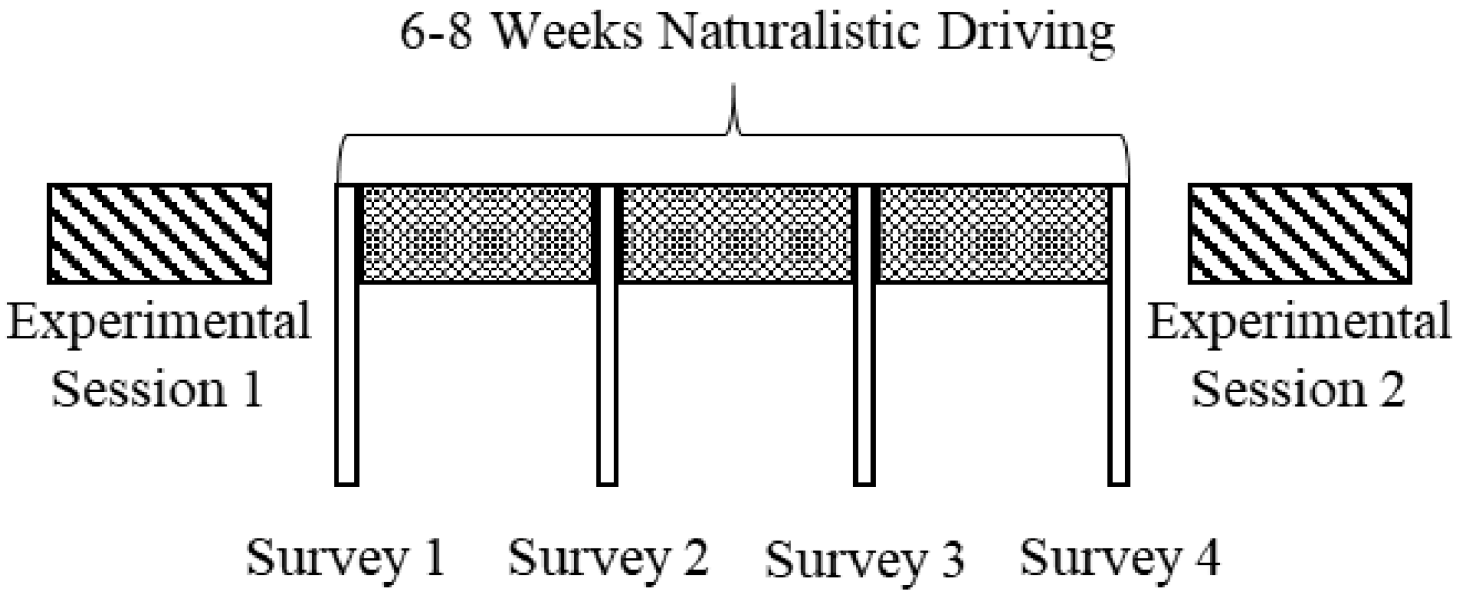
Joel Cooper PhD

Red Scientific Inc.

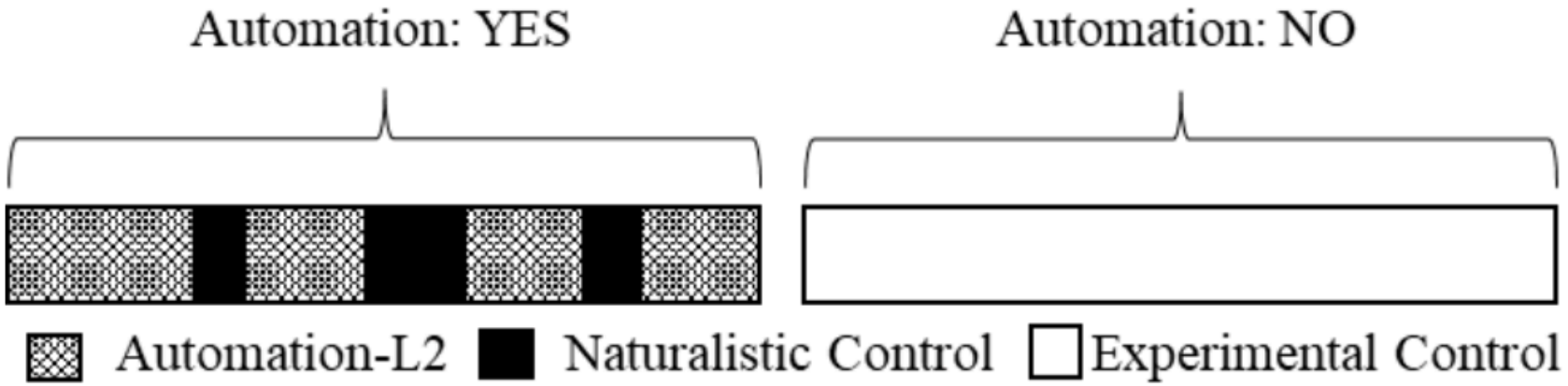
Salt Lake City, Utah

THE QUESTION

How do drivers change their behavior when using low-level (L2) vehicle automation?



THE APPROACH


Automation: YES
Automation: NO
Automation-L2
Naturalistic Control
Experimental Control

A TWIST

DUAL-CONTROLS

- Naturalistic control: Drivers chose not to use automation.
- Experimental control: Drivers are told not to use automation.

Controls for the potential confound that drivers are selective about when to engage vehicle automation and do so only when it is perceived to be safe and beneficial.

VEHICLES

- 2018 Tesla Model 3
- 2017 Tesla Model S
- 2018 Cadillac CT6
- 2018 Volvo XC90
- 2018 Nissan Rogue

All L2 equipped:

- Adaptive cruise control
- Lane centering

INSTRUMENTATION

- Cameras
  - Driver Facing
  - Forward Facing
  - Instrument Facing
- GPS
  - Speed
  - Location
  - Time

Behavioral Observation Research Interactive Software

- **Automation Usage**: Engagement/disengagement tracked via vehicle display and control activations for redundancy.
- **Warnings**: System warnings logged as discrete events.
- **Driving Demand**: Categorized as low (no poor conditions), moderate (one poor condition), or high (two or more). Poor conditions included weather, traffic, construction, etc.
- **Fatigue & Fidgeting**: Continuous coding of fatigue signs (e.g., yawning) and fidgeting behaviors (e.g., touching face, reaching, eating).
- **Distraction & Inattention**: Coded for activities like texting, calling, radio use, navigation, and video interaction. Interaction modality (visual/auditory) and interface (cell phone/IVIS) were tracked.

ANALYSIS

- **Data Source**: .csv from BORIS, tasks in columns, time in rows (binary indicators).
- **Transformation**: Time-series format using base R and Tidyverse.
- **Analysis**: Linear mixed-effects models (lmerTest) to account for repeated measures and missing data.
- **Random Effects**: Participant ID, AM/PM Drive.
- **Fixed Effects**:
  - **Session**: Continuous (numeric).
  - **Condition**: Discrete (3 levels: Automation-L2, Naturalistic, Control).
- **Tests**: Likelihood ratio (ANOVA), pairwise comparisons (contrasts).
- **Significance**: $p < .05$, $p < .01$, $p < .001$.

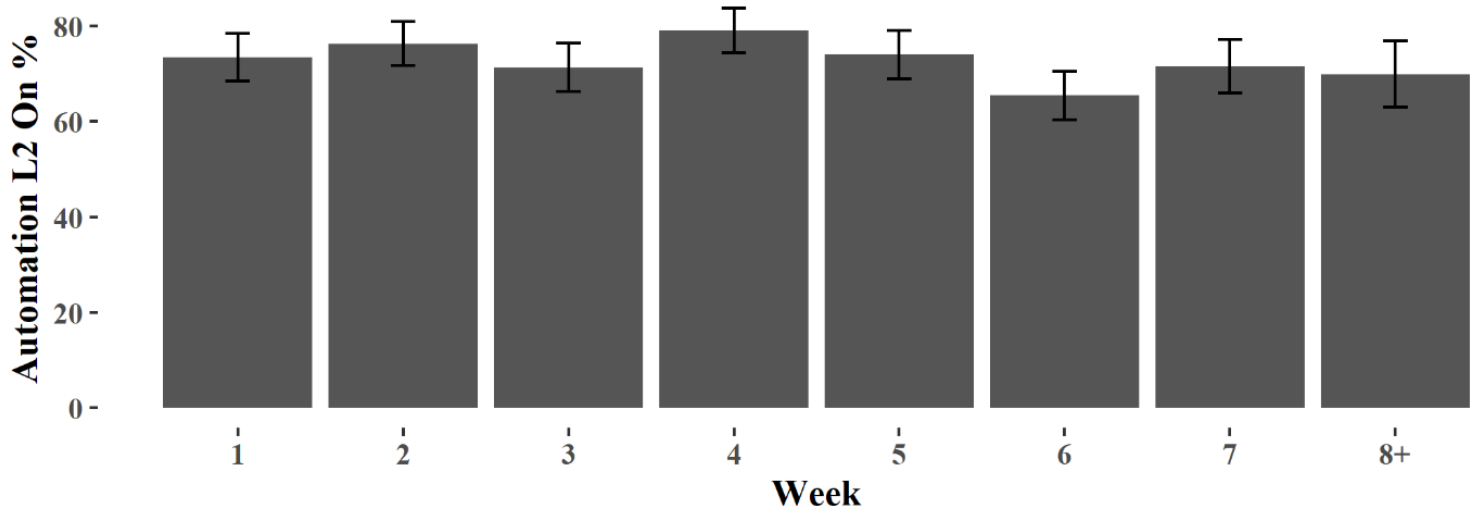
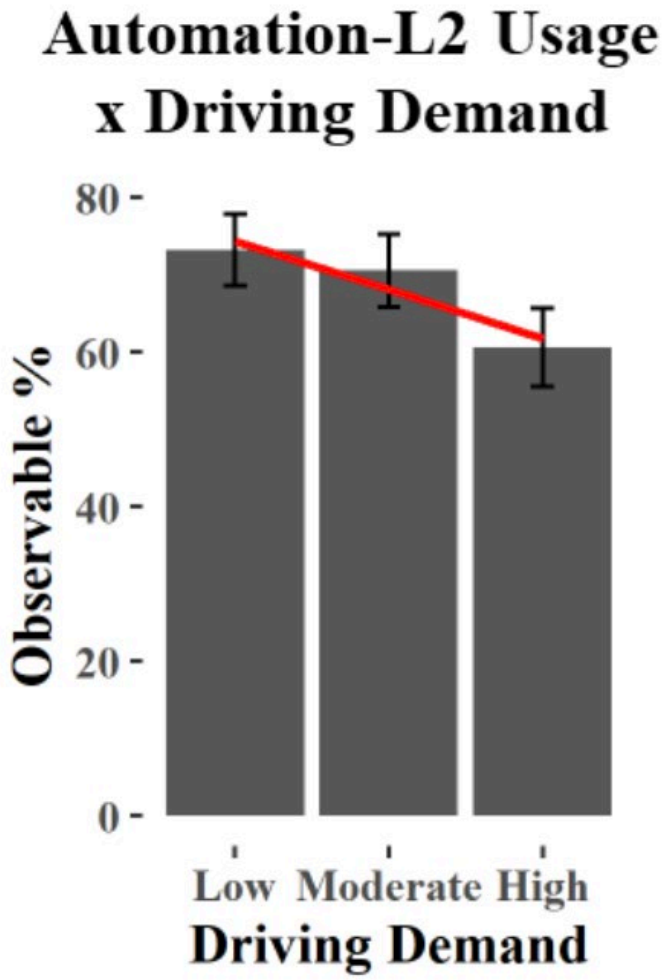


Figure 12. Automation-L2 Usage: Automation-L2 use by Week.

AUTOMATION USAGE REMAINED CONSTANT EACH WEEK

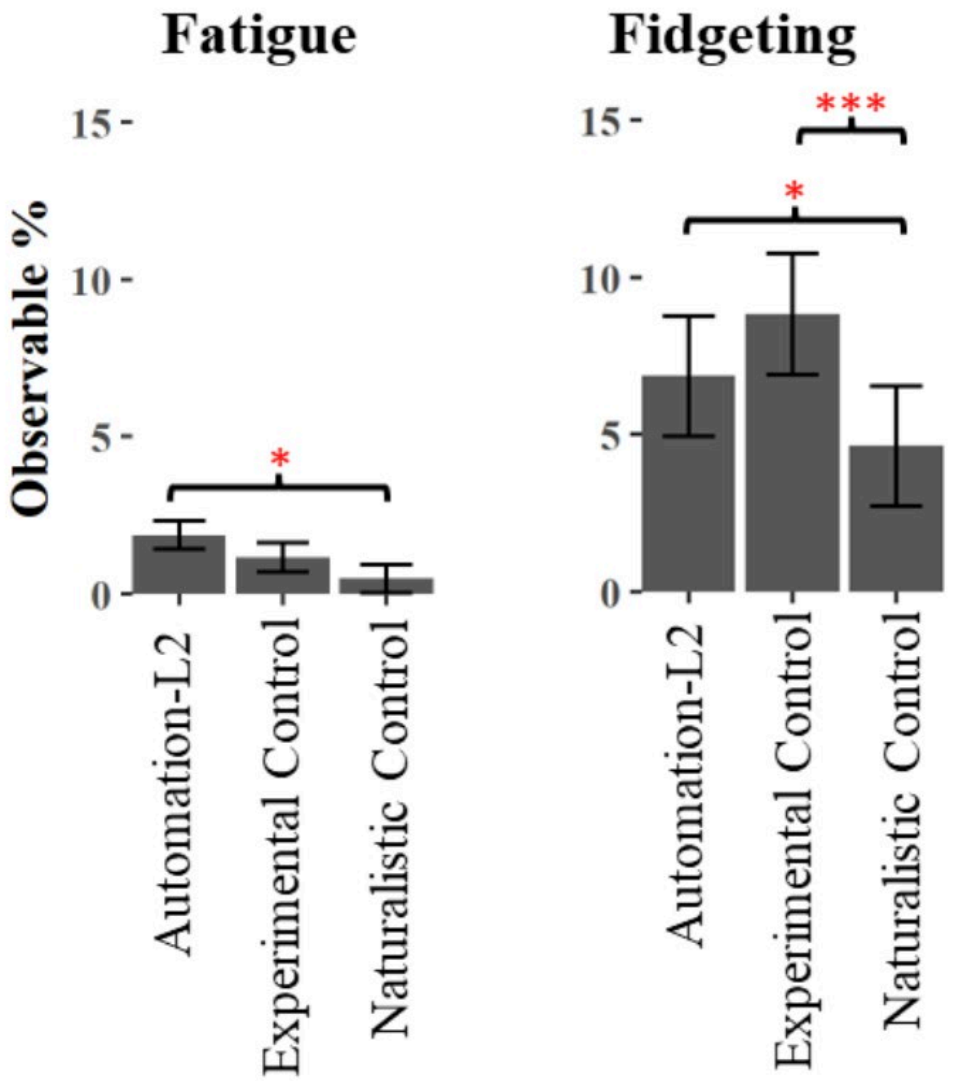
AUTOMATION USAGE DECREASED AS DRIVING DEMAND INCREASED



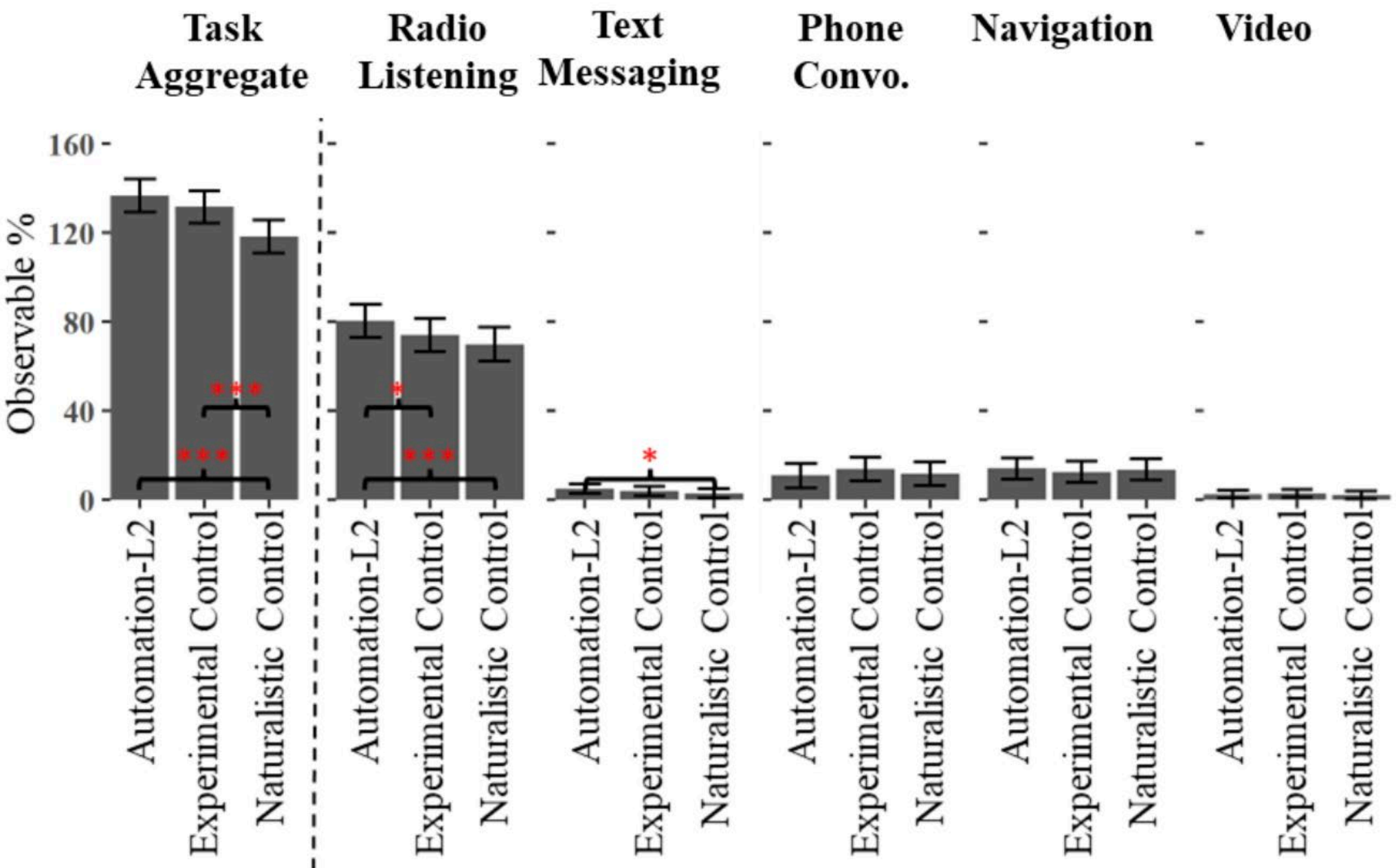
DESIGN REMINDER

- Automation L2: Drivers CHOSE TO use automation
- Naturalistic Control: Drivers CHOSE NOT to use automation.
- Experimental Control: Drivers were TOLD NOT to use automation

FATIGUE AND FIDGETING



SECONDARY TASK ENGAGEMENT



DISCUSSION

Secondary task engagement during automation use may NOT be the issue we feared

DISCUSSION

Drivers ARE selective about when to use automation. Thus, the control condition matters, lots.

SUPPORT

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THANK YOU