

EMPIRICAL SUPPORT FOR HUMAN FACTORS GUIDELINES FOR TIP CARD DESIGN

Abstract

Although new traffic control devices are expected to improve safety, it is critical to inform road users how they function and what actions to take. Our focus is on designing information resources for aging road users given their higher risk for injury and death in crashes. Tip cards are a potentially effective method for communicating this information. We first identified relevant theories and data concerning the design of public service materials to provide guidelines in the form of a human factors checklist. We then validated these guidelines in a series of experiments.

We tested samples of younger (21-35), middle-aged (50-64), and older (65+) drivers, conducting attitude and memory surveys, lab-based studies of speeded decision making, and a driving simulator study. We assessed human factors usability criteria of learnability, efficiency, memorability, errors, and satisfaction.

An initial study of 307 younger, 298 middle-aged and 324 older adults examined learnability based on participants' understanding of card information immediately following reading about flashing yellow arrow (FYA) and rectangular rapid flashing beacon (RRFB) traffic control devices via standard or enhanced tip cards. Results showed that guideline-enhanced tip cards were able to convey the same information in significantly less reading time (Control Front = 25.5s, Control Back = 67.2s, Enhanced Front = 27.8s, Enhanced Back = 34.4s) than existing tip cards with equivalent user satisfaction measured by attitude questions. We next evaluated tip card long-term memorability for standard vs. enhanced tip cards either immediately or after a one-week delay using lab-based experiments requiring rapid decision-making in traffic scenarios containing those traffic control devices. No difference in memorability was observed and overall performance was quite high even in the absence of tip card exposure. We found slightly, but significantly better performance using realistic photographs compared to stimuli created using 3-D modelling software for rapid decision-making about traffic control devices.

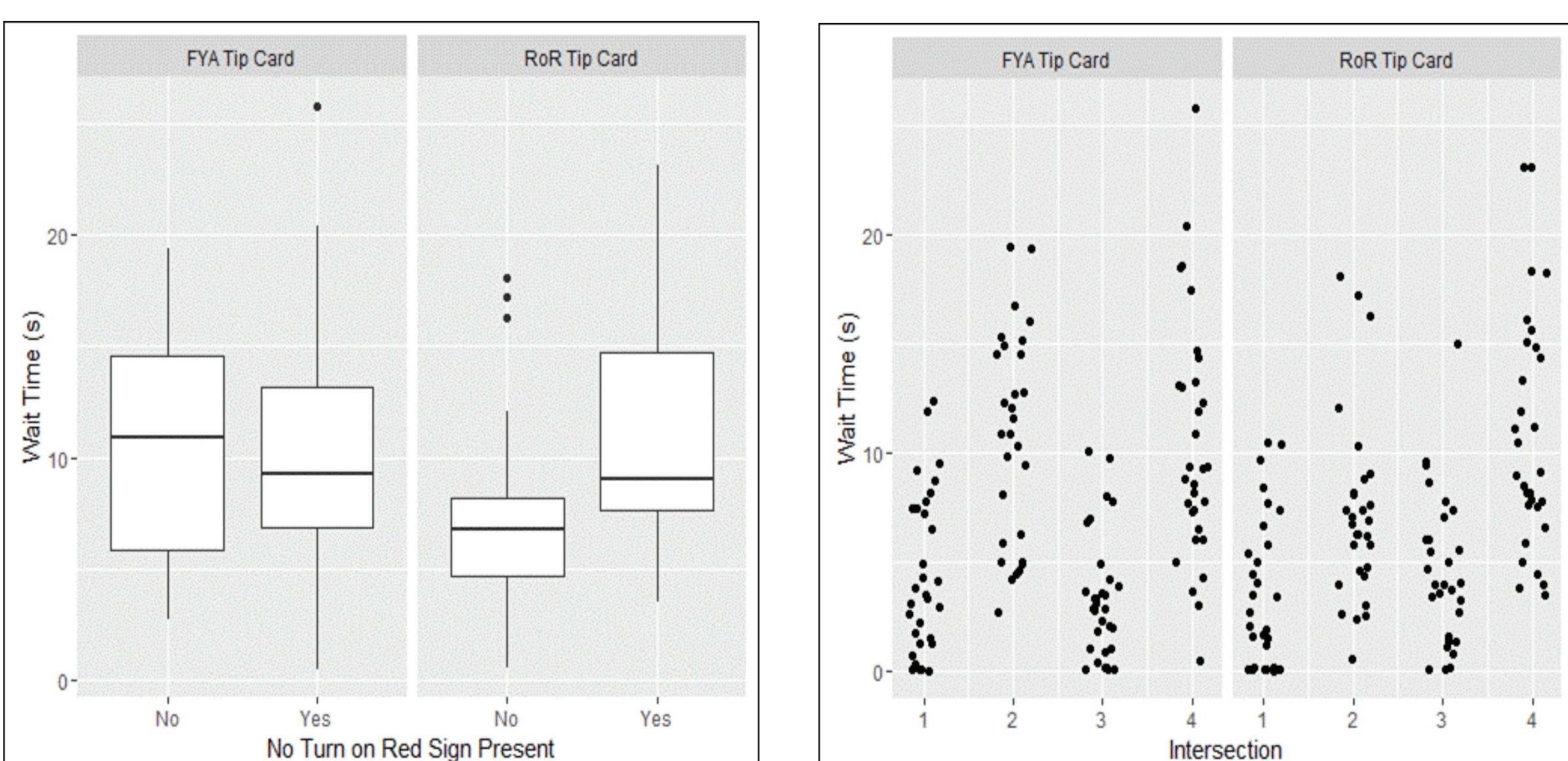
A simulator study ($n = 40$ middle-aged, 61 older adults) evaluated whether the enhanced tip cards would result in benefits to middle-aged and older driver behavior. We measured wait time to turn and number of permissible turns executed when drivers encountered FYA and right-on-red (ROR) traffic control devices in a driving simulation task after drivers read both a relevant and an irrelevant tip card. For FYA intersections, wait times did not depend on the presence of an oncoming vehicle, nor on the card the participants read, and did not differ between age groups. For ROR intersections, wait times differed such that participants who saw the ROR tip card waited for a shorter period of time compared to those who saw the FYA tip card when the intersection did not have a no-turn-on-red sign. There were only 3 instances in which participants turned in front of an oncoming vehicle. Based on the rating data, the waiting time data for the ROR tip card, the number of executed permissible turn results, and results from prior studies, we concluded that the enhanced tip cards were effective.



Condition	1st Tip Card Viewed	2nd Tip Card Viewed
A	FYA	RRFB
B	RRFB	FYA
C	FYA	Roundabout
D	Roundabout	FYA
E	Right on Red	RRFB
F	RRFB	Right on Red
G	Right on Red	Roundabout
H	Roundabout	Right on Red



Reason Excluded	Middle-Aged (50-64)	Older Adults (65+)
Simulator sickness	9	21
Opting out of study after consent	0	6
Wrong-turn terminated scenario	0	5
Software crash	0	1
Experimenter error	1	0



Methods

-This task presented the four tip cards Flashing Yellow Arrow (FYA), the Rectangular Rapid Flashing Beacon (RRFB), Turning Right on Red (ROR), and Roundabout
- Participants were exposed to 2 of the four tip cards (Relevant v. Irrelevant)
- Following a short practice task, drivers encountered intersections with the FYA signal and a right turn with and without a No Turn On Red sign.
- They encountered intersections with and without oncoming traffic.
- We measured wait time before executing a turn (left for FYA, right for permissible right-turn-on-red)
- We also recorded any risky turns (inter-vehicle distance) when there were opposing vehicles present
- Immediately following the simulator scenario, we evaluated their response to the tip cards via a questionnaire.

Participants

- 101 older adult participants were recruited from the Tallahassee, FL area.
- All older adults were licensed drivers.
- The final dataset included 62 participants who were not included in



Results

- R (Version 3.1) was used to conduct the analyses
- Tip Card reading time
 - * Time participants spent reading the card did not depend on the type of card they read
 - * The reading times for the filler cards did not differ from critical cards
 - * No effect or interaction of age group and the card
- Driving Simulator Data
 - * FYA & ROR: Participant wait time at intersections did not depend on the presence of an oncoming vehicle, nor the tip card participants read
 - * FYA: These variables did not predict wait time for FYA
 - * ROR: These variables did interact to predict wait time ($F(1,56) = 5.666, p = .021$)
 - participants who saw the ROR tip card waited at ROR intersections for a shorter period of time (compared to those in FYA)
 - * ROR: Little difference in waiting time for impermissible right turns
 - * ROR: Not dependent on age but they did depend on the interaction between age group and no-turn-on-red sign presence ($F(1,56) = 5.531, p = .022$)
 - Older participants waited at ROR intersections longer when the no-turn-on-red sign was present than when it was not
 - The same was not true for middle age participants
 - 98% of participants waited for the signal to turn green before making a right hand turn when the no-turn-on-red sign was present
- * 40% waited for the signal to turn green when the sign was not present

Discussion

- Higher than expected attrition
- We did not observe any consistent direct benefits for the enhanced Tip cards
- We did see significant benefit for right turns at right-on-red-permissible intersections
 - * Participants who read the ROR tip card waited less time (about 3 seconds) before turning right compared to those who saw the FYA tip card
 - If we restrict analysis to the case of permissible right-on-red turn opportunities only, a chi-square indicates that those who read the ROR tip card made more turns than those who read FYA
- Older adults tend to be more conservative in their decisions to traverse intersections
- Drivers rated the tip cards as being very helpful in informing them about traffic control device functioning
- Recommendations
 - * FDOT should use the tip cards based on human factors checklist to guide future tip cards
 - * Use templates for designing effective tip cards
 - * Further study of the relative effectiveness of photos versus 3-D images in educational materials distributed to aging road drivers
 - * Faulty recall of the tip card information could lead to safety-compromising errors, we should continue research into this issue, even though few mistakes were committed on the experimental or simulator tasks.