

Impact of road sign distance on driving performance of older and middle-aged drivers on rural highways

NDSU

CENTER FOR VISUAL AND COGNITIVE NEUROSCIENCE

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Introduction

According to the US Census Bureau, the population of older adults in North Dakota will increase from 15% in 2010 to 25% in 2030, with the highest concentration of older adults in rural areas. Physical (e.g., poorer visual acuity) and cognitive (e.g., cognitive slowing) changes with age have been shown to affect older adults' driving performance (Carr et al., 1004; Dulisse, 1997; Kortelling, 1994). Previous studies have assessed older adults' driving performance in urban and suburban areas (e.g., high amount of ambient traffic and road signs). The NDDOT is interested in how to increase driving safety for older adults in rural areas of North Dakota. We examined older adults' driving performance (e.g., preparatory behaviors at intersections) and manipulated the presence and distance of signs on a simulated rural highway to assess low-cost sign improvements that could increase driving safety for older adults.

Method

Participants:

- 19 middle-aged adults (40-58 years; M = 49 years; 10 F) and 19 older adults (60-84 years; M = 70 years; 13 F).
- Average near visual acuity was similar for middle-aged and older adults. (M = 20/23).
- All participants had a valid driver's license.

Stimuli and Procedure:

- Participants completed 36 driving scenarios (18 daytime and 18 nighttime) in a Drive Safety DS 600 C driving simulator that sampled at 10 Hz.
- The presence and distance of road signs was manipulated (Figure 1).
 - Destination road signs were placed 200, 400, or 600 ft (close, middle, or far distances) from the intersections.
 - An intersection warning sign could be present or absent.
- Participants drove and turned left or right at the target intersection (ABCville).

General Traveling Speed

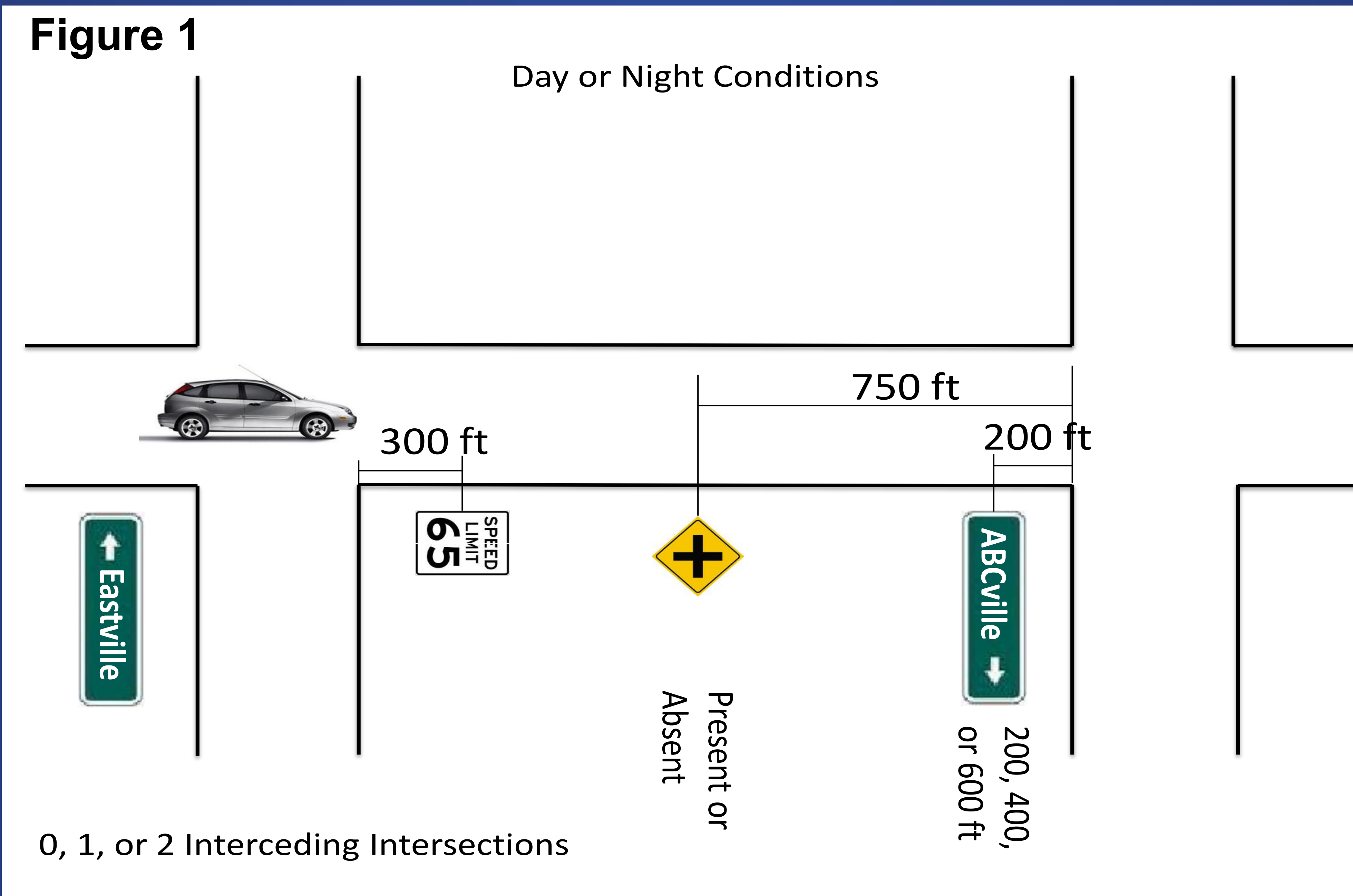
- Older adults were slower than middle aged adults, $p < .05$, but light condition did not impact travelling speed, $p > .35$.



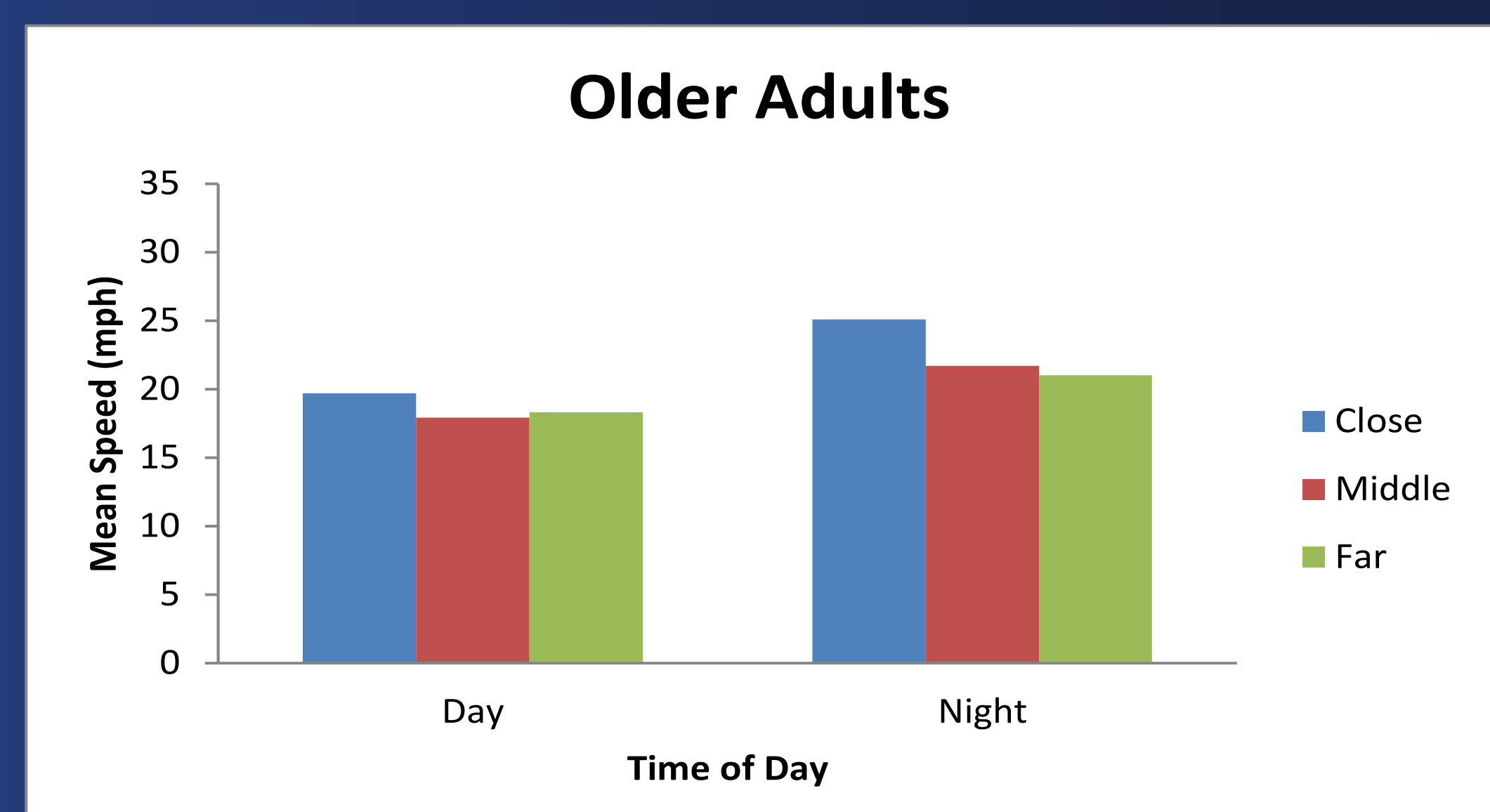
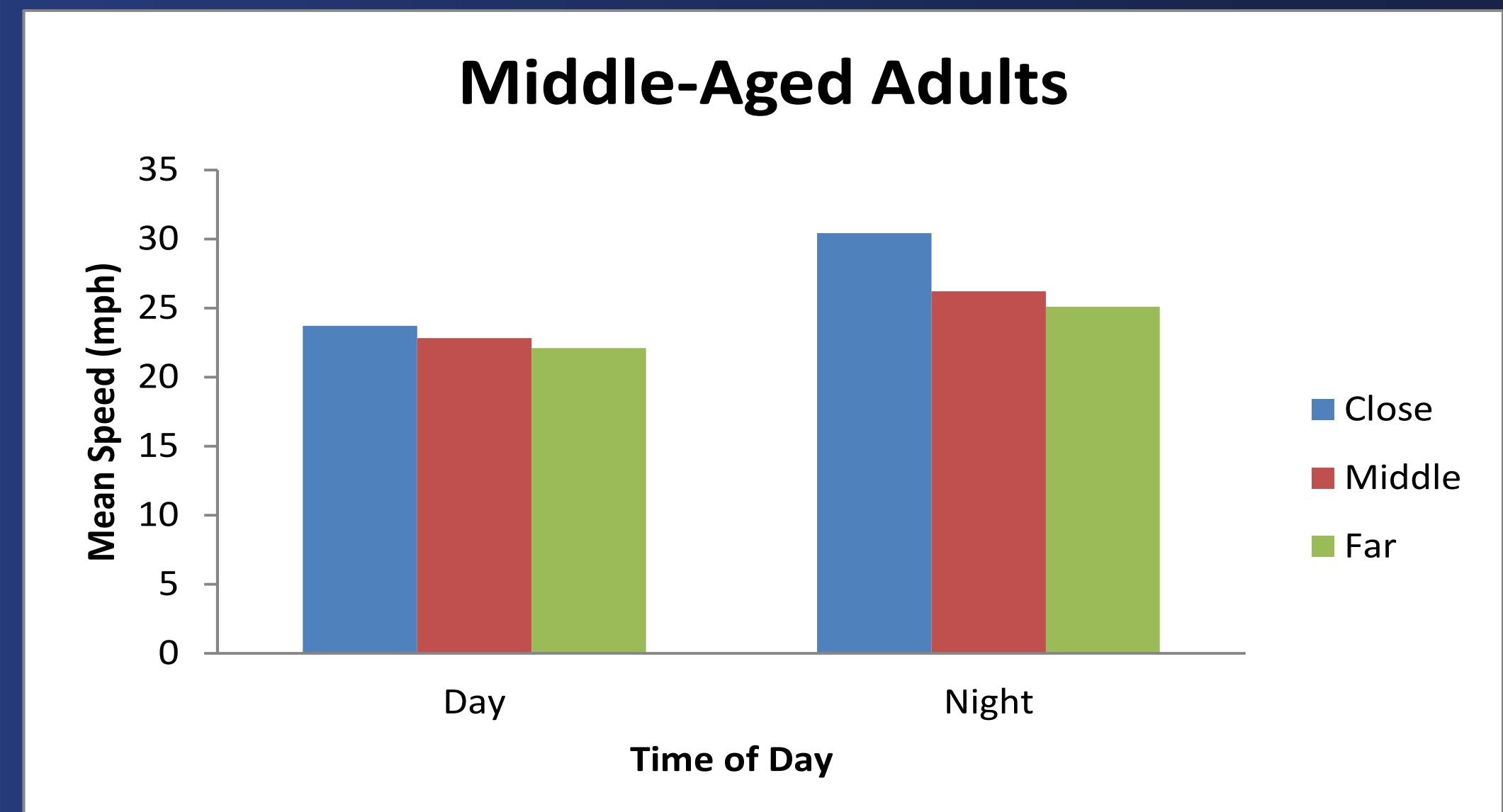
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Driving Scenario



Speed Going into the Turn



- Older adults were slower going into the turn than middle-aged adults, $F(1, 36) = 8.56, p < .01$. Participants were faster going into the turn at night than during the day, $F(1, 36) = 33.87, p < .0001$.
- We found a Light Condition \times Sign Distance interaction, $F(2, 72) = 5.44, p < .01$. Participants were faster going into the turn when the sign was close to the intersection than at middle or far distances, although the distance effect was bigger at night than during the day. This did not significantly vary by age group, $p > .50$.

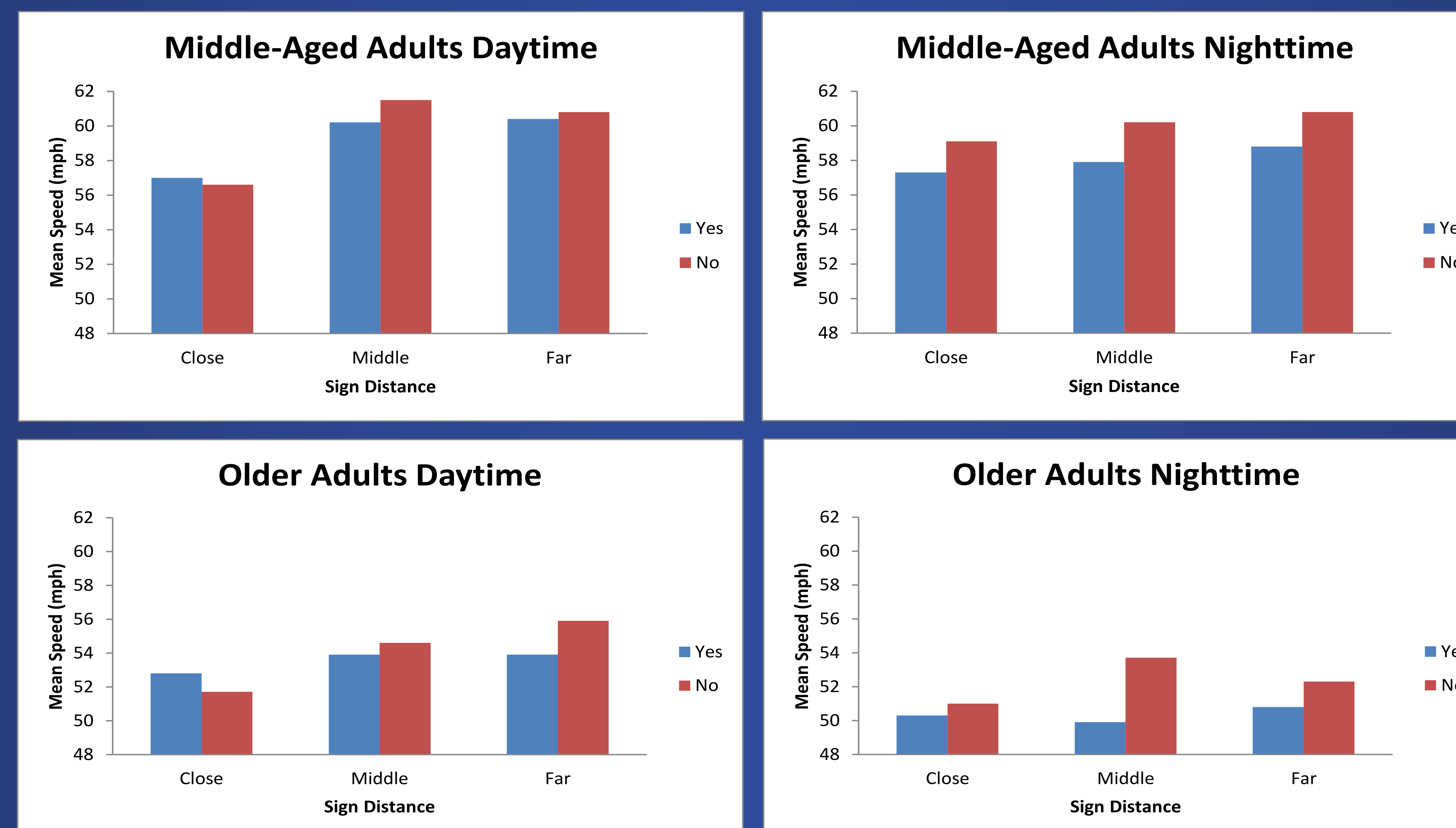
Discussion

Older adults drove more slowly than middle-aged adults, but other driving behaviors did not vary by age. Both middle-aged and older adults slowed down more at the destination sign when a warning sign was present than absent, particularly at night. Destination sign distance also impacted driving speed of both age groups. When a destination sign was close to the intersection, drivers slowed down more at the sign, but went faster into the turn, than when the sign was at greater distances. In conclusion, these findings suggest that, in rural areas, low-cost changes such as moving the destination road sign farther from the intersection and using warning signs, increases preparatory turn behaviors in middle-aged and older drivers and increases driving safety.

References

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Speed at the Target Destination Sign



- We found a Light Condition \times Sign Distance interaction, $F(2, 72) = 5.44, p < .01$. During daytime, participants were traveling slower at the destination sign when the sign was close to the intersection than at middle or far distances, $F(2, 74) = 18.67, p < .0001$, but not at night, $F(2, 74) = 1.92, p > .15$. This pattern did not vary by age group, $p > .15$.
- A Light Condition \times Warning Sign interaction, $F(2, 72) = 5.07, p < .05$, indicated that during daytime, warning sign presence did not impact the speed at the destination sign, $F(1, 37) = 1.39, p > .20$. At night, participants slowed down more when the sign was present than absent, $F(1, 37) = 16.12, p < .001$. This pattern did not vary by age, $p > .90$.
- Finally, we found a Warning Sign \times Sign Distance interaction, $F(2, 72) = 2.96, p < .10$. When the warning sign was absent, participants were slower at the ABCville sign when it was closer to the intersection than at middle or far distances, $F(2, 74) = 15.85, p < .0001$. This effect was reduced (only marginally significant) if the warning sign was present, because drivers were generally more cautious, $F(2, 74) = 2.51, p < .10$. This pattern did not vary by age group, $p > .55$.