“Choking Under Pressure” in Older Drivers

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Abstract

- Aging can impair executive control and emotion regulation, affecting driver decision-making and behavior, especially under stress.
- We used interactive driving simulation to assess left-turns across oncoming traffic under pressure in 13 older (> 65 yo) and 16 middle-aged (35-56 yo) drivers.
- Over 4 uncontrolled intersections, subjects made 2 left-turns while a vehicle honked aggressively behind (pressure condition) and 2 left-turns without the honking vehicle (control condition). Gaps between oncoming vehicles gradually increased from 2 s to 10 s.
- Results showed that middle-aged drivers made more cautious turning decisions under pressure (by waiting for larger and safer gaps), but older drivers did not. Further, older driver turning paths deviated under pressure compared to the control condition, but the middle-aged group did not.
- Across all drivers, better executive function correlated with larger increases of accepted gap size from control to pressure.
- The findings suggest that older drivers are more sensitive to traffic challenges associated with environmental pressure.

Background

- Being honked at may cause annoyance, stress, anger or panic that interferes with safe decision-making and driving. To mitigate this threat, drivers must minimize distracting negative emotions, focus on the road ahead, appraise the situation and respond safely..
- Aging is associated with decline of neural systems for executive control and emotion regulation (Tucker et al., 2012; Mather, 2012; West, 1996).
- We hypothesized that ***increased age is associated with poorer driver response to pressure from a honking vehicle***.

Methods

Subjects

13 older and ***16 middle-aged*** active drivers **(Table 1)**. All had normal or corrected-to-normal vision and were free from psychiatric and neurological conditions.

Left-turn Task

- NADS MiniSim™ **(Figure 1A)** was used.
- The task involved an rural driving through 4 target (and 5 non-target) uncontrolled intersections **(Figure 1B)**.
- In each target intersection, subjects had to make a left-turn across a stream of oncoming vehicles. Gaps between oncoming vehicles varied and gradually increased from 2 s to 10 s (e.g., 2, 2, 3, 2, 3, 4, 2, 4, 2, 2, 5) **(Figure 1C)**.
- At 2 target intersections, a vehicle applied pressure by honking aggressively behind the drivers as they contemplated the left-turn. The other 2 target intersections had no honking vehicle behind the drivers (control condition) **(Figure 1B)** .

Table 1. Demographic background, neuropsychological test scores, and DULA dangerous driving index.

		Middle-aged		Older				
	Sex	8 M, 8 F		9 M, 4 F				
	Handedness	15 R, 1 Mix		12 R, 1 Mix				
		M	*SD*	*M*	*SD*	*t*	*p*	
	Age	46.13	5.41	77.62	4.86	-16.30	0.00	***
	Years of Education	15.75	1.88	16.54	3.04	-0.86	0.43	
	Weekly driving days	6.06	1.53	6.31	1.11	-0.484	0.63	
	MMSE	29.88	0.34	29.31	0.75	2.71	0.02	*
	WCST (PE)	6.88	3.36	10.54	7.26	-1.80	0.11	
	TMT-B	58.66	20.06	85.89	31.22	-2.85	0.01	**
DULA	Negative Emotion	1.28	0.47	0.99	0.42	1.78	0.09	φ
	Aggressive Driving	0.49	0.43	0.16	0.24	2.46	0.02	*
	Risk Driving	0.40	0.35	0.35	0.18	0.51	0.59	

Note. M = Male; F = Female; R = Right; MMSE = Mini-mental state examination; WCST (PE) = Wisconsin card sorting task (perseverative error); TMT-B = Trail making test part B (time to complete, in seconds); DULA = DULA dangerous driving index. ***$p < .001$; **$p < .01$; *$p < .05$; φ$p < .10$.

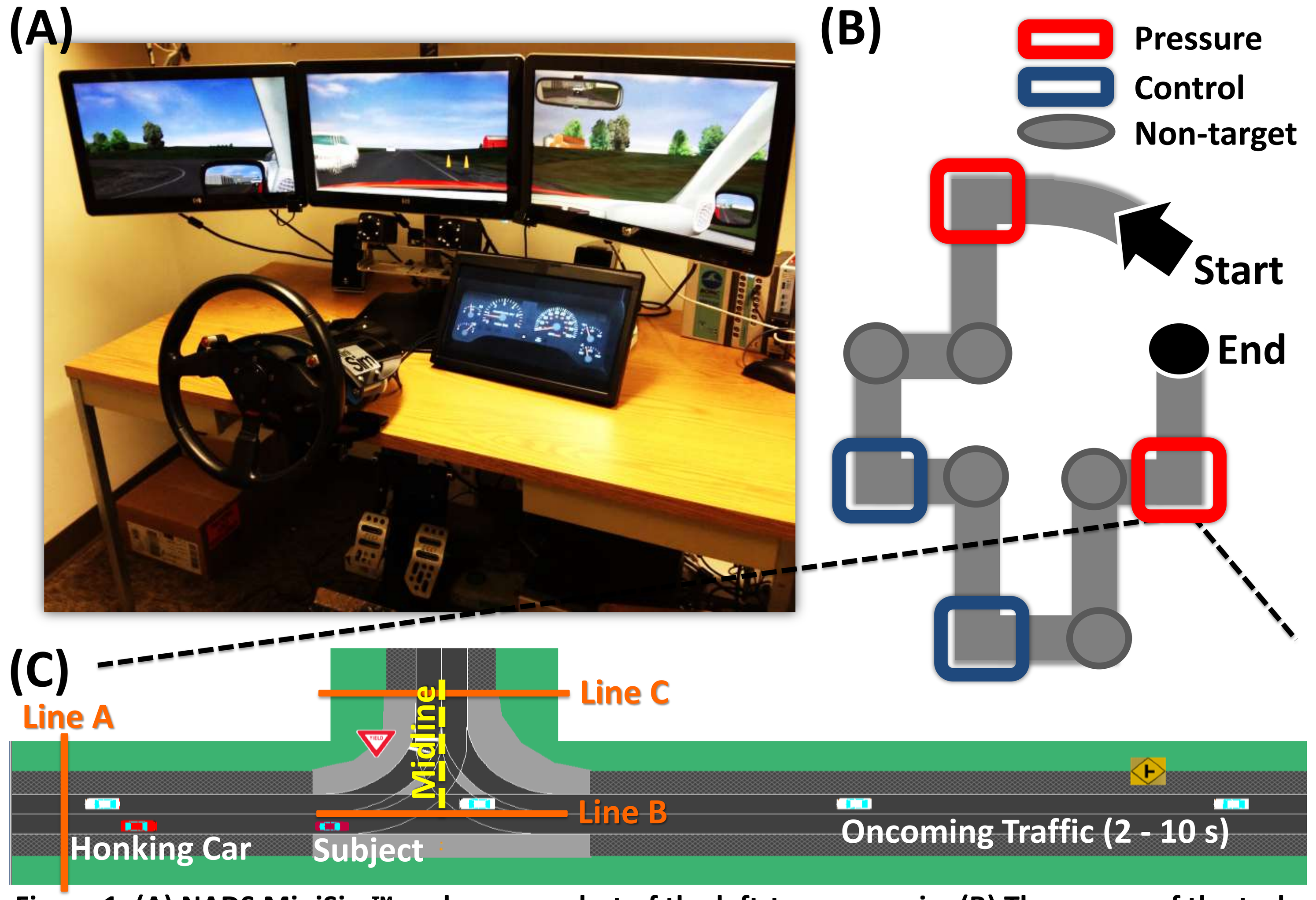

Figure 1. (A) NADS MiniSim™ and a screenshot of the left-turn scenario. (B) The course of the task. (C) Geographic window for analyzing SCR (line A to 5 s before line B) and deviation from road midline (line B to line C).

Dependent Variables

- **Skin Conductance Response (SCR)** indexed emotion arousal (Lykken, 1972). SCR data were recorded from driver's left foot (BIOPAC MP150 system) and analyzed with Ledalab (Benedek & Kaernbach, 2010). Geographic window for SCR analyses is shown in **Figure 1C** (between line A and 5 s before line B) .
- **Gap Acceptance**. We analyzed gaps sizes that drivers took for left turns.
- **Deviation from Road Midline**. To examine left-turn quality, we calculated longest distance from subject's path to road midline when the driver was between line B and C **(Figure 1C)** .
- **Executive functions.** Wisconsin Card Sorting Task (WCST; perseverative errors or PE) and Trail Making Test part B (TMT-B; time to complete, in seconds).

Results

- **SCR.** Exposure to pressure was associated with higher SCR (compared to control condition) in middle-aged drivers ($p < 0.04$). A similar trend was found in older drivers ($p < 0.06$), **Figure 2A**.
- **Gap Acceptance.** Middle-aged drivers took larger gap under pressure than in control condition ($p < 0.01$). Older drivers did not show this pattern, **Figure 2B**.

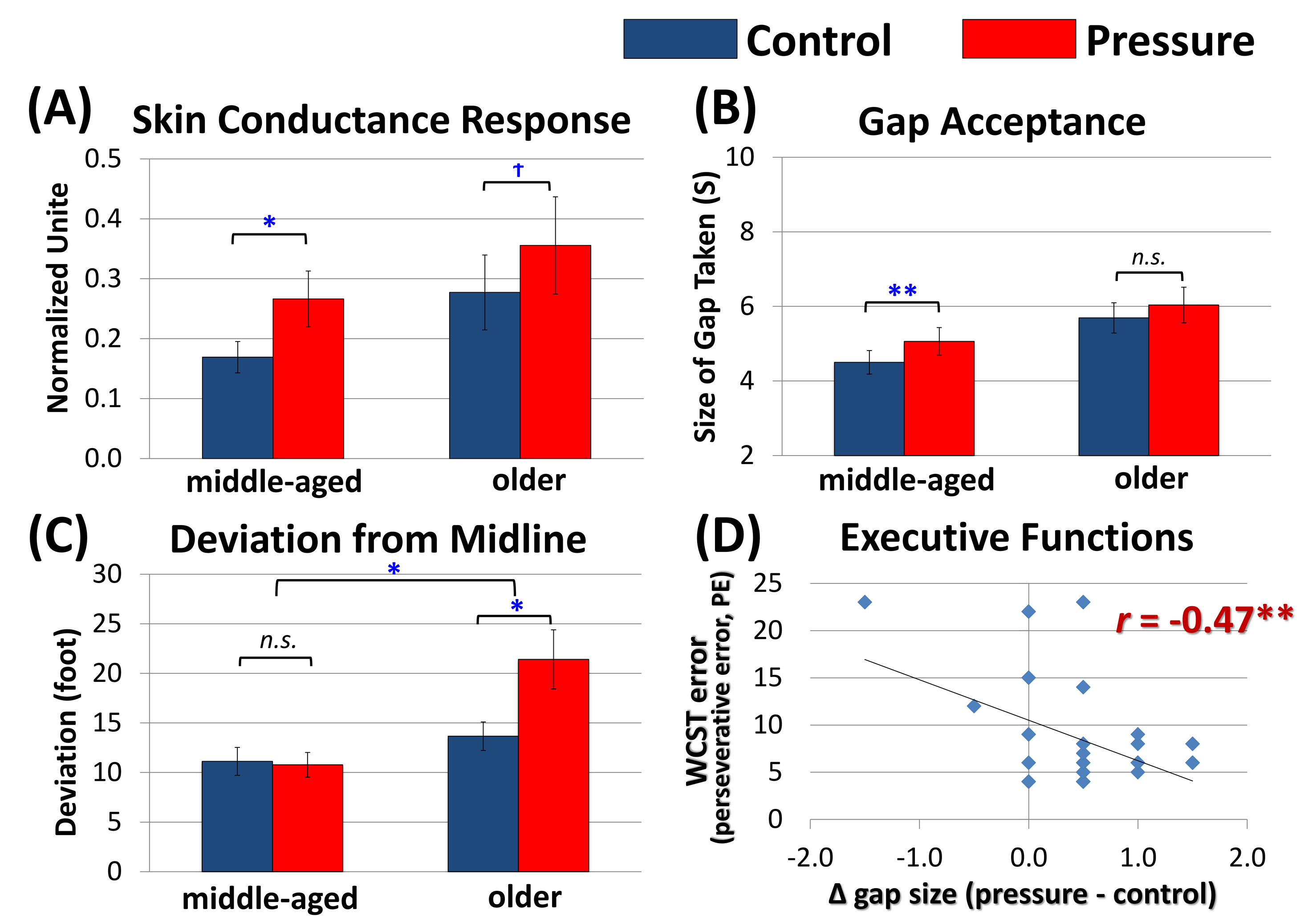

Figure 2. Mean comparison results on (A) skin conductance response, (B) gap acceptance, (C) deviation from road midline. (D) Pearson's correlation between WCST (PE) and change in gap acceptance from control to pressure conditions. **$p < .01$; *$p < .05$; φ$p < .10$.

- **Deviation from Road Midline.** Degree of deviation was unchanged across conditions in middle-aged drivers ($p > 0.83$). Older drivers deviated significantly more under pressure than in the control condition ($p < 0.02$), **Figure 2C**.
- **Executive functions.** Across all drivers, WCST (PE) correlated with changes in gap size accepted from control to pressure conditions ($r = -0.47$, $p < .01$), **Figure 2D**.

Conclusion

- In this study, middle-aged drivers displayed more cautious decision-making under pressure (by waiting longer for larger and safer gaps).

  Increased caution may reflect a driver's metacognitive awareness of potential adverse effects of pressure on decision-making.
- Older drivers did not display this pattern. In contrast, their turning paths became worse, tantamount to a “choking under pressure” effect (DeCaro et al., 2011).

  Declines in executive function and emotion regulation may contribute to “choking under pressure” in older drivers.
- Findings suggest that common driver-to-driver conflicts can disproportionally affect decision-making, performance and safety in drivers with age related cognitive decline. Factoring in age-related changes in executive control and emotional regulation should strengthen neural models of driving and interventions to improve older driver safety.

Acknowledgements

Supported by ***Nissan Motor Company***. We thank ***Andrew Veit***, ***Chris Schwarz***, ***David Heitbrink***, ***Omar Ahmad***, and ***Meiji Zhang*** for their advice on NADS MiniSim™ hardware and software. We thank ***Katherine Read*** and ***Kelsey Thompson*** for collecting partial neuropsychological data, ***Samantha Edwards*** and ***Ruth Henson*** for assistance with human subjects issues, and ***Amy Johnson*** for pre-processing simulator data. We also thank all of our subjects for their participation.

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