

## ***ON THE FAST LANE TO ROAD RAGE***

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**Summary:** Aggressive driving and road rage are increasing. The factors that trigger road rage are not well understood. The first goal of this study was to identify conditions likely to lead to aggressive driving/road rage. The second goal was to develop a paradigm that allows for the controlled study of road rage in the laboratory setting. A total of forty-five drivers participated in the study. Twenty-three drivers received non-contingent instructions that emphasized safely driving to a rest stop. The remaining drivers received contingent instructions that added a \$10 monetary incentive if they arrived at the rest stop in the top 50% of all drivers. Participants drove in two scenarios (regular / irregular flow) in a high fidelity driving simulator. We recorded cardiovascular reactivity while driving, and measured driving-related anger after completing each scenario. Overall, the driving task evoked minimal changes in blood pressure. However, an incentive by gender interaction for systolic blood pressure (SBP) reactivity indicated that males in the contingent incentive condition displayed greater SBP responses than males in the non-contingent incentive condition or females in the contingent incentive condition. Contingent versus non-contingent incentives had no effect on females' SBP response. We found no effect of incentive or traffic flow on anger, though analysis on an individual level indicated that some subjects were affected by the manipulation of driving condition. The present findings provide psychophysiological evidence that driving under time pressure and in irregular traffic flow may contribute to the genesis of road rage.

The Highway Traffic Safety Administration (NHTSA) defines aggressive driving as “the operation of a motor vehicle in a manner that endangers or is likely to endanger persons or property.” Examples for aggressive driving include speeding, improper lane changing, tailgating and improper passing. Aggressive driving is a traffic offense and road rage is the endpoint of escalating aggressive driving. Road rage is a criminal offense that can be described as a range of anti-social behaviors and/or acts of aggression including minor instances such as gestures and use of the car horn, through more serious violent acts such as assault or even murder. Aggressive driving and road rage have the potential to pose significant dangers to all traffic participants. Based on statistics from 1997, NHTSA and the AAA estimated that approximately 13,000 people have been injured or killed since 1990 in accidents caused by aggressive driving. Estimates of the Department of Transportation (DOT) are even higher: the DOT estimated that in 1996, two-thirds of the almost 42,000 reported deaths resulting from automobile accidents were attributable to aggressive driving (Martinez, 1997).

The majority of aggressive drivers are males between the ages of 18 and 26 (AAA, 1997), with only four percent of aggressive drivers being female (Mitzell, 1997). The motives for aggressive driving differ also for males and females; Deffenbacher, Oetting and Lynch (1994) found that women were more likely to become angry about traffic obstructions and illegal driving, whereas men were more likely to become angry about police presence and slow driving.

Given the importance of the issue, it is surprising that precursors and conditions triggering aggressive driving and road rage are not well understood. Overwhelmingly, studies about aggressive driving use epidemiological approaches. Though helpful in establishing an association, epidemiological studies only show relationships of aggressive driving with other variables like driving condition, time of day, or weekday. To understand the factors leading to aggressive driving behavior, we need to understand causal relationships.

One important factor thought to lead to aggressive behavior is anger. Based on the anger and aggression relationship, it seems safe to say that aggressive driving behavior and road rage have a precursor in anger. Anger can be measured in different ways—for example, by using subjective measures like questionnaires, or more sensitive physiological variables related to anger (i.e., cardiovascular reactivity) which precede anger (Levenson & Ruef, 1997).

The present study had two goals. The first goal was to identify conditions leading to aggressive driving behavior. The second goal was to develop a paradigm which allows for the controlled study of aggressive driving in a laboratory setting.

## METHODS

*Participants.* Forty-five students (21 female, 24 male) from the University of Utah participated in the study. Participants ranged in age from 18 to 28 (mean = 20.2) years. All participants had normal or corrected to normal visual acuity, normal color vision (Ishihara, 1993) and a valid driver's license.

*Stimuli and apparatus.* A PatrolSim™ high-fidelity driving simulator, manufactured by GE Capital I-Sim, was used in the study. A freeway road database simulated a 24-mile multi-lane beltway with on and off-ramps, overpasses, and two-lane traffic in each direction. Two driving conditions were used in this study. In the *regular-flow* driving condition, vehicles in the scenario moved at a steady, predictable pace. In the *irregular-flow* driving condition, vehicles changed lanes and speeds making it difficult for the participant to proceed smoothly.

*Procedure.* After providing informed consent, subjects answered questionnaires assessing their mood and driving attitudes. Next, baseline measures of heart rate and blood pressure were taken over a time interval of 10 minutes. Then, participants were familiarized with the driving simulator using a standardized 20-minute adaptation sequence. After finishing the familiarization, half of the drivers received non-contingent instructions that emphasized safely driving to a rest stop six miles down the road. The remaining drivers received contingent instructions that added a \$10 monetary incentive if they arrived at the rest stop faster than half of the prior participants. Incentive was used to increase the stress level of the participants, and subjects were randomly assigned to the two incentive conditions. Order of regular-flow and irregular-flow driving conditions were counterbalanced across participants. After driving the first

scenario, participants completed a driving anger questionnaire, took a five-minute break, and then proceeded to drive in the second scenario. After finishing both driving scenarios, subjects answered a battery of driving-related questionnaires.

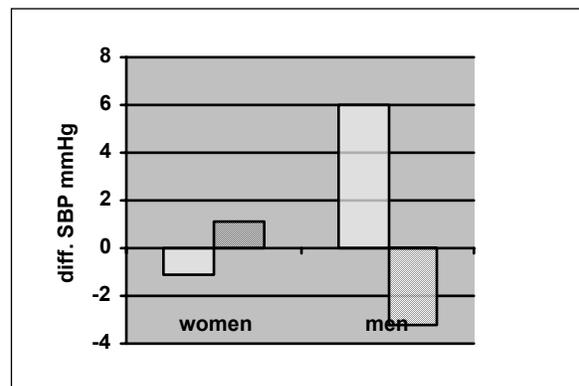
*Measures.* Before and while performing the simulated driving task, measures associated with cardiovascular reactivity (systolic/diastolic blood pressure, heart rate) were recorded. After finishing a scenario, we measured the driving-related anger of the participants with questionnaires. Additionally, we measured driving attitudes, aggression and anger at the end of the study.

*Design.* The study used a 2 x 2 factorial design with driving condition (regular flow v irregular flow) as a within-subjects factor and incentive (low vs high) as a between-subjects factor.

## RESULTS

*Manipulation check.* We performed a manipulation check of the independent variables by analyzing the subjective effort of driving (NASA TLX item 5: effort) and asked subjects if they understood that receiving the \$10 incentive was related to their performance. Driving in the irregular traffic condition was perceived as more effortful (4.3 (2.2)) than driving in the regular traffic flow (3.6 (2.2)) ( $F(1,43)=8.3$ ;  $p<.01$ ). Participants in the incentive condition were convinced that their performance was central for receiving the \$10 incentive (3.6 (1.9)), whereas participants in the non-incentive condition (1.4 (1.9)) were not ( $F(1,43)=60.1$ ;  $p<.01$ ).

*Cardiovascular reactivity.* Our first analysis focused on cardiovascular reactivity to determine if the measure varied as a function of incentive and driving condition. Analyses were performed for systolic and diastolic blood pressures and heart rate. A significant incentive by sex interaction for systolic blood pressure reactivity ( $F(1, 37) = 5.26$ ,  $p<.05$ ) indicated that males in the contingent incentive condition displayed greater SBP responses (+6.05 mmHg) than males in the non-contingent incentive condition (-3.18 mmHg) or females in the contingent incentive condition (-1.07 mmHg) (Figure 1). Contingent versus non-contingent incentives had no effect on females' SBP response (-1.07 mmHg vs. + 1.14 mmHg). A similar pattern emerged for diastolic blood pressure. These findings are consistent with the literature on social cognitive factors and stressors and their effects on cardiovascular reactivity.



*Driving anger.* Our second analysis examined whether incentives (stress) and driving condition lead to increased anger during simulated driving. Analyses of driving-related anger were conducted with incentive and driving condition as independent variables. The analyses revealed that there was no difference in driving anger as a function of driving condition or incentive (all  $F$ 's < 2).

Based on the results of the previous analyses, we were interested in exploring the factors that are related to self-reported anger in the literature (e.g., frustration, incentives and time pressure) and why these factors did not manifest themselves in the present study. To answer this question we took a more individual-centered approach in analyzing the data.

We were interested in how much anger participants expressed after driving in both driving conditions. Anger did not differ as a function of condition or gender (Table 1) (all F's <1). This lack of a difference may be attributed to a floor effect, with subjects expressing low anger due to weak effects of the experimental manipulation of driving condition and incentive.

	Regular flow	Irregular flow
Female	5.8 (2.5)	5.2 (2.3)
Male	6.0 (2.3)	5.5 (2.4)

**Table 1. Means and standard deviations (sd) of anger for driving condition and gender**

	Regular flow	
Irregular flow	anger low	anger high
anger low	35	1
anger high	4	5

**Table 2. Number of participants categorized as low/high in anger as a function of condition**

An alternative possibility is that only a subset of drivers were affected by the factors manipulated in the study, and therefore only minimal changes in the means for anger can be observed. To test this explanation we categorized participants as being average or high (one sd above mean) on the anger scale. We analyzed the number of participants whose anger changed after driving (Table 2). Of interest is the cell containing participants expressing average anger after driving in the regular flow condition, but high anger after driving in the irregular traffic flow condition. Participants in this cell were showing an increase in anger as a function of the driving condition.

## DISCUSSION

The goal of this research was twofold: we sought to identify conditions that were precursors to aggressive driving and to develop an experimental paradigm to study road rage and aggressive driving in a controlled laboratory setting.

The present study successfully demonstrated that stress (incentive) and driving conditions are precursors for aggressive driving/road rage as demonstrated by participants' cardiovascular reactivity. Men were vulnerable to stress (incentive) and driving condition as indicated by elevated blood pressure, while women did not show a cardiovascular response. These findings are consistent with findings that aggressive driving is predominantly displayed by male drivers (Mitzell, 1997). In the present study, only some participants' anger was affected by driving condition, as indicated by changes in anger. There are several potential explanations for this discrepancy: one is that the observed floor effect of anger is due to a lack of sensitivity of the questionnaire, while the psycho-physiological measures are more sensitive to changes in emotions. Another explanation is that only particular participants are vulnerable to driving conditions and stress (incentive) and as a result express anger. A third explanation is that the manipulation of incentive and driving condition were not sufficient to induce high levels of anger. Future studies would profit by increasing the incentive and by selecting participants who are more prone to road rage.

Taken together, the findings of the present study provide first evidence that the phenomenon of aggressive driving and road rage can be studied in controlled laboratory settings.

## REFERENCES

- American Automobile Association. (1997). Aggressive driving: Three studies. Washington, DC.
- Ellison, P.A., Govern, J.M., Petri, H.L., & Figler, M.H. (1995). Anonymity and Aggressive Driving Behavior: A Field Study. *Journal of Social Behavior and Personality*, 10, 265-272.
- Deffenbacher, J.L., Oetting, E.R., & Lynch, R.S. (1996). Development of a driving anger scale. *Psychological Reports*, 74, 83-91.
- Levenson, R.W. & Ruef, Anna M. (1997). Physiological aspects of emotional knowledge and rapport. In: Ickes, W.J. (Ed); *Empathic accuracy*. New York: Guilford Press, pp. 44-72.
- Martinez, R. (1997). *Statement of the Honorable R. Martinez of the NTSA*. U.S. House of Representatives.
- Mizell, L. (1997). *Aggressive Driving*. Report for the AAA Foundation for Traffic Safety.