Journal of Experimental Social Psychology 73 (2017) 82–85

Contents lists available at ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

FlashReport

The weapons effect on wheels: Motorists drive more aggressively when there is a gun in the vehicle☆

Brad J. Bushman[a,*], Thomas Kerwin[b], Tyler Whitlock[c], Janet M. Weisenberger[d]

[a] School of Communication and Department of Psychology, The Ohio State University, USA
[b] Driving Simulation Laboratory, The Ohio State University, USA
[c] Department of Psychology, The Ohio State University, USA
[d] Department of Speech and Hearing Science, The Ohio State University, USA

ARTICLE INFO

Keywords:
Weapons effect
Aggressive driving
Road rage
Driving simulator

ABSTRACT

In discussions about guns, one factor rarely considered is the fact that merely seeing a gun can increase aggression. This effect—called the "weapons effect"—was first demonstrated in a 1967 study, and has been replicated many times since then. The present experiment used a driving simulator to provide a novel test of the weapons effect. One of the most dangerous activities people engage in is driving a vehicle, and survey studies indicate that driving might be more dangerous if there is a gun in the vehicle. In this experiment, participants (N = 60) were randomly assigned to drive a frustrating driving scenario with a gun or a tennis racket in the vehicle's passenger seat. Participants drove more aggressively when there was a gun in the vehicle than when there was a tennis racket in the vehicle. These findings suggest that the mere presence of a gun can make drivers more aggressive.

1. The weapons effect on wheels: motorists drive more aggressively when there is a gun in the vehicle

In gun control discussions, one factor that is rarely considered is the fact that merely seeing a gun can make people more aggressive. This effect—called the "weapons effect"—was first demonstrated by Berkowitz and LePage (1967). In their seminal study, male college students evaluated each other's performance on a task using unpleasant electrical shocks. However, one of the participants was actually an accomplice. First, the accomplice evaluated the participant's performance by using either 1 shock (low anger condition) or 7 shocks (high anger condition). Next, the participant "evaluated" the accomplice's performance, which was the aggression measure. The participant was seated at a table that had a shotgun and a handgun on it, or badminton racquets and shuttlecocks. The items on the table were described as part of another study that another experimenter had supposedly forgotten to put away. There was also a control condition with no items on the table. The experimenter told participants to ignore the items on the table, but they apparently could not. Angered participants who saw the guns were significantly more aggressive than the other participants. Aggression levels did not differ for participants who saw the badminton racquets and shuttlecocks on the table, and those who saw no items on the table.

The weapons effect has been replicated many times, both inside and outside the lab (Benjamin, Kepes, & Bushman, 2017). The present study provides a novel experimental test of the weapons effect using a manipulation similar to the one used by Berkowitz and LePage (1967), but in a driving simulator car.

1.1. Aggressive driving and road rage

Driving a car is the most dangerous behavior most people engage in every day. According to the World Health Organization (WHO), about 1.25 million people die each year as a result of road traffic crashes, and they are the leading cause of death among 15 to 29 year olds (WHO, 2016). The leading cause of traffic crashes and injuries is aggressive driving, which accounts for more than half of all traffic fatalities (American Automobile Association, n.d.).

The National Highway Traffic Safety Administration (NHTSA) defines *aggressive driving* as "the operation of a motor vehicle in a manner which endangers or is likely to endanger persons or property" (NHTSA,

☆ Author Note: We would like to thank the employees of the Driving Simulation Lab for their help conducting this study, especially Kevin Smearsoll for his javascript help on the mimic car and traffic light obstacles. This study was supported by a Social and Behavioral Sciences Undergraduate Research Grant, College of Arts and Sciences to Tyler Whitlock, who is now at Wright State University.
The data for this study are available at https://doi.org/10.6084/m9.figshare.5086885.v1.

* Corresponding author at: School of Communication, The Ohio State University, 3016 Derby Hall, 154 North Oval Mall, Columbus, OH, USA.
E-mail address: bushman.20@osu.edu (B.J. Bushman).

http://dx.doi.org/10.1016/j.jesp.2017.06.007
Received 27 March 2017; Received in revised form 6 June 2017; Accepted 9 June 2017

2016, 2017). Examples include speeding, tailgating, blocking other drivers, driving off the road, running red lights or stop signs, honking horns, flashing bright headlights, making obscene gestures, and cursing or shouting angrily at other drivers.

The NHTSA defines *road rage* as "an assault with a motor vehicle or other dangerous weapon by the operator or passenger(s) of one motor vehicle on the operator or passengers(s) of another motor vehicle or vehicles precipitated by an incident which occurred on a roadway" (NHTSA, 2016, 2017). Examples include colliding into other vehicles or pedestrians. Road rage is a criminal offense. The present driving simulation experiment examined instances of both aggressive driving and road rage.

1.2. Survey evidence linking guns to aggressive driving

Survey research shows that drivers with guns in their vehicles are more aggressive drivers than drivers without guns in their vehicles. For example, a random-digit dialing survey of 2770 American drivers found that drivers who had a gun in their vehicle at least once in the past year were significantly more likely than drivers with no gun in their vehicle in the past year to make obscene gestures at other drivers (23% vs. 16%), tailgate (14% vs. 8%), or both (6.3% vs. 2.8%), even after controlling for many other factors related to aggressive driving, such as gender, age, urbanization, census region, and driving frequency (Hemenway, Vriniotis, & Miller, 2006). A random-digit dialing study of 790 Arizona drivers found similar results (Miller, Azrael, Hemenway, & Solop, 2002). However, causal inferences are difficult to make from these survey studies. Thus, we used an experimental design to test whether the mere presence of a gun increases aggressive driving.

1.3. Driving simulators

Because it is unethical to conduct experimental studies of aggressive driving using real vehicles on the road, this experiment used a driving simulator. Previous research has shown that driving behavior in simulators closely mirrors driving behavior in actual vehicles. A review of the available evidence concluded that driving simulators "provide a valid tool for assessing a variety of driving performance measures such as speed, lateral position, brake onset, divided, attention, and risky traffic behaviors" (Mullen, Charlton, Devlin, & Bedard, 2011, p. 13–1). This driving simulation experiment recorded speed, brake onset (i.e., tailgating), and risky traffic behaviors (e.g., driving off the road).

1.4. Overview

In the present driving simulation experiment, participants were randomly assigned to drive a frustrating scenario with a gun or a tennis racket in the passenger seat. We predicted that participants would drive more aggressively when there was a gun on the passenger seat than when there was a tennis racket on the passenger seat.

2. Method

2.1. Participants

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. Data collection in driver simulation experiments is quite expensive. According to NHTSA (2016), the minimum acceptable number of participants for driving simulation studies involving driver distraction from in-vehicle devices (e.g., texting) is 24 participants per group. Our goal was to test 30 participants per group. We continued to test participants until we achieved that goal. A total of 77 participants were tested, but 17 did not complete the study (9 experienced motion sickness, 1 had no experience driving, 6 sessions were terminated due to technical problems with the simulator, and 1 session was terminated due to experimental error). The final sample consisted of 60 university students (23 men in gun condition, 22 men in tennis racket condition, 7 women in gun condition, 8 women in tennis racket condition).

2.2. Procedure

Participants were tested individually. Prior to the experiment, participants reported their gender and completed the short Aggression Questionnaire (Bryant & Smith, 2001), which contains 12 items (e.g., "Given enough provocation, I may hit another person," "I can't help getting into arguments when people disagree with me"; 1 = *extremely uncharacteristic of me* to 5 = *extremely characteristic of me*; Cronbach $\alpha = .84$). We wanted to test whether the mere presence of a gun would increase aggressive driving above and beyond gender and any pre-existing aggressive tendencies of participants.

Participants were told that the researchers were studying how people behave in various driving situations. By the flip of a coin, participants were randomly assigned to a gun or no gun condition. In the gun condition, there was an unloaded black airsoft training pistol on the passenger seat, which looks like a real 9 mm semi-automatic handgun (i.e., same color, size, appearance, weight, texture). The experimenter looked at the gun and said, "I told the other experimenter to clean up after himself, but he must have forgot. Please leave that gun exactly where it is. It is unloaded. It is for a different study involving police officers." In the no gun condition, the experimenter said: "I told the other experimenter to clean up after himself, but he must have forgot. Please leave that tennis racket exactly where it is. It is for a different study." This manipulation is very similar to the one used by Berkowitz and LePage (1967). We did not include a control condition in which there was no object in the seat because Berkowitz and LePage (1967) found no difference in aggressive behavior between participants in the no-object control condition and participants in the sports equipment condition.[1]

Details about the driving simulator are in the Supplemental Materials section. The driving scenario mimicked a two-lane road with a posted speed limit of 60 miles per hour—mph (96.6 km per hour—kph). The simulated traffic was programmed to have an average speed of 55 mph (88.5 kph). Five frustrating events were programmed to take place at pre-determined spots in the driving scenario: (1) a car pulled out in front of the participant from a side-road, (2) traffic jam, (3) construction zone, (4) a mimic car that copied the participant's car, and (5) a short traffic light. Each frustrating event occurred once.

Although all the other cars were computer generated and controlled, participants were told that other participants were driving some of the other cars. This made the driving situation more realistic, and gave participants targets for their anger and aggression.

After 3–5 min of practice, the participant drove the simulated scenario. All participants were told to get to the end of scenario as quickly as possible, and that the top two finishers would each receive a $25 gift card. Participants took 15–25 min. A debriefing followed. No participants expressed suspicion about the object on the passenger seat, or about some cars being controlled by other participants.

[1] As an exploratory variable, we also manipulated whether the billboards in the driving scenario contained advertisements for alcoholic or nonalcoholic beverages. We averaged across billboard conditions because there was no interaction between type of billboard and type of object on the seat for any of the dependent variables ($ps > 0.19$). Unfortunately, there was a serious confound with the billboard manipulation. Namely, the alcohol billboards were more interesting and noticeable than the non-alcoholic billboards. We are planning a replication study about the effects of alcohol-related cues on aggressive driving, but using a similar manipulation to the one reported in this article. Specifically, we plan to put either a case of beer or a case of water on the passenger seat. In this study, we also included a measure of narcissism, which was positively related to aggressive driving. Those findings are reported in another article, along with two other studies that investigated the link between narcissism and aggressive driving (Bushman, Steffgen, Kerwin, Whitlack, & Weisenberger, 2017).

3. Results

3.1. Gender and trait aggressiveness

Males were more aggressive drivers than females, and trait aggressiveness was positively related to aggressive driving. However, neither gender nor trait aggressiveness were significant covariates for any of the dependent variables ($ps > 0.105$ for gender; $ps > 0.211$ for trait aggressiveness). In addition, the same pattern of results was obtained with and without the covariates. Thus, we report the simpler analyses that exclude gender and trait aggressiveness as covariates.

3.2. Primary analyses

We used two primary measures of aggressive driving—tailgating and speeding. We also analyzed other, less frequent measures of aggressive driving. We were able to analyze one measure of road rage—colliding into other vehicles.

3.2.1. Tailgating

We used three tailgating measures based on the number of seconds between the participant's car and the car in front of them. It is widely recommended that drivers use a 4-s following rule at speeds above 30 mph (48.3 kph), in heavy traffic, or when there are many obstacles (Nationwide, n.d.), as in the present driving scenario. Under normal driving conditions and speeds below 30 mph, a 3-second rule is recommended. For speeds above 30 mph, a 3-second rule is considered risky and dangerous. We also considered a 2-second rule, which is considered extremely risky and dangerous. Tailgating was specifically calculated as the proportion of time participants broke each of the three rules: 4-s (low aggression), 3-s (moderate aggression), and 2-s (high aggression).

All three tailgating measures were analyzed using a 2 (Item: gun, tennis racket) × 5 (Frustrating event: car pull out, traffic jam, construction zone, mimic car, short traffic light) mixed Analysis of Variance (ANOVA), with item as a between-subjects factor and frustrating event as a within-subjects factor (Table 1).

As can be seen in Fig. 1, drivers were more likely to tailgate when there was a gun on the passenger seat than when there was a tennis racket on the passenger seat. The difference was significant for highly aggressive (2-s) tailgating ($p = 0.022$, $d = 0.61$), and for moderately aggressive (3-s) tailgating ($p = 0.0413$, $d = 0.54$), and was nearly significant for low aggressive (4-s) tailgating ($p = 0.0982$, $d = 0.43$). There were large differences in tailgating for the different frustrations. Tailgating was most likely to occur in the traffic jam, and was least likely to occur in the construction zone, but a gun increased tailgating across all obstacles. The mere presence of a gun increased aggressive tailgating regardless of the frustrating event participants encountered in the driving scenario.

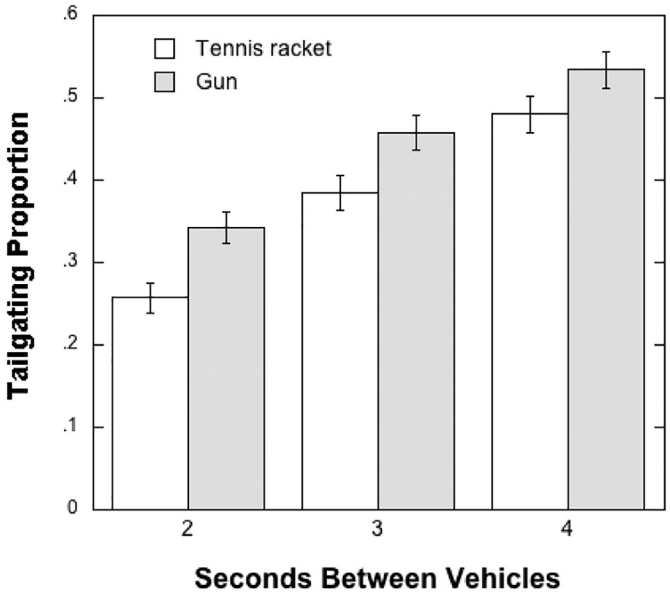

Fig. 1. Effect of item on passenger seat (gun vs. tennis racket) on tailgating. We measured whether there was at least 2 s, 3 s, and 4 s between the participant's vehicle and the vehicle they were following. Capped vertical bars denote 1 standard error.

3.2.2. Speeding

Average speed is a poor measure of speeding because it depends heavily on random influences. Instead, we used a relatively high speed cutoff before averaging because it removes the variability due to traffic when the participant is not travelling at a high speed. We chose 50 mph (80.5 kph) because it included all participants. A 55 mph cutoff excluded some participants that never drove over 55 mph.

Speeding was also analyzed using a 2 × 5 mixed ANOVA (Table 1). As expected, participants tended to drive faster (over 50 mph) when a gun was on the passenger seat ($M = 64.3$ mph, $SD = 4.9$) than when a tennis racket was on the passenger seat ($M = 62.3$ mph, $SD = 3.66$), although the difference was not quite significant ($p = 0.0846$, $d = 0.45$). As with tailgating, there were large differences in driving speed for the different frustrating events. In particular, driving speed was slowest in the traffic jam. The mere presence of a gun increased speeding regardless of the frustrating event participants encountered in the driving scenario.

3.2.3. Other measures of aggressive driving

Other less common measures of aggressive driving were combined to reduce the probability of Type I errors that could occur by conducting multiple tests for separate measures. These included off-road driving (e.g., crossing the double solid yellow lines into oncoming traffic, driving on the shoulder), attempting to honk the horn, verbal aggression (e.g., “This guy's a dickhead”), and aggressive gestures (e.g., giving another driver the middle finger). A Poisson regression showed that the number of aggressive actions increased by 1.82 times ($p = 0.0243$) when a gun was in the car ($M = 1.33$, $SE = 0.21$) than when a tennis racket was in the car ($M = 0.73$, $SE = 0.16$).

Table 1
ANOVA results for the different outcome measures. The covariates gender and trait aggressiveness were excluded from the model.

Source	Speeding	2-s between vehicles	3-s between vehicles	4-s between vehicles
Item	$F(1,58) = 3.08$, $p = 0.0846$, $\eta^2 = 0.036$	$F(1,58) = 5.54$, $p = 0.022$, $\eta^2 = 0.045$	$F(1,58) = 4.35$, $p = 0.0413$, $\eta^2 = 0.033$	$F(1,58) = 2.82$, $p = 0.0982$, $\eta^2 = 0.020$
Frustrating event	$F(4232) = 20.70$, $p < 0.0001$, $\eta^2 = 0.094$	$F(4232) = 27.00$, $p < 0.0001$, $\eta^2 = 0.19$	$F(4232) = 42.00$, $p < 0.0001$, $\eta^2 = 0.28$	$F(4232) = 52.70$, $p < 0.0001$, $\eta^2 = 0.35$
Item × frustrating event	$F(4232) = 1.83$, $p = 0.125$, $\eta^2 = 0.0091$	$F(4232) = 2.20$, $p = 0.0699$, $\eta^2 = 0.019$	$F(4232) = 1.97$, $p = 0.100$, $\eta^2 = 0.018$	$F(4232) = 2.22$, $p = 0.0679$, $\eta^2 = 0.022$

Note. $N = 60$ ($n = 30$ in the gun condition; $n = 30$ in the tennis racket condition).

3.2.4. Road rage

Three participants collided into another driver, two in the gun condition and one in the tennis racket condition.

4. Discussion

Consistent with a large body research showing that people are more aggressive in the mere presence of a gun (Benjamin et al., 2017), the present experiment showed that people drove more aggressively when a gun was present in their car — even though they did not put the gun there. There was a strong convergence across the different measures of aggressive diving, which are the same aggressive driving measures used by NHTSA. Several participants clearly became angry during the driving scenario (e.g., one participant grabbed the unloaded gun and shot it at another driver).

Although some effects were not statistically significant, they were not trivial in size. All of the effects exceeded the 50th percentile (d = 0.38, Lipsey & Wilson, 1993), and most were "moderate" in size (d = 0.50, Cohen, 1988).

4.1. Limitations

This study, like all studies, has limitations. One main limitation is the small sample size. However, collecting large samples in driving simulation experiments is very costly and labor intensive. A second limitation is that some acts of driver aggression were not measured. For example, we could not measure honking horn or flashing lights because these devices were disabled on the car we used. A third limitation is that we did not measure underlying processes. The primary theoretical explanation for the weapons effect is that weapons prime or activate aggressive thoughts in memory (Benjamin & Bushman, 2016). To reduce suspicion, the present study did not measure the accessibility of aggressive thoughts. However, a recent meta-analysis provided strong support for the priming explanation of the weapons effect (Benjamin et al., 2017).

5. Conclusion

This exploratory study shows that the mere presence of a gun in a vehicle can cause motorists drive more aggressively. Additional research is needed to explore in more detail the weapons effect on aggressive driving (e.g., whether the weapon is concealed or visible). It is clear that a more comprehensive picture of the factors that cause, as well as mitigate, aggressive driving is needed, to create a safer driving environment for everyone.

Author Note

We would like to thank the employees of the Driving Simulation Lab for their help conducting this study, especially Kevin Smearsoll for his javascript help on the mimic car and traffic light obstacles. This study was supported by a Social and Behavioral Sciences Undergraduate Research Grant, College of Arts and Sciences to Tyler Whitlock, who is now at Wright State University.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jesp.2017.06.007.

References

American Automobile Association (n.d.), Aggressive driving. Retrieved from https://www.aaafoundation.org/aggressive-driving

Benjamin, A. J., Jr., & Bushman, B. J. (2016). The weapons priming effect. *Current Opinion in Psychology*, *12*, 45–48.

Benjamin, A. J., Jr., Kepes, S., & Bushman, B. J. (2017). Effects of weapons on aggressive thoughts, angry feelings, hostile appraisals, and aggressive behavior: A meta-analytic review of the weapons effect literature. *Personality and Social Psychology Review* (in press).

Berkowitz, L., & LePage, A. (1967). Weapons as aggression-eliciting stimuli. *Journal of Personality and Social Psychology*, *7*, 202–207. http://dx.doi.org/10.1037/h0025008.

Bryant, F. B., & Smith, B. D. (2001). Refining the architecture of aggression: A measurement model for the Buss-Perry Aggression Questionnaire. *Journal of Research in Personality*, *35*(2), 138–167. http://dx.doi.org/10.1006/jrpe.2000.2302.

Bushman, B. J., Steffgen, G., Kerwin, T., Whitlack, T., & Weisenberger, J. M. (2017). *"Don't you know i own the road?" The link between narcissism and aggressive driving.* (Manuscript under review).

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed). Hillsdale, NJ: Lawrence Erlbaum.

Hemenway, D., Vriniotis, M., & Miller, M. (2006). Is an armed society a polite society? Guns and road rage. *Accident Analysis and Prevention*, *38*(4), 687–695. http://dx.doi.org/10.1016/j.aap.2005.12.014.

Lipsey, M. W., & Wilson, D. B. (1993). The efficacy of psychological, educational, and behavioral treatment. Confirmation from meta-analysis. *American Psychologist*, *48*(12), 1181–1209. http://dx.doi.org/10.1037//0003-066X.48.12.1181.

Miller, M., Azrael, D., Hemenway, D., & Solop, F. I. (2002). 'Road rage' in Arizona: Armed and dangerous. *Accident Analysis and Prevention*, *34*(6), 807–814. http://dx.doi.org/10.1016/S0001-4575(01)00080-X.

Mullen, N., Charlton, J., Devlin, A., & Bedard, M. (2011). Simulator validity: Behaviors observed on the simulator and on the road. In D. L. Fisher, M. Rizzo, J. K. Caird, & J. D. Lee (Eds.), *Handbook of driving simulation for engineering, medicine, and psychology* (pp. 13-1–13-18). Boca Raton, FL: Taylor and Francis.

National Highway Traffic Safety Administration (2016). Visual-manual driver distraction guidelines for portable and aftermarket devices. *Federal Register*. , December 5). Retrieved from https://www.federalregister.gov/documents/2016/12/05/2016-29051/visual-manual-nhtsa-driver-distraction-guidelines-for-portable-and-aftermarket-devices.

National Highway Traffic Safety Administration (2017). Retrieved from https://www.nhtsa.gov/.

Nationwide.com, n.d. Safe following distance Retrieved from (https://www.nationwide.com/teen-driving-following-distance.jsp)