Traffic Injury Prevention, 12:235–238, 2011

ISSN: 1538-9588 print / 1538-957X online
DOI: 10.1080/15389588.2011.562945

Taylor & Francis
Taylor & Francis Group

Toward Understanding On-Road Interactions of Male and Female Drivers

MICHAEL SIVAK and BRANDON SCHOETTLE
The University of Michigan Transportation Research Institute, Ann Arbor, Michigan

Objective: *This study examined gender effects in six geometric scenarios of 2-vehicle crashes in which an involved driver could potentially ascertain the gender of the other driver prior to the crash.*

Method: *The actual frequencies of different combinations of the involved male and female drivers in these crash scenarios were compared with the expected frequencies if there were no gender interactions. The expected frequencies were based on annual distance driven for personal travel by male and female drivers.*

Results: *The results indicate that in certain crash scenarios, male-to-male crashes tend to be underrepresented and female-to-female crashes tend to be overrepresented.*

Conclusions: *The obtained pattern of results could be due to either differential gender exposure to the different scenarios, differential gender capabilities to handle specific scenarios, or differential gender expectations of actions by other drivers based on their gender. The current lack of information on gender exposure in different scenarios, scenario-specific driver skills, and driver expectations based on other drivers' gender prevents ruling out any of these possible explanations.*

Keywords Two-vehicle crashes; Gender differences; Exposure; Skills; Expectations

INTRODUCTION

The likelihood that a given driver will be involved in a 2-vehicle crash depends on a variety of driver, vehicular, and environmental factors (Elvik et al. 2009; Evans 2004; Shinar 2007). There are 3 dominant driver-related factors: (1) the exposure, or the probability of being at the wrong place at the wrong time; (2) one's own driving skills; and (3) the driving skills of the other involved driver.

Success in handling on-road conflicts depends not only on psychomotor ability but also on the outcome of complex social interactions between traffic participants. In turn, these interactions are influenced by expectations based on prior experience. For example, though drivers are generally not surprised to see a sports car weaving through a multilane roadway, they may not expect to see this behavior from a driver in a minivan. Another set of common stereotypical expectations that drivers (especially experienced ones) have concerns the behavior of male and female drivers.

Stereotypical expectations are important for 2 reasons. On one hand, if drivers follow the expected stereotypical behaviors, others respond more readily because they are primed to do so. On the other hand, if drivers do not follow what is expected of them (especially if what is expected is a benign nonaction), delayed reaction is likely.

This exploratory study was designed to examine crash records for evidence that would be *consistent* with possible gender interactions. Specifically, the study explored the involvement of male and female drivers in selected 2-vehicle crash scenarios in which a driver could make a visual determination of the gender of the other driver. However, this study was not designed to *isolate* the effects of exposure, skills, and expectations.

METHOD

Approach

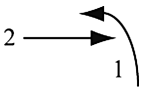
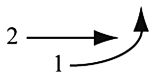
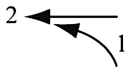
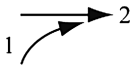
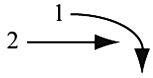
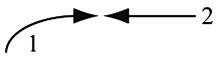
The approach involved an analysis by gender of drivers in selected 2-vehicle crashes in which an involved driver could potentially ascertain the gender of the other driver prior to the crash. The actual frequencies of different combinations of the involved male and female drivers in these crash scenarios were compared with the expected frequencies if there were no gender interactions. The expected frequencies were based on annual distance driven for personal travel by male and female drivers.

Data Sources

Crashes. Crash records of the General Estimate System (GES) were examined. Data for the GES come from a nationally representative sample of police-reported crashes of all types, ranging from property damage only to fatal. The analysis

Received 28 January 2011; accepted 10 February 2011.
Address correspondence to Michael Sivak, The University of Michigan Transportation Research Institute, 2901 Baxter Rd., Ann Arbor, MI 48109-2150. E-mail: sivak@umich.edu

Table I Examined 2-vehicle crash scenarios

Scenario	Maneuver	*N*
1		3 131 243
2		862 849
3		850 205
4		850 035
5		500 119
6		300 948

included data for daylight crashes that involved 2 light-duty vehicles. The weighted data for 20 years (1988 through 2007) were used. The examined crash scenarios were selected because in these scenarios the relative geometry and the relative speed could allow a driver to make a visual determination of the gender of the other driver. The selected 6 scenarios are shown in Table I.

Distance driven. The annual mileage driven by gender was obtained from the National Household Travel Survey (Department of Transportation 2001).

RESULTS

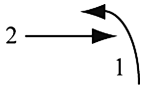
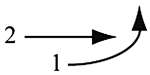
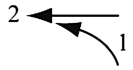
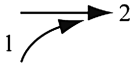
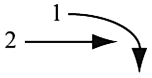
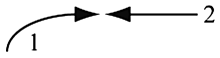
Expected Involvement of Male and Female Drivers in 2-Vehicle Crash Scenarios

According to the 2001 National Household Travel Survey (Department of Transportation 2001), for the period between 7:00 am and 6:59 pm (the operational definition of "daytime" in this study), 60.2 percent of the distance driven was performed by male drivers and 39.8 percent by female drivers. (In comparison, the corresponding percentages for the entire 24 hours are 62.0 and 38.0, respectively.) Consequently, the expected involvement by gender in 2-vehicle crashes is given in Table II. (For example, the expected percentage of crashes that involve 2 male drivers is given by $0.602 \times 0.602 \times 100 = 36.2\%$.)

Table II Expected involvement by gender in 2-vehicle crashes if there were no gender interactions

Driver 1	Driver 2	Percentage of crashes
Male	Male	36.2
Female	Female	15.8
Male	Female	24.0
Female	Male	24.0

Table III Involvement of male and female drivers in the examined crash scenarios. The entries are percentages that sum to 100 for each scenario

		Driver 1–Driver 2			
Scenario	Maneuver	M–M	F–F	M–F	F–M
1		28.0	23.7	21.8	26.5
2		31.5	20.0	20.5	28.0
3		29.8	22.6	24.5	23.1
4		28.3	24.1	22.6	25.0
5		36.5	15.7	23.9	23.9
6		37.4	17.0	25.6	19.9
Expected involvement		36.2	15.8	24.0	24.0

The expected involvement shown in Table II is based on the assumptions that male and female drivers are (1) equally likely to be involved in the maneuvers in question and under the same conditions (eg, weather, speed, etc.), (2) equally skillful in performing the maneuvers, and (3) equally successful in compensating for the behavior of the other driver involved regardless of gender.

Actual Involvement of Male and Female Drivers in the Examined 2-Vehicle Crash Scenarios

The involvement of male and female drivers in the examined crash scenarios is listed in Table III.

General Tendencies for Crash Over- and Underinvolvement

Over- and underinvolvement of male and female drivers in the examined scenarios is quantified in Table IV. The entries in Table IV are percentage changes from the expected frequencies.

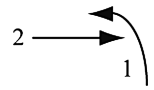
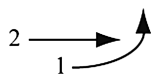
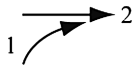
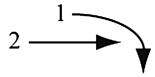
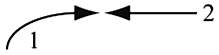
The general patterns (not necessarily holding for all scenarios) are as follows:

1. Female-to-female crashes tend to be overrepresented.
2. Male-to-male crashes tend to be underrepresented.
3. The frequencies of male-to-female and female-to-male crashes tend to be close to the expected frequencies.

Crash Over- and Underinvolvement by Scenarios

Over- and underinvolvements by more than 20 percent (an arbitrary cutoff) are highlighted in bold and italics in Table V.

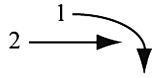
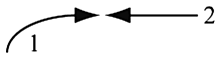
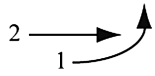
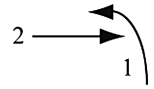
Table IV Over- and underinvolvement of male and female drivers in the examined crash scenarios. The entries are percentage changes from the expected frequencies

Scenario	Maneuver	Driver 1–Driver 2 M–M	F–F	M–F	F–M
1		−23	+50	−9	+10
2		−13	+26	−15	+17
3		−18	+42	+2	−4
4		−22	+52	−6	+4
5		+1	−1	0	0
6		+3	+7	+7	−17

Below, scenarios with similar patterns of crash involvement by gender are grouped together.

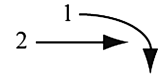
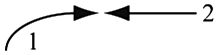
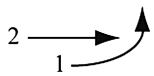
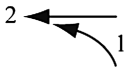
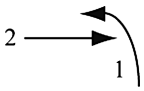
- *Close to the expected involvement in all four gender combinations.* Scenarios 5 and 6 exhibit close to the expected involvement in all 4 gender combinations.

Table V Over- and underinvolvement of males and females in the examined crash scenarios. The entries are percentage changes from the expected frequencies

Scenario	Maneuver	Driver 1–Driver 2 M–M	F–F	M–F	F–M
5		+1	−1	0	0
6		+3	+7	+7	−17
2		−13	**+26**	−15	+17
3		−18	**+42**	+2	−4
1		*−23*	**+50**	−9	+10
4		*−22*	**+52**	−6	+4

Note: Overinvolvements by more than 20 percent are in bold, and underinvolvements by more than 20 percent are in italics.

Table VI Characteristics of the maneuvers

Scenario	Maneuver	Direction of the approach of driver 1	Path	Original relative angle (degrees)	Relative speed
5		Left	Across	0	Small
6		Left	Into	90	Medium
2		Right	Across	0	Small
3		Left	Into	90	Medium
1		Right	Across	90	Medium
4		Right	Into	90	Medium

- *Overinvolvement in female-to-female crashes.* Scenarios 2 and 3 show a substantial overinvolvement in female-to-female crashes.
- *Overinvolvement in female-to-female crashes and underinvolvement in male-to-male crashes.* Scenarios 1 and 4 show both a substantial overinvolvement in female-to-female crashes and a substantial underinvolvement in male-to-male crashes.

DISCUSSION

Geometric Configuration and Relative Speed

Table VI categorizes the examined scenarios in terms of the direction of the approach of driver 1 (relative to driver 2), relative paths, original relative angle, and relative speed. (The direction of the approach was considered, because drivers in left-hand-drive vehicles tend to pay more attention to the left than to the right, and the visibility is generally better to the left than to the right.) However, no pattern appears to be evident in Table VI to explain the grouping of scenarios by gender interactions evident in Table V.

Driver Stature and Visibility Out of the Cabin

On average, females have shorter stature than do males. In turn, driver stature affects the visibility out of the cabin. However, stature is unlikely to account for the patterns in Table V given that scenarios 2 and 5, which are mirror images of each other, exhibit different crash patterns.

Frequency of Crashes

The 4 most frequent crash types (scenarios 1, 2, 3, and 4; see Table I) show the strongest gender interactions, whereas the 2

least frequent crash types (scenarios 5 and 6) exhibit no or only weak interactions.

Exposure

The simplest explanatory hypothesis would posit that the results reflect the differential exposure of male and female drivers to the examined scenarios. Indeed, the obtained patterns are qualitatively consistent with such a hypothesis. For example, let's consider scenario 1. If males were less likely than females to attempt such a maneuver, one would expect that (1) male-to-male crashes would be underrepresented, (2) female-to-female crashes would be overrepresented, and (3) male-to-female and female-to-male crashes would be in between these 2 extremes.

Gender Effects on the Overall Fatality Rate and on Driving Skills

In the United States, the fatality rate per distance driven is higher for males than for females (eg, Massie et al. 1995). However, whether this difference reflects gender differences in exposure to more challenging conditions or gender differences in general driving skills is not known. Furthermore, and of particular importance for the present study, no information exists on gender differences in skills specifically relevant for the examined scenarios.

Expectations Based on the Gender of the Other Driver

Only anecdotal evidence exists on driver expectation of actions of other drivers based on their gender. Furthermore, although the examined scenarios were selected in such a way that a visual determination of the gender of the other driver *could* possibly be made, it is unclear in what proportion of actual cases such a determination is made prior to a crash.

Countermeasures

The results indicate that in certain crash scenarios, male-to-male crashes tend to be underrepresented and female-to-female crashes tend to be overrepresented. This pattern of results could be due to either differential gender exposure to the different scenarios, differential gender capabilities to handle specific scenarios, or differential expectations of actions by other drivers based on their gender. The current lack of information on gender exposure in different scenarios, scenario-specific driver skills, and driver expectations based on other drivers' gender prevents ruling out any of these possible explanations. Consequently, identification of countermeasures for the overrepresentation of female-to-female crashes in certain scenarios is contingent on understanding the underlying mechanism(s) for the overrepresentation. This is the case because overrepresentation due to increased exposure would call for different countermeasures than overrepresentation due to differential driver skills or inappropriate driver expectations.

ACKNOWLEDGMENTS

This research was supported by the University of Michigan Sustainable Worldwide Transportation (http://www.umich.edu/~umtriswt).

REFERENCES

Department of Transportation. *National Household Travel Survey*. Available at: http://nhts.ornl.tables/. Accessed October 21, 2009.

Elvik R, Høye A, Vaa T, Sørensen M. *The Handbook of Road Safety Measures.* 2nd ed. Bingley, UK: Emerald Group Publishing; 2009.

Evans L. *Traffic Safety.* Bloomfield Hills, Mich: Science Serving Society; 2004.

Massie DL, Campbell KL, Williams AF. Traffic accident involvement rates by driver age and gender. *Accident Analysis and Prevention* 1995;27:73–87.

Shinar D. *Traffic Safety and Human Behavior*. London, England: Elsevier; 2007.