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# TOWARD UNDERSTANDING ON-ROAD INTERACTIONS BETWEEN MALE AND FEMALE DRIVERS

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16. Abstract

This study examined gender effects in six geometric scenarios of two-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 to 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.

The results indicate that in certain crash scenarios, male-to-male crashes tend to be under-represented and female-to-female crashes tend to be over-represented. 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.

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# Contents

# Introduction

The likelihood that a given driver will be involved in a two-vehicle crash depends on a variety of driver, vehicular, and environmental factors (Elvik, Høye, Vaa, and Sørensen, 2009; Evans, 2004; Shinar, 2007). There are three 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, while drivers are generally not surprised to see a sports car weaving through a multi-lane 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 two 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 non-action), 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 two-vehicle crash scenarios in which the relative geometry and the relative speed could make visual determination of the gender of the other drivers possible. However, this study was not designed to *isolate* the effects of exposure and skills.

# Method

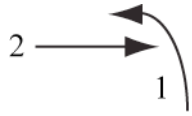
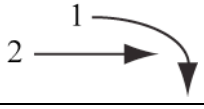
## Approach

The approach involved an analysis by gender of drivers in selected two-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 to 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 included data for daylight crashes that involved two light-duty vehicles. The weighted data for 20 years (1988 through 2007) were used. The six examined crash scenarios are shown in Table 1.

Table 1
Examined two-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 |

*Distance driven.* The annual mileage driven by gender was obtained from the National Household Travel Survey (NHTS, 2001).

## Results

### Expected involvement of male and female drivers in two-vehicle crash scenarios

According to the 2001 National Household Travel Survey (NHTS, 2001), for the period between 7:00 a.m. and 6:59 p.m. (the operational definition of "daytime" in this study), 60.2% of the distance driven was performed by male drivers and 39.8% by female drivers[1]. Consequently, the expected involvement by gender in two-vehicle crashes is given in Table 2. (For example, the expected percentage of crashes that involve two male drivers is given by 0.602 * 0.602 * 100 = 36.2%.)

The expected involvement shown in Table 2 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 (e.g., 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.

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

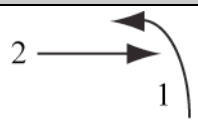
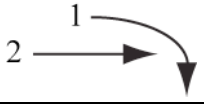
| Driver 1 | Driver 2 | Percentage of crashes |
|---|---|---|
| Male | Male | 36.2 |
| Female | Female | 15.8 |
| Male | Female | 24.0 |
| Female | Male | 24.0 |

[1] In comparison, the corresponding percentages for the entire 24 hours are 62.0 and 38.0, respectively.

**Actual involvement of male and female drivers in the examined two-vehicle crash scenarios**

The involvement of male and female drivers in the examined crash scenarios is listed in Table 3.

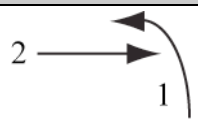
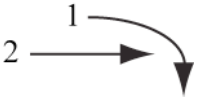
Table 3
Involvement of male and female drivers in the examined crash scenarios.
The entries are percentages that sum to 100 for each scenario.

| Scenario | Maneuver | Driver 1 - Driver 2 | | | |
|---|---|---|---|---|---|
| | | 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 |

**General tendencies for crash over- and under-involvement**

Over- and under-involvement of male and female drivers in the examined scenarios is quantified in Table 4. The entries in Table 4 are percentage changes from the expected frequencies.

Table 4
Over- and under-involvement 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 |

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

(1) Female-to-female crashes tend to be over-represented.

(2) Male-to-male crashes tend to be under-represented.

(3) The frequencies of male-to-female and female-to-male crashes tend to be close to the expected frequencies.

**Crash over- and under-involvement by scenarios**

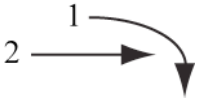
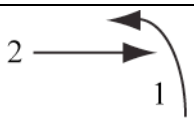
Over- and under-involvements by more than 20% (an arbitrary cutoff) are highlighted in color in Table 5. Below, scenarios with similar patterns of crash involvement by gender are grouped together.

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

*Over-involvement in female-to-female crashes.* Scenarios 2 and 3 show a substantial over-involvement in female-to-female crashes.

*Over-involvement in female-to-female crashes and under-involvement in male-to-male crashes.* Scenarios 1 and 4 show both a substantial over-involvement in female-to-female crashes and a substantial under-involvement in male-to-male crashes.

Table 5
Over- and under-involvement of males and females in the examined crash scenarios. The entries are percentage changes from the expected frequencies. Over-involvements by more than 20% are in red, and under-involvements by more than 20% are in blue.

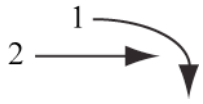
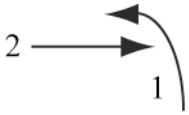
| Scenario | Maneuver | Driver 1 - Driver 2 | | | |
|---|---|---|---|---|---|
| | | M - M | F - F | M - F | F - M |
| 5 |  | +1 | -1 | 0 | 0 |
| 6 |  | +3 | +7 | +7 | -17 |
| 2 |  | -13 | +26 | -15 | +17 |
| 3 |  | -18 | +42 | +2 | -4 |
| 1 |  | -23 | +50 | -9 | +10 |
| 4 |  | -22 | +52 | -6 | +4 |

## Discussion

### Geometric configuration and relative speed

Table 6 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[2]. However, no pattern appears to be evident in Table 6 to explain the grouping of scenarios by gender interactions evident in Table 5.

Table 6
Characteristics of the maneuvers.

| Scenario | Maneuver | Direction of the approach of Driver 1 | Path | Original relative angle | 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 |

[2] 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.

**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 4 given that Scenarios 2 and 5, which are mirror images of each other, exhibit different crash patterns.

**Frequency of crashes**

The four most frequent crash types (Scenarios 1, 2, 3, and 4; see Table 1) show the strongest gender interactions, while the two 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 under-represented, (2) female-to-female crashes would be over-represented, and (3) male-to-female and female-to-male crashes would be in-between these two extremes.

**Gender effects on the overall fatality rate and on driving skills**

In the U.S., the fatality rate per distance driven is higher for males than for females (e.g., Massie, Campbell, and Williams, 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 visual determination of the gender of the other drivers *could* possibly be made, it is unclear in what proportion of actual cases such a determination is made prior to a crash.

## Conclusions

This study examined gender effects in six geometric scenarios of two-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 to 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.

The results indicate that in certain crash scenarios, male-to-male crashes tend to be under-represented and female-to-female crashes tend to be over-represented. 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.

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Massie, D.L., Campbell, K.L., and Williams, A.F. (1995). Traffic accident involvement rates by driver age and gender. *Accident Analysis and Prevention*, *27*, 73-87.

NHTS [National Household Travel Survey]. (2001). Available at: http://nhts.ornl.tables/. Accessed September 30, 2009.

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