

# Health and Transportation: the Dangers and Prevalence of Road Rage within the Transportation System

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**Abstract** Road rage is accepted as a legitimate danger to the safe, effective, and efficient operation of the transportation system, it is important to understand its prevalence, and the characteristics of drivers that can be used to predict potential for it. By distributing a modified version of the Deffenbacher Driving Anger Scale to a wide variety of drivers and compiling the data collected from that, it was possible to determine just how common driving anger and road rage truly were. It was found that nearly all drivers of either gender and any age were prone to at least moderate levels of anger, though specifics about driver commutes, such as length and type of commute, did significantly influence likelihood of experiencing anger. While it is likely impossible to ever eliminate this driving anger entirely, there are measures that can be taken to significantly reduce the frequency of its occurrence. By implementing changes to modern transportation engineering city design and development models, particularly focusing on reducing or reimagining urban sprawl, improving traffic flow in city driving, and implementing more strict anti-road rage laws which discourage drivers from acting on their driving anger, it is possible to eliminate some of the factors most likely to induce driving anger and road rage, thereby reducing the frequency of road rage occurrence within the transportation system as a whole.

**Keywords:** road rage, characteristics of drivers, road safety

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## 1. Introduction

With the advent of the interstate highway system, in combination with the construction of many thousands of smaller roads that allows people to reach nearly any destination in relatively short periods of time (compared to their late 19th and early 20th century counterparts), society has begun mass-migrating yet again; not nearly to the extent that it did so many thousands of years ago to populate the world in which we live today, but still on a considerable scale that is rapidly changing the landscape of the world as we know it. Whereas a large percentages of the American population once resided very close to major metropolitan areas, allowing walking to represent a very common and practical mode of transportation, large swaths of formerly urban populations are now moving further away from cities into rapidly expanding suburban areas, in a process called urban sprawl, where driving to virtually any destination is a necessity [1,2,3,4]. The unfortunate truth of city driving is that congestion and 'stop-and-go' traffic are inevitabilities. Traffic congestion occurs because the available capacity cannot serve the desired demand on a portion of the roadway at a particular time [5,6,7,8], leading to traffic problems that are no longer minor, occasional inconveniences, but rather

inevitably, and along with these issues, health problems related to them have arisen.

Recent research on the transportation system and the ways in which people interact with it has shown, increasingly, that human health is linked quite significantly to it. Scholars and practitioners from two very different worlds-the world of public health and the world of transportation engineering-have recognized that various connections between human health and transportation do exist, and more importantly, have taken note of the criticality of understanding the importance of these connections. Using this ever-growing body of knowledge, these two groups have made strides toward improving the general ease of inevitable interactions between the two. Despite this growing recognition of and response to this need, however, research has, thus far, been focused heavily and almost exclusively on the physical aspects of human health due to use of and interaction with the built transportation environment. While this focus on physical health is, without question, vital, considering the increasing physical health issues that are essentially plaguing the United States, there is a second aspect of human health that is just as critically important, but that has thus far been largely ignored in existing research, i.e. mental health [9,10].

While the tendency toward a stronger focus on the study of physical health in the transportation environment,

in lieu of mental health, is in some ways understandable, primarily because physical health concerns related to transportation are almost universally more readily apparent than their typically less tangible mental health counterparts, mental health issues can be just as problematic, and in some cases significantly more so. The bias toward physical health, and thereby relative marginalization of the importance and mental health research, is perhaps a major contributor to many of the issues that drivers experience on the road every day.

One mental health issue that is of particular cause for concern is road rage, largely because it is viewed as a typical human response to various traffic problems, frequently overlooked as being less dangerous than it actually is, and allowed to continue as a result, despite evidence indicating that it truly is worthy of concern [11]. Since 2006, road rage has been officially classified as a medical condition of the mental health variety, called intermittent explosive disorder (the same disorder associated with continuous and violent domestic abuse) [12]. Given this status, it is more important than ever that this mental health issue, which is directly connected to driving (though it can be influenced and/or augmented by other external or internal stimuli) be considered seriously as a potential road hazard and a danger to the efficient, effective, and safe operation of our transportation system, rather than continue to be overlooked as a trivial daily aspect of life simply because it has become commonplace in our society.

The purpose of this research is to determine the typical potential for driving anger that drivers experience due to various common driving problems (from minimal to extreme anger), to gauge the prevalence of road rage behaviors that result from this driving anger, and to determine how these kinds of responses feed negatively back into the transportation system. To achieve this objective, this paper will (1) determine the kinds of stimuli within the transportation environment that are most likely to elicit angry or aggressive responses from drivers; (2) quantify and rate the levels of potential for driving anger among drivers of various backgrounds; (3) determine the prevalence of angry driving and road rage behaviors across a range of driver demographics and other factors; (4) determine whether or not a driver's belonging to a given demographic group is an indicator of potential driving anger, which can be used to predict the potential for anger in other similar drivers; and (5) consider and suggest methods for reducing the prevalence of road rage within the transportation system. The ultimate goal of this research is to broaden the body of knowledge regarding mental health as it relates to the built transportation environment, attempting to identify specific factors that can serve to predict drivers' proneness to road rage, and to raise awareness of the growing dangers linked with road rage due to its far too frequently overlooked danger.

This paper is organized as follows. Section 2 will provide a review of the existing body of knowledge on the road rage and its status as a mental disorder. Section 3 will describe the setup for the data collection method. Section 4 will detail a comprehensive analysis of the results. Section 5 will provide a summary of the research as a whole, and draw some final conclusions regarding the data. Recommendations will be made for possible future studies.

## 2. Literature Review

The concept of annoyed, angry, aggressive travelers is something that has, in all likelihood, existed for as long as road travel alongside other travelers has been a part of life, even prior to the introduction of motor vehicles as a societal norm. This problem has, of course, been severely exacerbated through the decades as more and more people have taken ownership of vehicles and the once-dirt roads and meadows of days gone by have evolved into the complex transportation system upon which we rely today [13,14]. With the growing transportation system, increasing congestion that is unlikely to disappear in the foreseeable future has become commonplace and, along with it, more drivers have become increasingly more frustrated with their daily commutes [15]. This has led to a greater amount of driver stress, annoyance, and anger, and road rage has, as a result, become a gradually more frequent occurrence on the road, creating an environment that is arguably more dangerous to drivers than ever before.

The actual term "road rage" originated during a dark period in late-1980's Los Angeles, during which a rash of extreme violence spread on the major freeways of Los Angeles. The term was supposedly coined by newscasters at KTLA, a local LA television station. At this time, shooting sprees and violent physical assaults became fairly regular occurrences, as more and more drivers were responding dangerously to their escalating frustration with Los Angeles traffic congestion [16]. Road rage appears to be a mostly cyclical occurrence wherein negative events within the transportation system cause road rage, and this road rage leads to further negative events within the transportation system.

Most recently, as effort has been put forward to better understand road rage (albeit very little), a few strides have been made to help the public better understand the seriousness of the issue. In 2006, road rage was officially classified as a psychological disorder, under a new, more scientific term: intermittent explosive disorder, or IED. Intermittent explosive disorder is characterized by the occurrence of discrete episodes of extreme, often violent expressions of anger and/or aggression, which are disproportionate to the situation which brings them about. It is an impulse control disorder belonging to the same family as such disorders as kleptomania and pyromania [17].

This perception is of particular concern considering numerous reports by drivers indicating that they have felt significant anger while driving, witnessed it directly, or committed some form of road rage act themselves, on at least one occasion, and in most cases more. A survey distributed by the Automobile Association in 1995 reported that "90% of motorists questioned had experienced at least one 'road rage' incident in the previous year" [18]. In 1996, a report released by The Lex Report stated that "44% of people surveyed said that they suffered verbal or gesticulatory abuse in the past 12 months and that 9% of people claim to have been forced to pull off the road because of aggressive driving by others" [19].

While some of these examples of driving-related aggression are extreme, two facts should be noted. First, these kinds of aggressive acts are surprisingly common.

“89% of drivers have admitted sometimes committing aggressive violations such as chasing other drivers, indicating hostility to other drivers, or sounding the horn to indicate annoyance with other drivers” [20]. The second startling, and perhaps more pertinent, fact to note, is that each of these acts of aggression has contributed to and/or been the primary cause of a very significant number of vehicular crashes, many of which have been fatal. In fact, the American Automobile Association has stated that between 2003 and 2007, aggressive driving was a factor in more than half of all of fatal car crashes in the United States (55.7%, more specifically), accounting for 106,727 fatalities [21].

Perhaps the greatest danger that road rage poses to the transportation system and the people who use it, however, is not in the experience itself, but rather in the outward conveyance of that rage. This anger often manifests itself in the form of aggressive driving and, based on the statistics which state that aggressive driving is a factor in more than half of all fatal car accidents, is perhaps significantly greater problem than anyone realizes.

### 3. Research Methodology

In order to determine the prevalence of road rage across a range of drivers, a data collection procedure was developed to quantify the potential for driving anger given a set of known anger-inducing driving scenarios.

#### 3.1. Data Collection Procedures

Several steps were required to develop a data collection method that would allow for the quantification of driving anger, which, in its strictest sense, is non-physical and, thereby, very challenging to measure.

##### *Step 1: Development of road rage prevalence survey*

In order to begin collecting data, it was first necessary to develop a survey that asked a random sampling of drivers to consider various driving scenarios which are potentially anger-inducing and gauge their reactions to each. Then these results were compiled and analyzed in order to draw conclusions about the prevalence of driving anger, which leads to road rage, aggressive driving, and in many cases even death. The following sections discuss, in detail, the process used for developing and analyzing the data obtained from this survey.

##### *Step 2: Selection of driving scenarios*

To create a survey that considers the driving anger of a variety of driver demographics, which will allow for the development of a multidimensional assessment of road rage prevalence, it was necessary to first determine the kinds of driving incidents that occur on the road, which commonly lead to road rage behaviors. In 1994, research was completed by Jerry L. Deffenbacher, Eugene R. Oetting, and Rebekah S. Lynch, through which a comprehensive, 53-item list of these types of driving situations was built, for the purpose creating the Driving Anger Scale. This list of driving incidents was compiled via faculty and student interviews at the University of Colorado, regarding the “things that angered them while driving” [22].

From this 53-item list, Deffenbacher et al developed a short form of the driving anger scale which captures very similar data, with adequate variance, but using only using

14 items (each coming from one of the aforementioned clusters. This 14-item short form scale is the list of undesirable driving situations that will be used to assess driving anger prevalence. It presents the following scenarios:

- Someone is weaving in and out of traffic.
- A slow vehicle on a small road will not pull over and let people by.
- Someone backs right out in front of you without looking.
- Someone runs a red light or stop sign.
- You pass a radar speed trap.
- Someone speeds up when your try to pass him/her.
- Someone is slow in parking and is holding up traffic.
- You are stuck in a traffic jam.
- Someone makes an obscene gesture toward you about your driving.
- Someone honks at you about your driving.
- A bicyclist is riding in the middle of the lane and is slowing traffic.
- A police officer pulls you over.
- A truck kicks up sand or gravel on the car you are driving.
- You are driving behind a large truck and you cannot see around it.

Due to the range and variety of scenarios, and the general high regard for the Deffenbacher Driving Anger Scale, the scenarios presented in the short form scale were used in the final survey.

##### *Step 3: Modification of source material*

After the Deffenbacher Driving Anger Scale short form was selected as the source for potentially anger-inducing driving scenarios, it was modified in order to compare results across various demographics. The purpose of this demographic comparison was to compare the pervasiveness of the various driving scenarios among different groups of drivers, to determine who was most prone to road rage.

This was accomplished by adding four questions regarding demographics that accompanied the 14-item short form driving anger scale. These demographics include driver’s gender, age group, length of average daily commute, and typical commute type, and were chosen on the basis of the following rationale:

Gender-This demographic was chosen on the basis of a general public belief that males experience a greater level of anger while driving than females.

- Male
- Female

Age Group-This demographic was chosen based on the linkages between road rage, aggressive driving, and fatal car crashes, combined with the fatal car crash data which breaks down fatalities by age group. The oldest age group (45-54 years old) was chosen based on the oldest driver that was surveyed).

- Younger than 20 years old
- 20-24 years old
- 25-34 years old
- 35-44 years old
- 45-54 years old

Length of Average Daily Commute-This group was based on the linkages between urban sprawl and road rage, due to longer commutes.

- Less than 10 minutes
- 10-25 minutes
- 25-40 minutes
- Longer than 40 minutes

Typical Commute Type-This group was based on the observation that the occurrence of road rage seems to be higher on more heavily congested, smaller city roads than highways.

- City
- Highway
- Combined

**Step 4: Distribution of survey**

The modified driving anger survey was distributed to 157 drivers of various backgrounds, ages, education levels, geographic locations (within the United States), commute lengths and types, etc. This allowed for a sampling of data that represented the driving public as a whole much more closely than would a sample group made up of similar kinds of drivers.

**3.2. Data Analysis Methodology**

Following distribution of the modified driving anger survey, 37 were received back, from which a data set was built. This data set was compiled into a single data table that painted a total image of the survey respondents' driving anger potential. This main data set was finally broken down into four smaller data sets which compare potential for driving anger on the basis of the demographics discussed previously and analyzed individually to develop more specified results. An anger rating system was used, based on the scores the survey respondents provided for each scenario presented, and was calculated using the following equation:

$$\text{Anger Rating} = \frac{\Delta \text{ Anger Scores}}{\Delta \text{ Max Possible Scores}} \times 100\% \quad (1)$$

This anger rating, shown as a percentage, represented an overall estimated potential for driving anger for each respondent, and was the primary factor used in determining prevalence of driving anger.

**4. Evaluation of Data and Final Results**

After compiling all of the survey responses into a comprehensive data table, specific sub-categorical data was drawn out to form smaller groups, based on four demographic groups of drivers.

**4.1. Interpretation of Results**

As has been established, the demographic groups that were chosen to compare against average driving anger, given various different problematic driving scenarios, include:

- Driver's Gender
- Driver's Age Group
- Length of Average Daily Commute
- Typical Commute

The following subsections detail the specific results obtained from the data analysis.

**4.1.1. Total Driving Anger Data**

The following data (Table 1) refers to the total group of 37 drivers who responded to the modified driving anger scale. It provides a general measurement of the amount of driving anger that occurs within the transportation system throughout the United States, and includes responses from drivers of various backgrounds, geographies, etc. While the data does not take into account the effects of the various demographic groups to which each of the respondents belong, it does note which demographic group each respondent falls into for the four test areas to follow. It should be noted that the statistical accuracy of the sample, based on the total potential number of respondents (157) was found to be ±7.31%, given a confidence interval of 95% (calculated using the Sample Size Calculator from the National Statistical Service) [23].

**Table 1. Overall anger ratings for survey respondents**

Driver	Anger Rating		Demographics			
	Sum	Anger %	Gender	Age Group	Avg. Commute Time	Typical Commute Type
1	50	71%	M	25-34	>40	Combined
2	32	46%	M	20-24	<10	City
3	47	67%	F	20-24	>40	Highway
4	42	60%	F	35-44	25-40	Combined
5	37	53%	F	25-34	10-25	Combined
6	38	54%	F	20-24	10-25	Highway
7	36	51%	M	25-34	>40	Combined
8	28	40%	F	20-24	25-40	Highway
9	22	31%	M	25-34	<10	Highway
10	52	74%	F	25-34	25-40	City
11	45	64%	M	25-34	<10	City
12	42	60%	M	35-44	25-40	Combined
13	43	61%	M	20-24	>40	Highway
14	41	59%	F	< 20	10-25	Combined
15	40	57%	M	25-34	10-25	Combined
16	40	57%	F	< 20	<10	Highway
17	51	73%	M	< 20	10-25	City
18	40	57%	F	20-24	25-40	Combined
19	46	66%	F	< 20	10-25	Combined
20	41	59%	M	20-24	25-40	City
21	37	53%	M	45-54	25-40	Highway
22	42	60%	M	45-54	25-40	Highway
23	42	60%	F	25-34	10-25	Combined
24	37	53%	M	20-24	10-25	Highway
25	45	64%	M	45-54	>40	City
26	40	57%	M	45-54	10-25	City
27	50	71%	F	< 20	25-40	Combined
28	43	61%	F	25-34	25-40	City
29	45	64%	M	45-54	>40	Combined
30	39	56%	F	20-24	10-25	City
31	31	44%	F	45-54	<10	Combined
32	45	64%	M	20-24	25-40	City
33	45	64%	F	35-44	25-40	City
34	44	63%	M	< 20	25-40	Combined
35	38	54%	F	35-44	<10	Highway
36	49	70%	M	< 20	>40	Combined
37	42	60%	M	35-44	25-40	Combined
<b>Average</b>	<b>41.27</b>	<b>58.96%</b>				

Simple observation of the 'Anger %' column of Table 1 indicates that not only is driving anger quite common among all types of drivers, but also that it occurs generally moderate to moderate-high levels given the common problematic driving scenarios used to develop the data set. Ultimately it was found that 89% of the test group (33 out of 37 survey respondents) experienced moderate to high potential for significant driving anger, and that, of this group, 13.5% (5 out of 33) experienced high potential for anger. From this point, this data set was broken into the previously established demographic groups, and these

newer data sets were analyzed independently of each other. These independent analyses are to follow.

**4.1.2. Gender**

The first subcategory into which the total data set was divided was based on the genders of the drivers in question. As previously mentioned, this demographic was chosen on the basis of public perception that males experience more driving anger and road rage than do their female counterparts.

Because there were no significant differences in average driving anger between males and females, specific responses to the various scenarios presented in the survey were compared. The purpose of this comparison was to determine whether specific events elicit more anger in one gender than the other, despite the fact that they all balance out when taken as a whole. Figure 1 shows a comparison of average scores provided by the survey respondents for each of the 14 driving scenarios believed to cause anger.

It was found that males exhibited notably more anger as a total group than females when presented with the following scenarios:

- Scenario 3: Someone backs right out in front of you without looking.
- Scenario 4: Someone runs a red light or stop sign.
- Scenario 8: You are stuck in a traffic jam.
- Scenario 9: Someone makes an obscene gesture toward you about the way you are driving.
- Females, on the other hand, experienced more than their male counterparts due to the following scenarios:
- Scenario 1: Someone is weaving in and out of traffic.
- Scenario 2: A slow vehicle will not pull over and let people by.
- Scenario 6: Someone speeds up when you try to pass him/her.
- Scenario 13: A truck kicks up sand or gravel on the car you are driving.

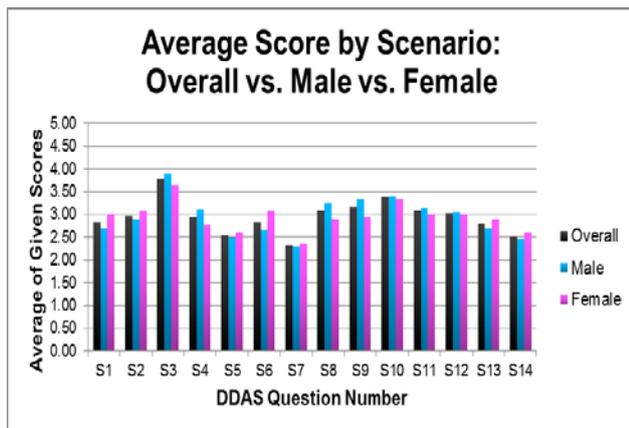


Figure 1. Anger potential by scenario-driver gender vs. overall

Overall, based on the results of the survey data, it does not appear that the gender of a driver is a significant indicator of predisposition to driving anger and road rage. It seems that all drivers, whether male or female, are at risk of exhibiting some form of road rage, to varying degrees given the proper provocation.

**4.1.3. Age Group**

The age groups to which the survey respondents belong was also an important demographic to compare due to linkages between road rage, aggressive driving, and vehicular accidents. Observing the data in terms of age group produced results that were, for the most part, expected. As seen in Figure 2, average anger ratings fell into the previously established 50% to 70% norm for all age groups, with all age groups except one averaging anger ratings below 60%.

Since crash data is often analyzed on the basis of the ages of the drivers involved, in addition to more than half of all fatal crashes being attributed, entirely or in part, to aggressive driving (a road rage behavior), it was important to determine whether or not the prevalence of road rage and driving anger among different age groups could be associated with the fatal car crashes statistics in 2009.

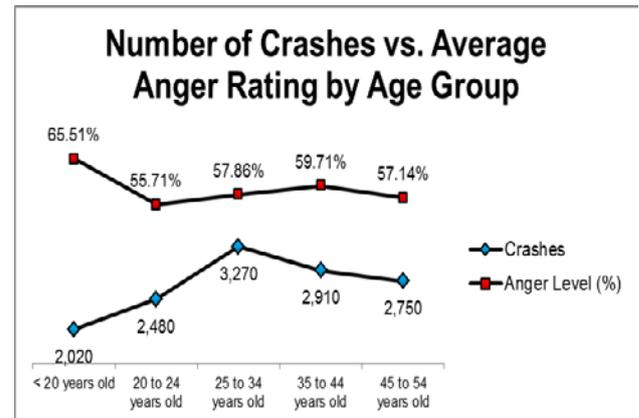


Figure 2. Driving anger vs. crash statistics by age group

As Figure 2 illustrates, fatal car crashes were lowest among drivers younger than 20 years old, and increased for drivers between ages 20 and 24, finally peaking among drivers aged 25 to 34, and then dropping off for the subsequent two age groups. Anger ratings, on the other hand, follow a very different path whereby average anger potential peaked twice, among drivers younger than 20, and among drivers ages 35 to 44. It appears, based on this information, that, while driving anger and road rage are associated with driving fatalities, age does not seem to significantly influence this relationship.

**4.1.4. Average Length of Daily Commute**

The next demographic group to be analyzed was chosen on a very different basis than the first two subgroups (the same applies for the fourth demographic group, to follow) in that it was not based on factors outside of human control, as gender and age were, but was rather chosen based on the idea that urban sprawl has fundamentally changed the ways in which we move about the world and use the transportation system. This group was determined by respondents' self-reported average length of daily commute. The purpose of this analysis was to determine the strength of correlation between increasing average commute times and driving-related anger, in an attempt to quantify the effects of urban sprawl on the mental health of drivers (in this case, proneness to driving anger/road rage). Average length of commute was divided into 4 subsets: shorter than 10 minutes, 10-25 minutes, 25-40 minutes, and longer than 40 minutes.

By separating the survey group's responses to the 14 potentially anger-inducing driving scenarios by average length of daily commute, it was found that higher average anger seemed to occur with increasing length of commute. This indicated that there was a relationship between urban sprawl (and the longer average commutes that have result from it) and the amount of anger that drivers experience while on the road. As seen in Figure 3, as length of commute increases, potential for a greater amount of road rage increases as well.

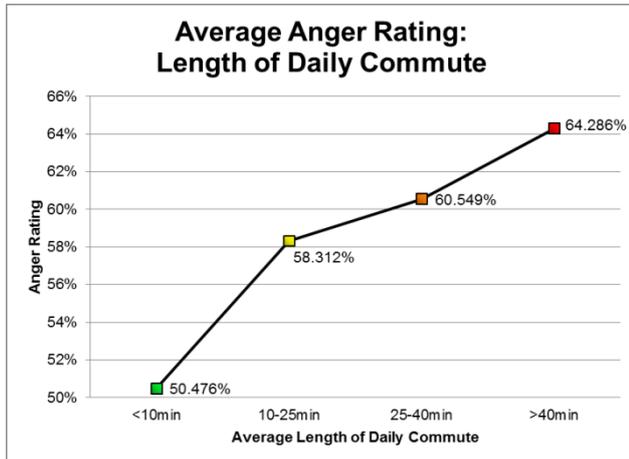


Figure 3. Average anger rating vs. length of daily commute

#### 4.1.5. Typical Commute Type

The fourth and final factor that was expected to play a significant role in triggering driving anger and road rage behaviors, such as aggressive driving, was the type of commute (i.e. city vs. highway travel) that drivers experience day to day. The survey group was again divided into subgroups on the basis of the type of commute that makes up the majority of their daily commute, wherein subgroups included city commute, highway commute, and combined city/highway commute.

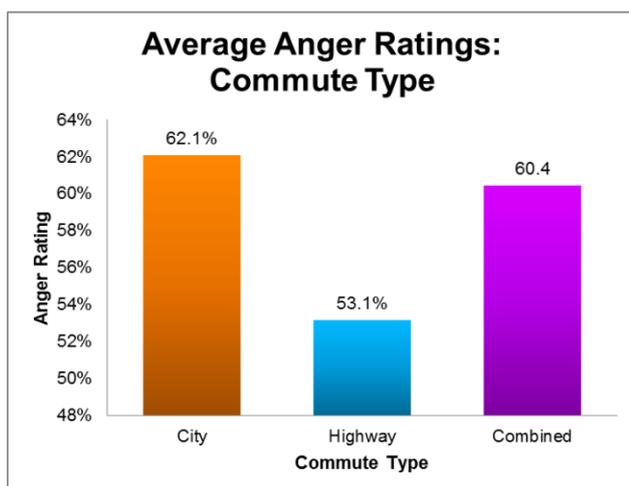


Figure 4. Average anger ratings due to typical commute type

As expected result-city commuters are more prone to angry driving and road rage-was corroborated by the data collected from the survey group. As seen in Figure 4, average anger ratings increased with the amount of city driving that comprised a commute. Primarily highway-based commuters experienced the lowest average anger while driving, whereas anger ratings were quite a bit

higher with at least partial city driving, as in combined city/highway commutes, and were greatest for purely or primarily city driving commuters.

The finding that city drivers tend to be more prone to driving anger is likely attributed to a few factors that make city driving unique from highway driving. The first factor is that several of the most consistently anger-inducing driving scenarios presented in the driving anger survey are more likely to occur in more congested city environments, especially the following:

- Scenario 3: Someone backs right out in front of you without looking
- Scenario 4: Someone runs a red light or stop sign
- Someone is slow in parking and is holding up traffic
- A bicyclist is riding in the middle of the lane and is slowing traffic

The other major factor is that city driving presents several challenges to drivers that highway drivers are less likely to encounter, such as signalized intersections, mixed-use roadways, pedestrian traffic (and therefore crosswalks), greater potential for bottlenecking due to construction, parking vehicles, accidents within intersections, etc.

Taking these differences into account, it is important to note that, while city and combine city/highway commutes do lead to greater potential for driving anger overall, highway commuters are still prone to moderate levels of anger in general. Moreover, it is possible that primarily-highway commuters are even more prone to road rage and aggression when they enter city-driving situations, as they tend to be less adapted to such environments and driving challenges (as mentioned above), and therefore may be less-equipped to cope.

Ultimately, based on the results of the typical commute type analysis, it appears that the driving environment in which a given driver spends the most amount of time is a factor that can be used to predict susceptibility to driving anger and road rage. Additionally, these results paint a picture of generally problematic city driving environments that must be taken into consideration for future improvements in city planning, road design, and decisions to implement multi-use facilities.

## 4.2. Recommendations for Reducing Road Rage

A major step that should be taken toward significantly reducing the prevalence of driving anger and road rage behaviors within the transportation system involves implementing better measures to reduce the propagation of urban sprawl, including low-density development, separation of land uses, leapfrog development and automobile-dependent development [24,25].

One practical suggestion for reduction of driving anger is a returning to the old gridiron design philosophy for modern streets. By implementing this older idea, which existed due to limited means of travel, interconnectivity within communities would be significantly improved and would reduce the need for constant driving. As discussed, less driving leads to less driving anger.

Additionally, introducing more variation in land use within given areas outside of major metropolitan areas is a crucial change to modern development models. This measure will allow people to travel to a central location to

accomplish multiple tasks, reducing the amount of driving necessary within a given day and, thereby, reducing the potential for driving anger. It will also allow people to avoid more congested (and thus more anger inducing) metropolitan centers, while still completing the same tasks.

Another potential option for reducing the occurrence of road rage behaviors within the transportation system is through the implementation of government policies which discourage drivers from acting upon their driving anger via more severe penalties. While it is difficult to gauge the long-term effectiveness of more severe laws against road rage, the potential benefits are substantial and more widespread adoption could go far to reduce road rage and the dangers associated with its behaviors.

## 5. Conclusions

The purpose of this research was to measure the potential for driving anger of the general driving public in the United States, and to determine the overall prevalence of driving anger within the transportation system. These were important measures because they are critical to the increased understanding of the true dangers of road rage, and the driving situations that are most likely to trigger it.

With the goal of identifying some of the factors that are and are not capable of predicting the potential for driving anger, a driving anger survey was developed, using the Deffenbacher Driving Anger Scale as a basis. This modified anger survey allowed the survey group's responses to be measure not only as a single, mixed group, but also in terms of the various demographic subgroups to which each of them belong. These demographic groups included gender, age group, length of average daily commute, and typical commute type. These subgroups were analyzed separately and a variety of results were found. The most prominent findings included the following:

In general, nearly all drivers experience anger while driving, and most have the potential to experience this anger at moderate to moderate-high levels.

- Males and females experience anger while driving at nearly identical levels, though there is some variation in the specific anger-inducing scenarios that anger each gender the most significantly.
- In general, all age groups experience driving anger at about the same rate (moderate).
- While road rage and aggressive driving are directly linked to fatal car crashes, age does not appear to influence this relationship.
- Length of average daily commute seems to be directly related to potential for driving anger. As length of commute increases, so do potential anger ratings.
- Anger levels while driving do have a relationship the type of commute that drivers experience day to day, wherein congested city driving elicits greater anger than more free-flowing highway commutes.

Driving anger and road rage are problems within the transportation system that, in all likelihood, will never be eliminated completely. However, by implementing changes to modern development models, particularly in terms of reducing or reimagining urban sprawl, and improving traffic flow in city driving, it is possible to

eliminate some of the factors most likely to induce driving anger and road rage, thereby reducing the frequency of occurrence. Going a step further, by implementing more severe laws which discourage drivers from acting on their driving anger, the prevalence of road rage can be reduced even further.

There were a few limitations associated with data collection and analysis which led to some challenges and warrant future extended research on this topic. The first limitation was inherent in the data collection method that was used in order to quantify driving anger. As with any survey, while the intention is always to represent a certain group (in this case, drivers in America) as accurately as possible, this can be difficult to ensure. This was particularly true with the fairly small sample set that was used for this study. The method of survey distribution is intended to create as diverse of a survey pool as possible in order to avoid this issue. The second limitation is the difficulty of isolating anger due strictly to driving situations from external factors within a driver's life, which might influence how they respond to a given scenario. The limitations of this research was the inability to consider stimuli unrelated to the driving environment as an influencing factor in drivers' potential for driving anger, such as preexisting psychological disorders.

In the future, additional research could be conducted to include a variety of demographic groups not considered in this study, such as the aforementioned sufferers of psychological disorders, to gain an even broader perspective of the kinds of stimuli that actually influence driving anger most significantly. Additionally, while it is extremely important and quite timely to continue broadening the knowledge base of the drivers who are most susceptible to driving anger and road rage, as well as the characteristics that can help predict these actions, is to consider the engineering and transportation planning practices which are most strongly linked to road rage and work on what can be done that will both reduce the frequency of road rage.

Perhaps most importantly, further research should be completely on potential engineering improvements which will help to curb the prevalence of driving anger and road rage. The linkages between urban sprawl and the proliferation of road rage need to be studied in greater detail in order to best develop a course of action for correcting the problem. While it is clear that a relationship between sprawl and road rage does exist, it is important that the strength of this correlation be tested in greater detail to gain a better understanding of how humanity's evolving occupation of the world is influencing the mental, social, physical dangers of using the transportation system.

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