Bias in Driver Yielding Behavior at Crosswalks

August 21st, 2015

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Abstract:

Seattle is a heavily populated city with dense neighborhoods and busy streets. There is an increasing need for proactive research in order to implement safer parameters for communities. In response, we have conducted a field experiment to learn about human behavior and their tendencies, specifically geared towards discovering if there is racial bias and/or sex bias at the crosswalks. This involved recruiting volunteers and conducting a field experiment in order to see if drivers have an increased chance of yielding for one characteristic over the other. We tested the hypothesis to see if drivers’ behavior exposes racial or sex bias towards pedestrians. This controlled observation field experiment at an unsignalized mid-block marked crosswalk was conducted in Seattle, Washington near the University of Washington. A total of fourteen participants simulated an individual pedestrian crossing while an observer took note of the number of vehicles passing before a driver comes to a complete stop, the time it took for a vehicle to stop, first vehicle stop, and the distance the vehicle stopped from the pedestrian. White males had a shorter wait time and lower average number of vehicles that passed before a vehicle stopped compared to Black males. In addition, there were more first stop vehicles and a longer average distance for White males. Results for sex bias found that females had a lower average number of vehicles that passed before a vehicle stopped with a shorter wait time compared to males. Females also had a higher percentage of first stop vehicles but a shorter distance between where drivers stopped and where the pedestrian stood at the crosswalk. The different compliance rates illustrates racial and gender discrimination by drivers.
Introduction:

A study found that African Americans experience considerably more discrimination due to race compared to whites, with an additional increase in risk from 45-54 year old (Puhl et al. 2008). This shows that in the United States, discrimination is still prevalent and pervasive. Seattle is a growing urban city that is highly populated and diverse. Among the 652,405 people living in Seattle, a data set from 2013 illustrates that there were 10,310 police-reported collisions in Seattle while 155 people were seriously injured and 23 were killed ("Seattle’s Plan to End…” 2015). If streets do not seem safe, people will become discouraged from walking or cycling, compelling more people to drive in the safety of their own vehicle. This will contribute to environmental degradation because of increased carbon dioxide emitted into the atmosphere. In addition, there is an equal distribution between male and female populations in all of the counties in Washington, including Seattle’s (“Current Seattle Washington Population”. 2014). My study will delve in to see how the proportions of fatalities are distributed amongst different sexes. This will elucidate if Seattle is either sex neutral or a sex biased city. In parallel, my internship field experiment with Seattle Neighborhood Greenways will mirror a study conducted in Portland, Oregon called “Racial Bias in Driver Yielding Behavior at Crosswalks”. This study displayed results that Black pedestrians waited twice as long as White pedestrians when crossing the street (Arlie et al. 2014). This surprising fact illustrates that the number of vehicles who refuse to yield differed significantly by race, implying there is in fact racial bias so prevalent that it affects the safety of people who walk.
Understanding what is happening in the real world is the first step before any action can be taken to minimize polarized behavior. In addition, by being aware of different biases through factual evidence as well as familiarizing the relationship between crosswalk and driver interaction, one can have a better comprehension of how to approach the situation. Shedding light on the current negative humanistic behavior and publicly addressing the issues on the current discriminative actions of others will hopefully engage others to realize there must be a shift in both attitude and perceptual changes. Seattle Neighborhood Greenways is a local grassroots non-profit whose mission is to “empower our neighbors to identify, advocate for, and activate safe and healthy streets for all people” and envisions “A well-used, linked network of safe, pleasant, and healthy streets in Seattle.” Organizations like Seattle Neighborhood Greenways can play a role in preventing traffic violence and discrimination in by advocating for safer streets and equitable traffic enforcement.

According to Washington State Law, every pedestrian has the right of way when crossing a road. More specifically, RCW 46.04.160 states that a crosswalk is defined as a “roadway between the intersection area and a prolongation or connection of the farthest sidewalk line or in the event there are no sidewalks then between the intersection area and a line ten feet therefrom, except as modified by a marked crosswalk” (“SDOT”, 2015). All of the crosswalks observed in this particular study had a pedestrian crossing indicator, which were illustrated by white parallel lines. This indicator is a signal to drivers that indicates where pedestrians may cross the road. Drivers must yield and stop for pedestrians before the vehicle reaches the crosswalk. These crosswalks give the
pedestrians the right of way at any given time. This study is not a test to see if people follow the law, but to elucidate differences in the compliance rate by race and sex.

**Methods:**

*Subjects and Design:*

The field experiment required a total of fourteen volunteers. Throughout the course of five weeks, I recruited three White males, three Black males, two Asian males, two White females, two Black females, and two Asian females. Pedestrian race (Black, White, and Asian) and sex (Female vs. Male) were the independent variables for this study. Three White males and three Black Males were observed to test racial bias. Meanwhile, two White males, two Black males, two Asian males, two White females, two Black females, and two Asian females were observed to test sex bias. Each pedestrian completed a total of fifteen crossing trials, resulting in ninety total crossings for the racial bias field study and a total of 180 crossings for the sex bias field study.

*Location and Time:*

A specific mid-block crosswalk on 41st street and University Ave NE was designated, located near the University of Washington Seattle.
This crosswalk is a busy two-way street with no stop sign or stoplight, but a traditional gridded zebra-print paved crosswalk clearly indicating that this is a pedestrian crossing. The trials were initiated between the dates July 13\textsuperscript{th} and August 7\textsuperscript{th} on weekdays, between the times 3 p.m. and 6 p.m. Subjects approached the crosswalk with the intent to cross the street, making it physically obvious to the driver that the pedestrian was waiting for the vehicle to stop so that they may cross. If there were additional pedestrians, the subject would not cross and wait for the next approaching vehicle. As a driver drove forward, the observer noted the results of the driver including time, distance, first vehicle stop, and number of vehicles passed before a vehicle actually came to a complete stop for the subject. The data was collected only from vehicles heading Southbound.

\textit{Experimental Procedure:}

Three White men, two White women, three Black men, two Black women, two Asian men, and two Asian women were recruited as research subjects to participate in this study as pedestrians. All participants were in their twenties and wore very similar outfits (gray t-shirt with brown shorts/pants) with somewhat similar physical characteristics. By wearing khaki pants or shorts and a plain gray t-shirt, it provides a
neutral picture for the driver so that there is no obvious social characteristics or socio-economic status indicators.

One observer stood approximately thirty feet from the designated crosswalk hidden from the oncoming drivers, and recorded the action of the drivers as the pedestrian approached the crosswalk. Four main factors were recorded on the data collection sheet. The first factor was the number of cars that passed before a vehicle yielded for the pedestrian. The second was the time elapsed for the vehicle to actually stop completely for the pedestrian to cross. Third, was to record if the first approaching vehicle stopped for the pedestrian at the crosswalk. Lastly, the distance between where the driver stopped from where the pedestrian was standing.

The pedestrian would wait at the crosswalk one at a time. The observer started the timer when the driver was approximately 300 feet away, after being stopped at a stoplight. The subject indicated their intent to cross by waiting at the edge of the sidewalk, showing with their body posture that they are waiting to cross, also making eye contact if possible. Once a vehicle stopped completely, the observer would stop timing and the pedestrian would safely cross the crosswalk. If the first vehicle did not stop, the timer would continue until the next vehicle behind the initial timed vehicle stopped for the pedestrian. Once a vehicle did stop, the observer would estimate the approximate distance between the vehicle and the pedestrian. There was a one-minute break before the next crossing. The Washington law requires the driver to yield since pedestrians have the right of way. This experiment however, does not test the compliance with the law but to see if there are differences in the compliance rate by race and sex.

Results:
Differences between the behavior of drivers towards race and sex were examined for a total of four variables of interest: number of cars that passed without yielding for the pedestrian, the time elapsed before the pedestrian could cross safely, whether the first approaching vehicle stopped for the pedestrian, and the distance between where the driver stopped and where the pedestrian stood.

*Descriptive Statistics:*

For this experiment, a total of 426 drivers passed through the crosswalk during the 210 total trials. The average number of cars to pass before a vehicle stopped for all fourteen participants was 2.03. The average wait time until a car yielded for all participants was 14.48 seconds. The average first vehicle stop was 51% and the average distance was 21 feet.

*Number of Cars Passed Before a Vehicle Stopped:*

The results to test for racial bias indicated that Male White pedestrians had a lower average of vehicles that passed before a vehicle stopped. The average for White males was 2.09, while the average for Black males were 2.60. Furthermore, the results to test for sex bias signified that females have a lower average of vehicles that passed before a vehicle stopped. The average for females was 1.79 compared to a 2.22 average for males. This illustrates that more vehicles passed males than females.
The Average Time Elapsed Before The Pedestrian Could Cross Safely:

The results to test for racial bias indicated that Black males waited longer for the vehicle to stop compared to White males. White males had an average wait time of 13.76 seconds while Black males had an average wait time of 15.71 seconds. Also, the results
to test for sex bias signified that females had a shorter wait time compared to males.

Females had an average wait of 13.48 seconds while males had an average wait of 15.08 seconds.

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**Average Time Before Vehicle Stops For Pedestrian**

![Graph showing average time before vehicle stops for different racial backgrounds](image1)

**Average Time Before Vehicle Stops For Pedestrian**

![Graph showing average time before vehicle stops for different sex](image2)

*Percentage of first approaching vehicle stop for pedestrian:*
The results to test for racial bias indicated that Black males had a lower percentage of first car stops. Black males had a 40% average for the first car to stop for the pedestrian. White males had an average of 49%. In addition, the results to test for sex bias signified that females had a much higher average for first car stops compared to males. Females had a 61% average while males had a 41% average.
Average Distance Between Pedestrian and Driver:

The results to test for racial bias indicated that Black males had a shorter distance than White males. White males had an average distance of 23 feet while Black males had an average distance of 21 feet. The results to test for sex bias signified that females had a shorter distance than males. Females had an average distance of 19 feet while males had an average distance of 23 feet.
Discussion:

In this controlled observational field experiment, drivers were less likely to stop for Black Pedestrians than White pedestrians. As you can see, Black pedestrians experienced longer wait times, higher number of vehicles passing before one would stop, lower first car stop percentage, and shorter distances between the vehicle and pedestrian. This illustrates the biased tendencies people make while driving, making it less safe for minorities to walk the streets of Seattle. In parallel, drivers were also less likely to stop for males than females. Although the difference isn’t drastic, the average results indicate a pattern between these two different groups. The overall difference may seem small but when cumulatively added, these differences grow in magnitude through different street crossings. These differences definitely impact daily walking, making some people scared of walking in fear that they will be in danger, or experience uncomfortable uneasiness.

When drivers speed past pedestrians waiting to cross, pedestrians may perceive drivers as aggressive and rude. When this incident occurs multiple times, pedestrians are discouraged to walk because it may put them in danger, leaving pedestrians to find other modes of transportation. This can adversely affect the environment and human health. Walking is a great form of exercise that does not emit pollutants into the environment and provides excellent exercise. Through the repetition of unsafe crossing conditions, people will choose other alternatives since walking may become stressful. This can partially explain the high number of fatalities from car accidents as mentioned in the introduction.

Although this study aimed to address all variables, there were some limitations. Although all participants in this study wore neutral colored clothing, the style of clothing did not all match and can be a possible influence on the data results. This study also
aimed to recruit participants that had a similar physical build, reducing further variables. Unfortunately, not all participants had the same body type and height. Some participants were taller than others and some participants varied in weight. These factors can all have an influence on acquired data as other biases may come into play. Additionally, the speed of the vehicles played a big role, since one of the four variables of interest was timing the vehicles from 300 feet away until the car came to a complete stop. The speed consistency fluctuated drastically as some vehicles drove at an extremely slow pace while others drove at an extremely high pace. Lastly, since all of my participants could not meet all at once due to separate schedules, there may have been some day-to-day variability. As a result, some participants were observed one day individually, which may impact the data as each day differs.

Much like the Portland study also looking into Racial Bias in Driver Yielding Behavior at Crosswalks, data from both studies indicate that drivers were less likely to stop for Black pedestrians than for White pedestrians. White males had a shorter wait time, higher percentage for a first car stop and lower average number of vehicles that passed before a vehicle stopped compared to Black males. For the total wait time in the Portland study, Black pedestrians had to wait 2.39 seconds longer while this study illustrated that Black pedestrians had to wait 1.95 seconds longer. For yielding behavior based on first car stops, the Portland study stated that although results did not significantly differ by race, Black pedestrians were more than twice as likely as White pedestrians to have to wait for two or more vehicles. This study demonstrates that black pedestrians have a 9% less likelihood for vehicles to stop when the first vehicle approaches than when compared to White pedestrians. Lastly, the average number of
vehicles that passed before a Black pedestrian could safely cross was more than twice the average than for White pedestrians in the Portland study. In this study, Black pedestrians had .51 more cars pass before the pedestrian could safely cross the street. The data comparison between these two studies shows different magnitudes of racial bias. Nonetheless, both elucidate that racial bias is still prevalent today.

Part of sustainability includes understanding the human dimension segments of human behavior since “throughout the 1990’s, assessments of racial and ethnic relations in the United States suggest[s] that we have become increasingly polarized” (Bobo. 2001). Through utilizing the findings from this study, it can help Seattle Neighborhood Greenways gain a better insight on racial, ethnic and sex polarization in present time and use it to promote healthier neighborhoods in Seattle. An article states that, “…whites may have implicit negative racial attitudes; these attitudes may be reflected in more negative nonverbal behaviors in the interactions with Blacks than in their interactions with Whites” (Dovidio et al. 2002). This study tests whether racial attitude tendencies change between Whites and Blacks in Seattle, Washington. My field experiment and results can be used as a model for future scientific studies, allowing this scholarly knowledge to be exemplified to a broader or more specific topic. If more people are aware of discrimination, the room for biases to grow and persist can be reduced. Further investigation with other crosswalks and reduced variables would be quite useful in order to understand discrimination prevalence in different areas.

**Conclusion:**

Based off of this data, there are differences in compliance rates between both race and gender. Both data sets however, illustrate racial bias and sex bias is pervasive. Black
males and males in general have a more difficult time safely crossing the road which affects their daily lives. Our findings illustrate the need for more crosswalk parameters in order for all pedestrians to walk around safely and reduce pedestrian fatalities and injuries. Interventions like flashing lights can help reduce driver aggression so that compliance rates are faster for everyone with different racial and gender backgrounds. Further studies of which design features at crosswalks are the most effective in terms of influencing drivers to stop would be a helpful and useful study. Hopefully this research will encourage people to reflect on their driving subconsciously impacted by racism, since racial discrimination is one of the most prevalent types of discrimination (Puhl et al. 2008). Moreover, I believe this contribution will promote additional safety and encourage safer street changes. That way more minorities and both males and females will be motivated to use healthier transportation modes such as walking and cycling. Decreasing racial bias in drivers’ behavior will lead to safer crosswalk experiences as well as improvement in overall public safety.
References:


## Driver Behavior at the Crosswalk

**Date:**

**Time:**

**Data Collector:**

**Weather Condition:**

**Crosswalk Location:**

**Crosswalk Description (traffic volume, surrounding urban environment):**

<table>
<thead>
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<th># of vehicles passed before a vehicle stopped</th>
<th>Time</th>
<th>First car step? Y/N</th>
<th>Pedestrian Description</th>
<th>Roll Step? Y/N</th>
<th>Approx. Distance</th>
<th>Notes</th>
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