**A Study of Crash Patterns Over the Past Ten Years (2003-2012)**

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## Executive Summary

The following is an abstract of a study performed using crash reports from Alabama over the past ten years. Some differences in the reporting process itself originated in July 1, 2009 when DPS and several key local reporting agencies began using eCrash, Alabama's electronic crash reporting system. In 2012 eCrash was used in over 90% of the reports.

**Fatal crashes** as a proportion of all crashes has dropped off significantly the last half of the 2003-2012 decade, and it has remained quite stable in the last four years. This reflects a trend toward reduced discretionary travel by high-risk drivers, which tends to be in the rural areas. Reinforcing this is the trend toward a greater proportion of crashes occurring in urban areas (an increase from about 72% to 76% over the ten year period). The urban fatality proportion has also risen from about 32% in 2003 to about 44% in 2012. This is clearly indicative of a trend toward more urban driving and the accompanying benefits of reduced speeds and an overall reduced fatality rate. However, it also shows the need for more focus on urban crashes.

Concentration should always be on issues correlated with the most fatalities. The Statewide Highway Safety Plan indicates that these include the following, in order of estimated number of fatalities involved: restraint deficiencies, impaired driving, speed, hit obstacles, young drivers, motorcycles, and pedestrians. Other factors commonly of high interest are distracted driving, workzones and heavy trucks.

**Restraints.** Restraint use has increased continuously over the past ten years, from its 2003 level of about 77% to the average over the past four years, which has leveled out at about 90%. Officer-reported crash data over the past ten years indicates that the probability of being killed in any crash is 20 times higher if not properly restrained; 0.30% if restrained, 5.97% if not restrained. Comparable results are obtained for child restraint use effectiveness.

**Impaired driving.** This includes impairment to the driver caused by either alcohol or other drugs, or the combination of both. Impaired driving crash frequencies follow the overall crash pattern very closely, peaking in the 2005-2006 years, seeing significant reductions in 2008-009, and then leveling off in 2010-2012 to about half way between these two earlier extremes. Drugs (other than alcohol) are being reported at a much higher rate in the most recent three years. In 2003, only about 14% of crashes were reported to involve non-alcohol drugs; in 2012 this number rose to nearly double its value – over 27%.

**Speeding.** There has been a consistent and obvious improvement in the proportion of crashes for which speeding involvement was indicated in almost every year over the past decade. From a high of about 10% of all reported crashes in 2003, it is now at a low of a little over 7%. The severity of speeding-involved crashes, in terms of both injuries and fatalities, has also declined, indicating slower speeds and improved EMS (perhaps due to closer proximity to urban areas).

**Hit obstacles.** The pattern over the past ten years show continuous improvement in the relative number of crashes involving single-vehicle run-off-the-road crashes into a fixed obstacle. From a high of 16.7% in 2003, the reduction has been to 14.5% in 2012. These types of crashes typically occur on county roads and they are particularly lethal due to their rural locations (higher speeds and less access to EMS). The observed reduction further supports the trend toward urban driving, with the accompanying fatality-reduction benefits.

**Young drivers (ages 16-20).** There is a clear national trend of less driving by drivers in this age bracket. Economics and the availability of alternatives play a very large part, and typically these factors are in the more urbanized areas. The reduction is from the high of nearly 22% in 2003 to less than 18% in 2012. Recognize that although their relative numbers have been reduced, 18% for the five ages (16-20) is well over twice their expected number compared to all other ages. So this remains a fruitful target group, especially recognizing that improved habits could be retained over their lifetimes.

**Motorcycles.** Many have taken to the use of motorcycles in response to the rising fuel costs, and this trend is quite apparent in crash patterns from 2009-2012, especially in the fatality rate of motorcycle crashes. This may indicate that the motorcycle demographics are trending toward older and/or less experienced drivers.

**Pedestrians.** Pedestrian involvement has taken a shocking uniform increase in the last four years. Recent national studies have indicated that up to a third of pedestrian fatalities are attributed to drugs and alcohol. The role of electronic devices cannot be ignored in that the injurious behavior of those using electronic devices while walking is well documented (i.e., distracted walking).

**Distracted driving.** Although data to support comparable analyses are not available, this category should not be neglected. Everyone observes the frequency with which distracted driving involving electronic devices cause abnormalities in driving, and the consequences are also quite obvious. Chances of a crash increase from 4 to 23 times, meaning those who persist in this practice are almost certain to cause a crash. Federal estimates are that from 15% to 30% of all crashes involve some form of distraction. This is not only a major problem today, but it is the most alarming, since it is almost totally correlated with general electronic device use, which only shows signs of continued exponential growth.

**Workzones.** Results here were mixed. There was clearly a lull in workzone related crashes in the 2005-2009 time frame. And, while there was a sharp increase in the proportion in 2010 and 2011, this proportion fell back to its previous levels in 2012.

**Heavy trucks.** Large truck crash frequency has been reduced considerably in the second five years of the 2003-2012 decade. While still much more severe than the most other types of crashes, heavy trucks are involved in less than 6% of fatality crashes, and the trucker has been found at-fault in only about 25% of two-vehicle fatal crashes involving a passenger vehicle.

The complete report is available at:
http://www.safehomealabama.gov/DataAnalysis/CrashFacts.aspx

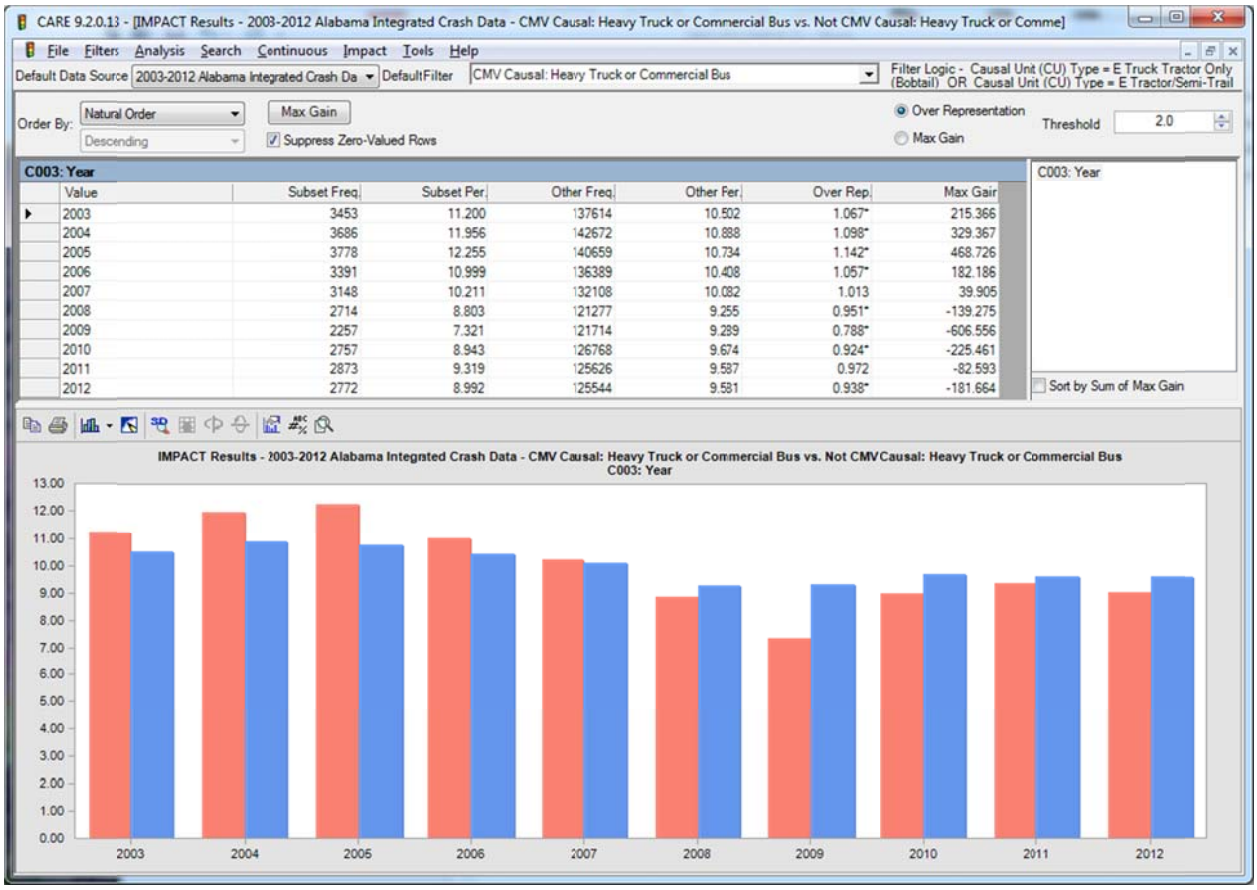
## Introduction

This document contains a series of CARE IMPACT runs that had as their primary purpose to surface significant changes that have come about over the 2003-2012 time period. All of the outputs are quite similar in that the red bars represent the relative frequency for the particular subject under consideration, while the blue bars represent the complement of that subset. So, for example, the first IMPACT compares Heavy Trucks and CMVs (HTCs) against all other vehicles (non-HTCs). The proportion being compared is the relative frequency (which might be viewed as a fractional proportion or percent) of the total crashes in that category that occurred for that year.

The expectation for any cell is 0.01 or 10%. Think of it this way: suppose there were no changes in anything (and we mean ANYTHING) over the ten year period. You would expect the exact same number of crashes every year, so one tenth of them would fall in any given year. In addition, you would expect that in any category of crash (e.g., HTC crashes) that one tenth of them would also fall in each of the ten years. It is these actual proportions that are being compared. When the red bars are compared with themselves then the overall increase or decrease of crashes in general can be perceived. Similarly, the comparison of just the red bars among themselves shows how the subject of interest (e.g., HTCs) increased or decreased over the years. Putting the red and blue bars on the same display enables the non-subject crashes to serve as a control. For example, in the HTC case, the number of non-HTC crashes would serve as a control to which the number of HTCs could be compared. If, for example, the non-HTCs in a given year were 12% rather than their expected 10%, then it would be reasonable if the number of HTC crashes were also 12%. If this occurred it would indicate that something outside of the HTC population caused that increase – something in the traffic mix in general as opposed to something within the HTC subset.

Conversely, when it is observed that a subject (red) bar is significantly higher or lower than its comparable blue bar, then we must conclude that something took place in the test (subject) subset that was unexpected because the same thing did not occur in the control subset (i.e., the non-subject traffic mix). As an example, consider 2005 for HTCs on the following page. While both the test and the control are higher than 10% (seems to be a bad year all the way around), the CMV proportion was 12.255%, while the non-CMV proportion was only 10.734% (just a little above its expectation of 10%). The OverRep column contains what statisticians call the odds ratio. It is just the 12.255/10.734 = 1.142* – the asterisk indicating that it is statistically significant at a very high level. So we have no problem whatsoever in declaring that there was something going on to affect HTCs during this year that was not affecting the overall population. In this case it could be that the HTCs were sustaining their mileage while the non-HTCs had a significant decline in their mileage. While we can prove that *something* caused this difference it is not possible without further analysis to determine just what that something was.

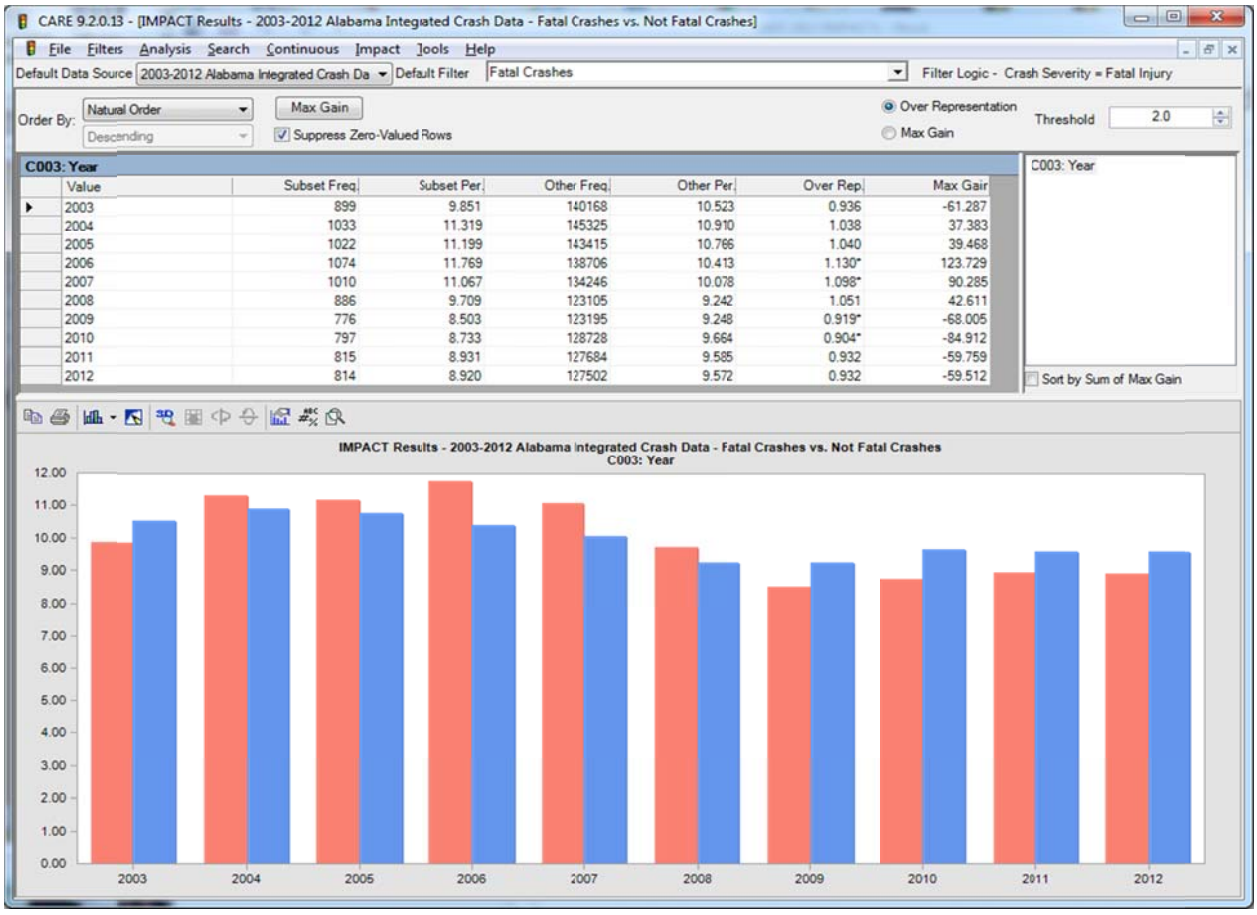
## Heavy Trucks and CMVs




| Value | Subset Freq | Subset Per | Other Freq | Other Per | Over Rep | Max Gain |
|---|---|---|---|---|---|---|
| 2003 | 3453 | 11.200 | 137614 | 10.502 | 1.067* | 215.366 |
| 2004 | 3686 | 11.956 | 142672 | 10.888 | 1.098* | 329.367 |
| 2005 | 3778 | 12.255 | 140659 | 10.734 | 1.142* | 468.726 |
| 2006 | 3391 | 10.999 | 136389 | 10.408 | 1.057* | 182.186 |
| 2007 | 3148 | 10.211 | 132108 | 10.082 | 1.013 | 39.905 |
| 2008 | 2714 | 8.803 | 121277 | 9.255 | 0.951* | -139.275 |
| 2009 | 2257 | 7.321 | 121714 | 9.289 | 0.788* | -606.556 |
| 2010 | 2757 | 8.943 | 126768 | 9.674 | 0.924* | -225.461 |
| 2011 | 2873 | 9.319 | 125626 | 9.587 | 0.972 | -82.593 |
| 2012 | 2772 | 8.992 | 125544 | 9.581 | 0.938* | -181.664 |

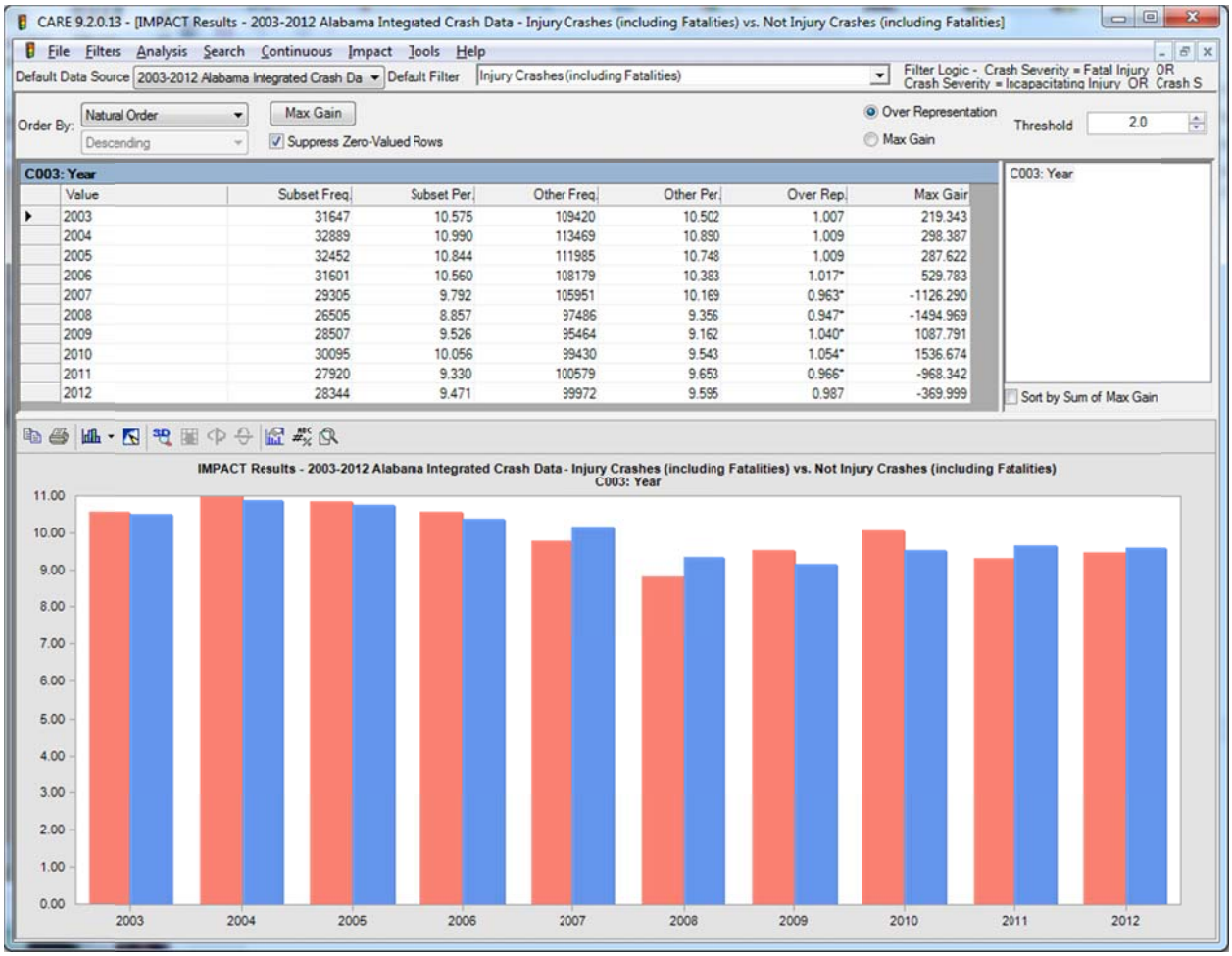
As discussed above, the overall trend of HTCs was down sharply until 2009 at which time the proportion regressed to about the 2008 level. The blue bars reflect a fairly consistent general downward trend in bib-HTC crashes in general with about a 1% drop from 2003 through 2012.

## Fatal Crashes



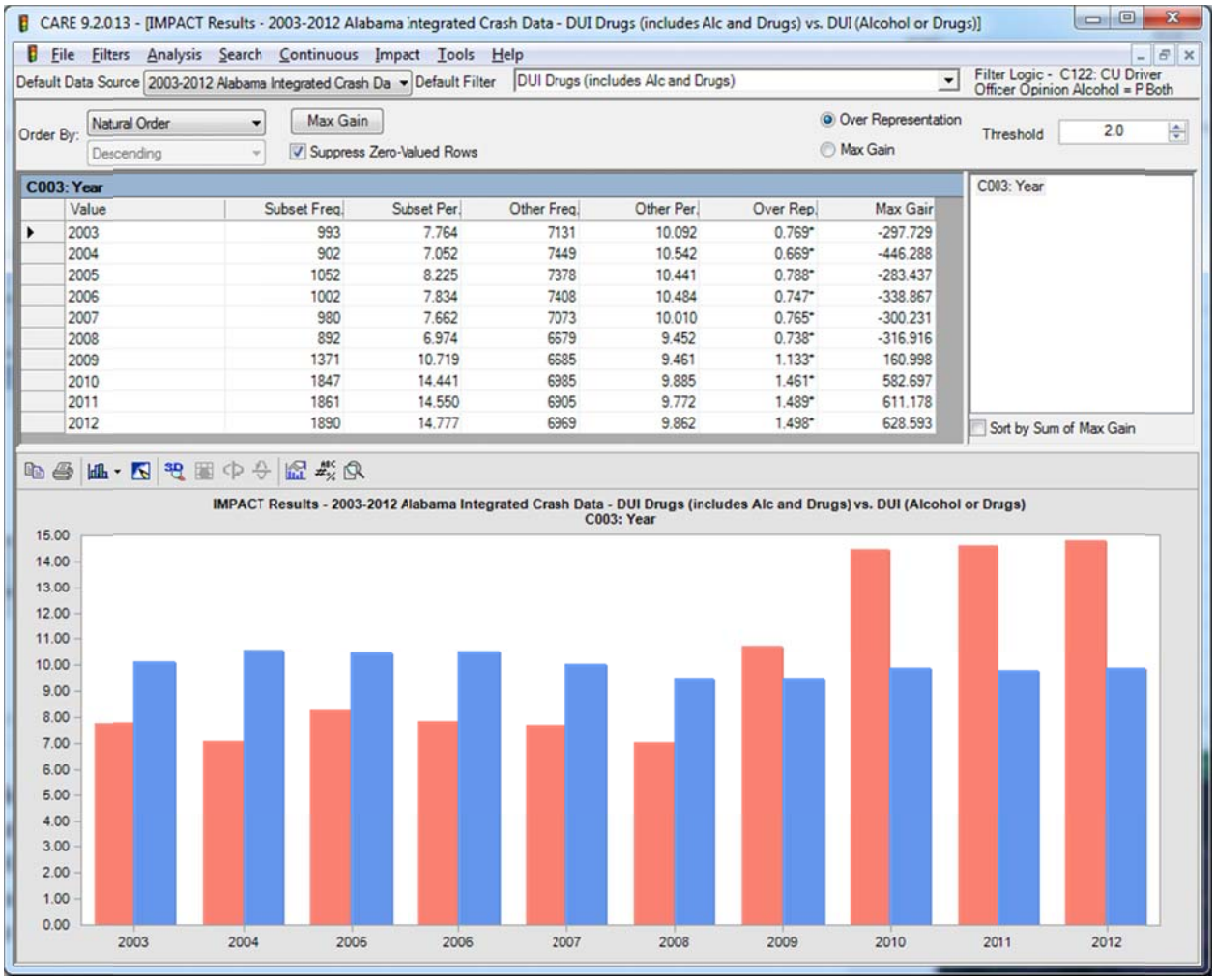

Note that this comparison is for fatal crashes and not for number of fatalities. The latter metric is subject to potential large influences from a single crash, and for that reason we view fatal crashes as a more reliable metric. This poses some interesting aspects of the fatality issues, especially in regard to the question: was the reduction in fatalities seen from 2006 just the result of fewer crashes in general. The chart above answers this question in the negative. Collectively 2004-2007 had significantly more fatal crashes than would be expected from the number of crashes in general. We can see the blue bars declining from 2005-2008, indicating a drop off in crashes in general (potentially the result of decreased traffic volume). However, fatality crashes lag behind this decrease, and as the overall crashes regress to their mean in 2010-2012, fatal crashes remain at a fairly lower level. There are a large number of reasons that have been proposed as causing this, but the fact that the recession hits the unsafe drivers much more dramatically than the safer drivers is a major factor. By “relatively unsafe” we mean younger drivers, older drivers (who themselves are not necessarily unsafe, but when they get in crashes tend to have far more fatalities), and drivers of older, less crashworthy vehicles. Professional drivers and commuters would be among those who are relatively safe, and their miles driven would not drop as much as the others.

## Injury Crashes



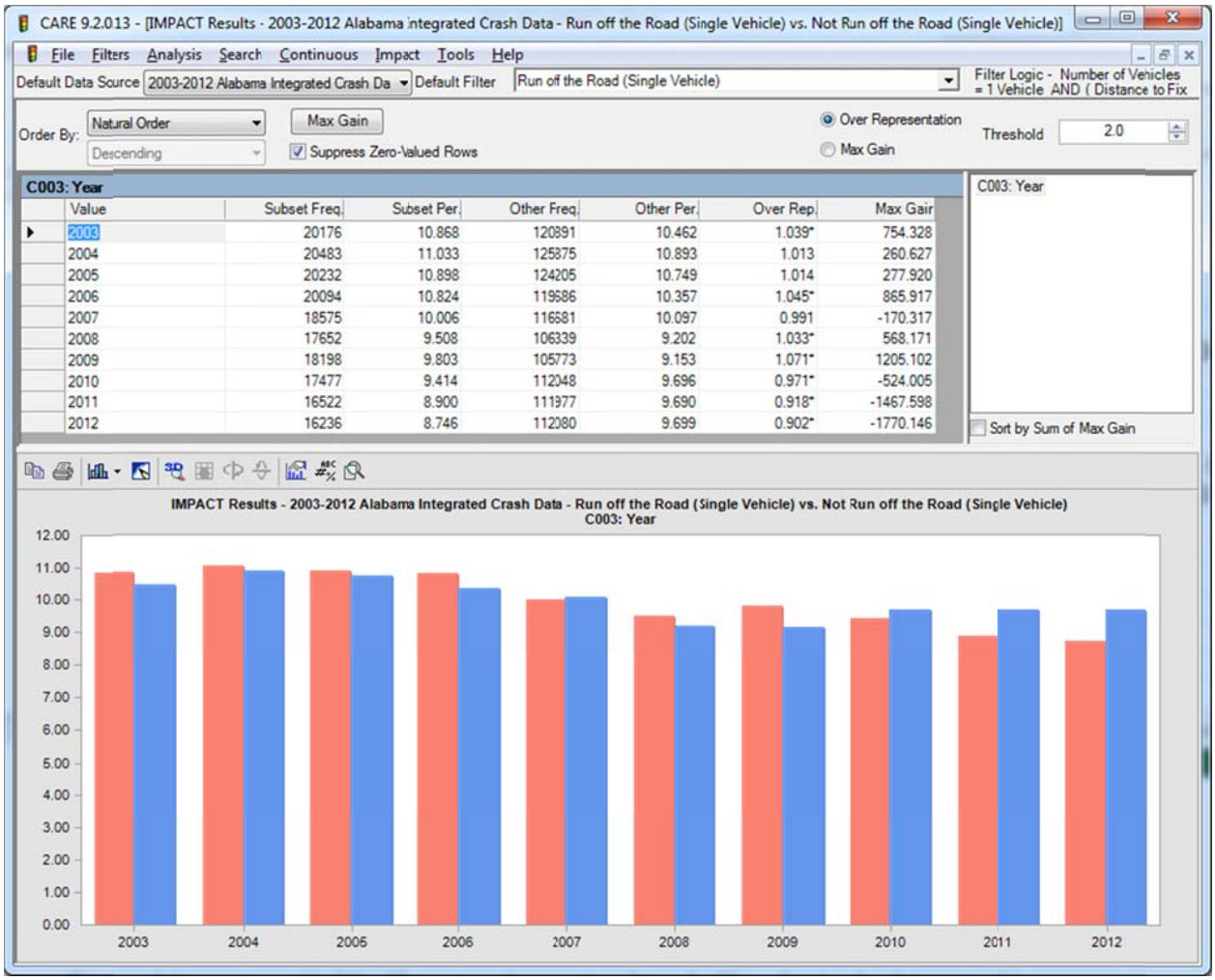

We would not expect injury crashes (which in this analysis includes fatal crashes) to be as sensitive to the factors mentioned above that drive fatal crashes). The trend, however, is quite similar, with a few notable exceptions. In particular, while 2009-2010 were significantly under-represented in fatal crashes, we find them significantly over-represented in injury crashes. This would be evidence that the fatality reduction may not be so much due to driver behavior as to vehicle crashworthiness. The severe crash events are occurring; they are just not resulting in deaths as often. An exception to this would be in the area of restraint use, which is certainly a driver behavioral factor.

## DUI Drugs (Includes all crashes that involved drugs)



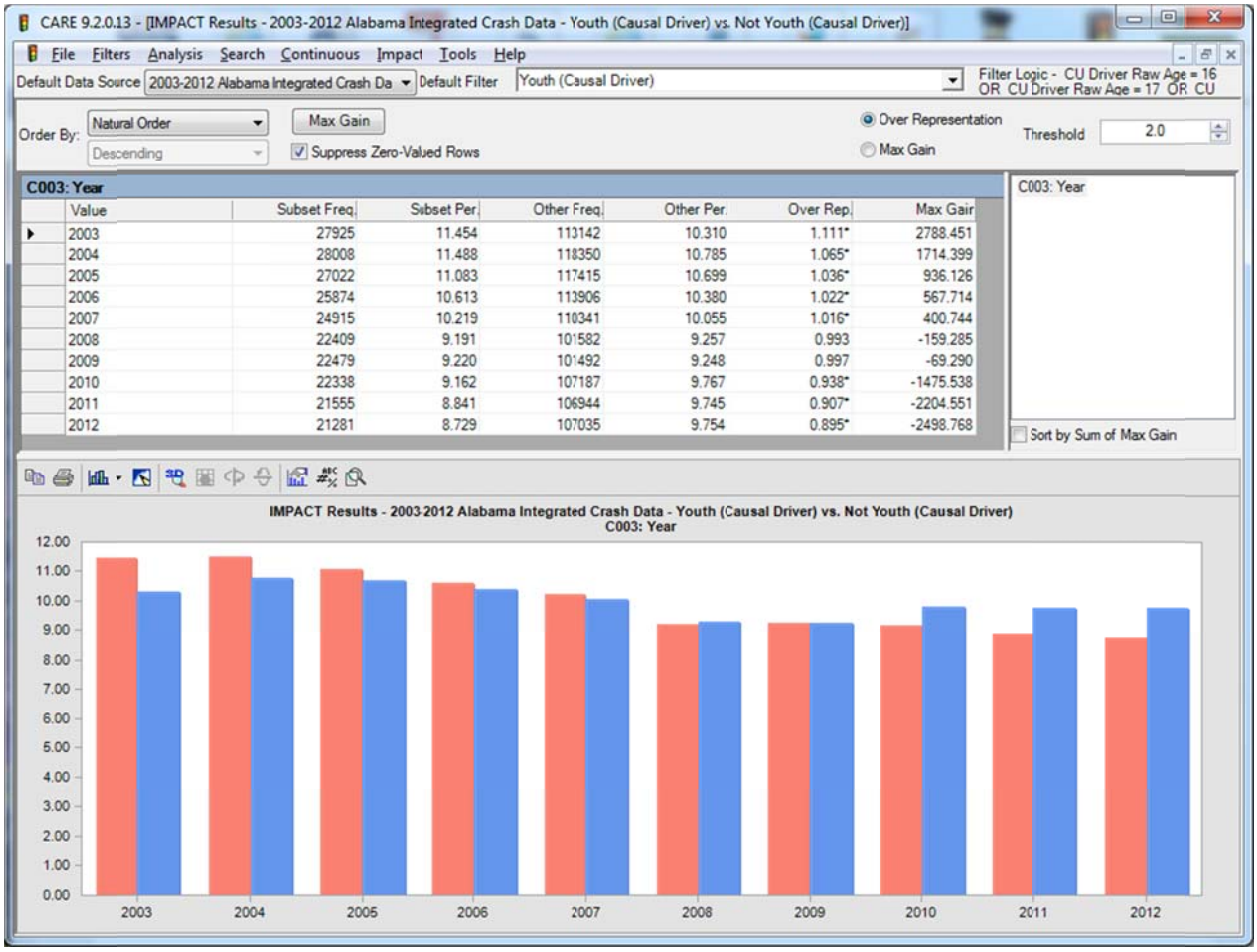

This analysis included all cases in which drugs were reported. It seems clear that the eCrash adoption, which started in June 2009 created a much higher tendency to report drug involvement. Noticing the stability in the number of reports from 2010 through 2012, no inferences should be drawn from any comparison of these with previous years other than that the reporting has become more complete.

## Run Off The Road Crashes



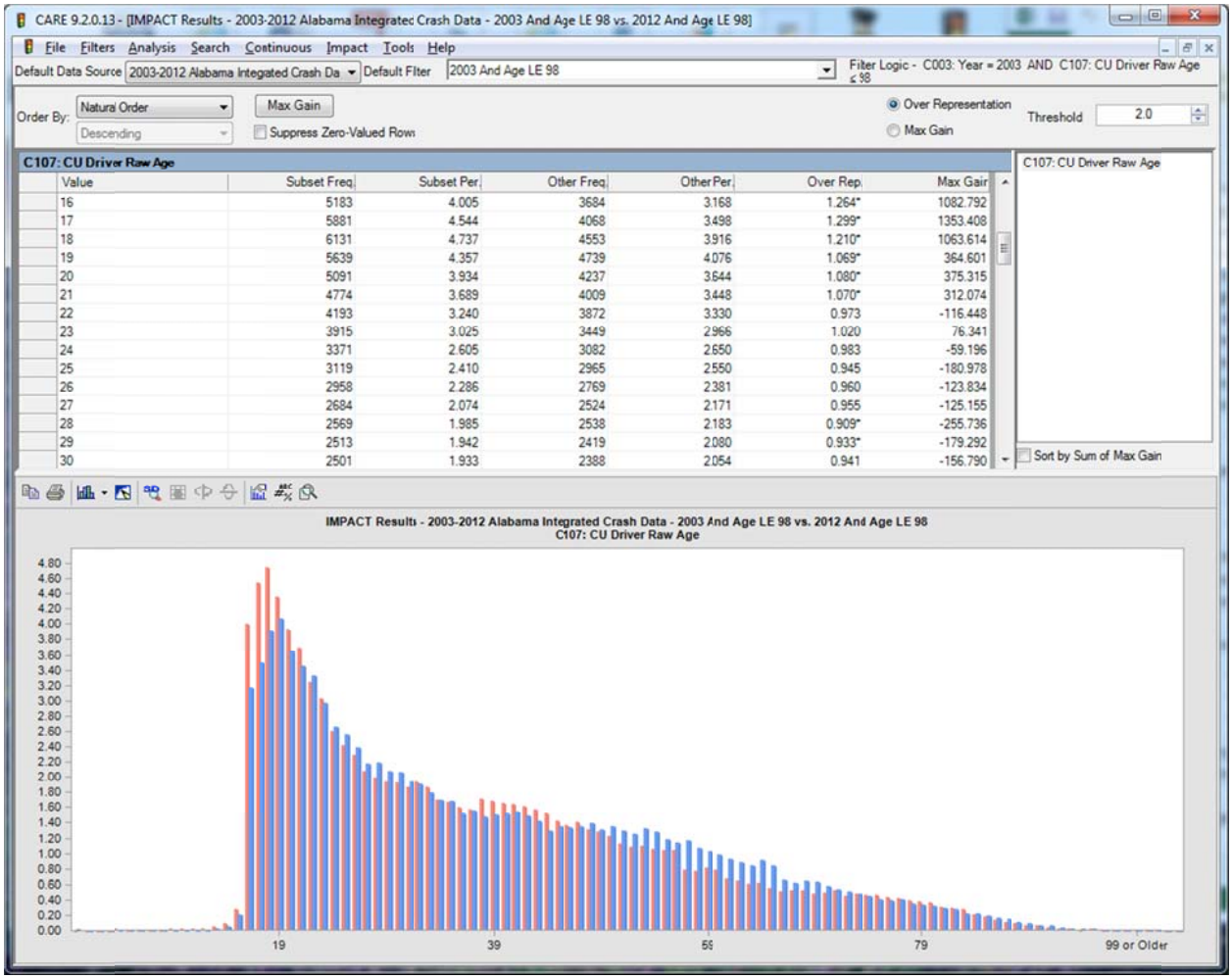

This comparison over the years is for run-off-the-road, hit-object type crashes, usually involving a single vehicle (exceptions might occur where non-contact vehicles are involved). In a sense these are what might be called “unforced errors.” They are heavily correlated with DUI. No doubt there is a significant downward trend from significant over-representation in 2003 and 006, to significant under-representation in the last three years.

## Youth (Age 16-20) Caused Crashes




This is another extremely positive trend, although it is mitigated somewhat by the drop off in the number of young people who are securing their drivers licenses at age 16. See the article on http://www.safehomealabama.gov/InfoTraining/YoungDriverIssues.aspx under Links: Teens Waiting Longer to Take the Wheel. Teens also tend to be more affected by the recession, loss of their part time jobs, and the increase cost of fuel. The important aspect of this analysis is to recognize that the decrease is from a situation in which this driver subset (age 16-20) still is having about three times the number of crashes as the rest of the driving population. This is a good direction, but we have a long way before we can say we have arrived.

The following puts this into perspective. The red bars are from 2003 and the blue bars are from 2012. Comparing shows that the relative causation of the 16-20 age group has in fact come down significantly. However it still dwarfs the older ages. And is well over two times the average for all ages.


CARE 9.2.0.13 - [IMPACT Results - 2003-2012 Alabama Integrated Crash Data - 2003 And Age LE 98 vs. 2012 And Age LE 98]
File Filters Analysis Search Continuous Impact Tools Help
Default Data Source 2003-2012 Alabama Integated Crash Da
Default Filter 2003 And Age LE 98
Filter Logic - C003: Year = 2003 AND C107: CU Driver Raw Age ≤ 98
Order By: Natural Order
Descending
Max Gain
Suppress Zero-Valued Rows
Over Representation
Max Gain
Threshold 2.0
C107: CU Driver Raw Age
Value Subset Freq Subset Per Other Freq Other Per Over Rep Max Gain
16 5183 4.005 3684 3.168 1.264* 1082.792
17 5881 4.544 4068 3.498 1.299* 1353.408
18 6131 4.737 4553 3.916 1.210* 1063.614
19 5639 4.357 4739 4.076 1.069* 364.601
20 5091 3.934 4237 3.644 1.080* 375.315
21 4774 3.689 4009 3.448 1.070* 312.074
22 4193 3.240 3872 3.330 0.973 -116.448
23 3915 3.025 3449 2.966 1.020 76.341
24 3371 2.605 3082 2.650 0.983 -59.196
25 3119 2.410 2965 2.550 0.945 -180.978
26 2958 2.286 2769 2.381 0.960 -123.834
27 2684 2.074 2524 2.171 0.955 -125.155
28 2569 1.985 2538 2.183 0.909* -255.736
29 2513 1.942 2419 2.080 0.933* -179.292
30 2501 1.933 2388 2.054 0.941 -156.790
C107: CU Driver Raw Age
Sort by Sum of Max Gain
IMPACT Results - 2003-2012 Alabama Integrated Crash Data - 2003 And Age LE 98 vs. 2012 And Age LE 98
C107: CU Driver Raw Age
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
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2.00
1.80
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0.40
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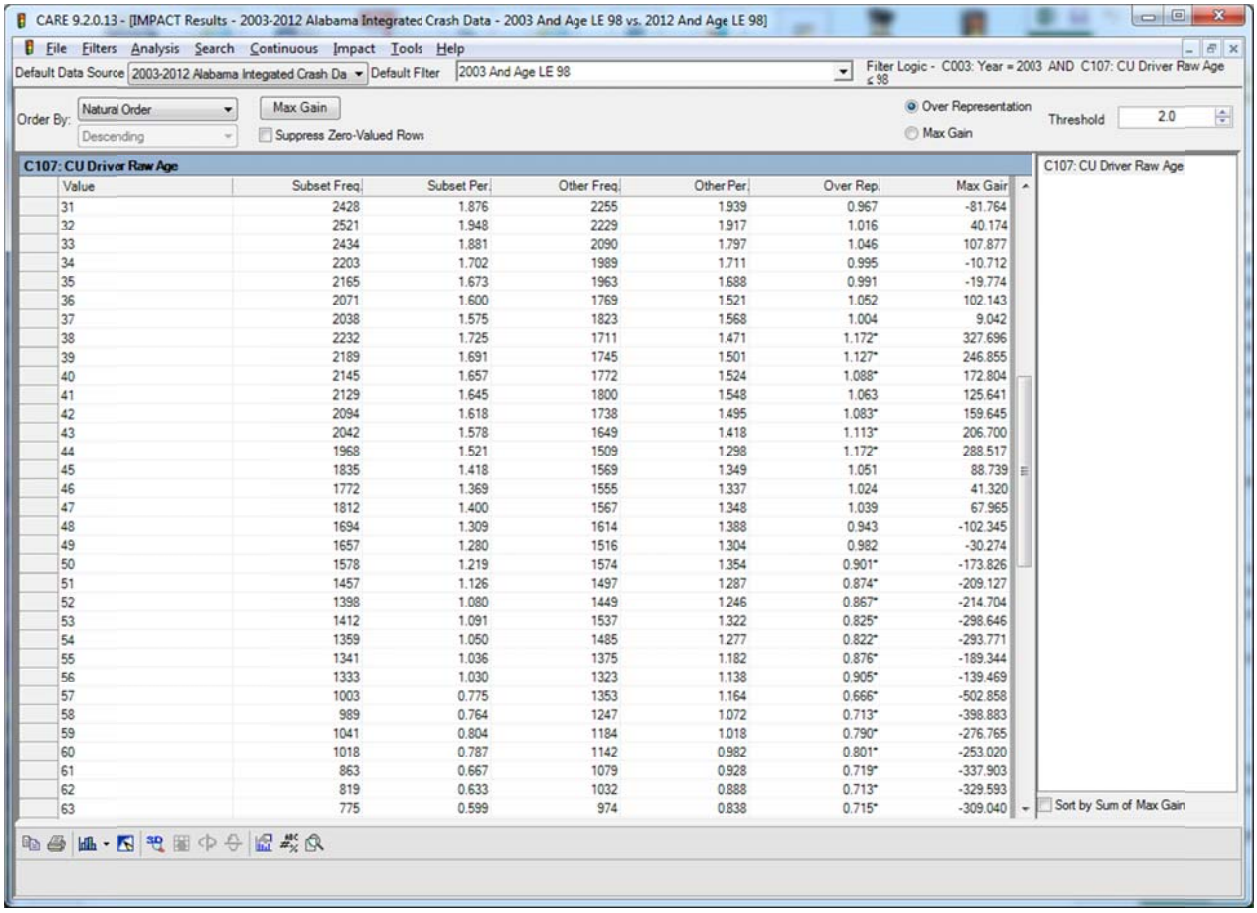
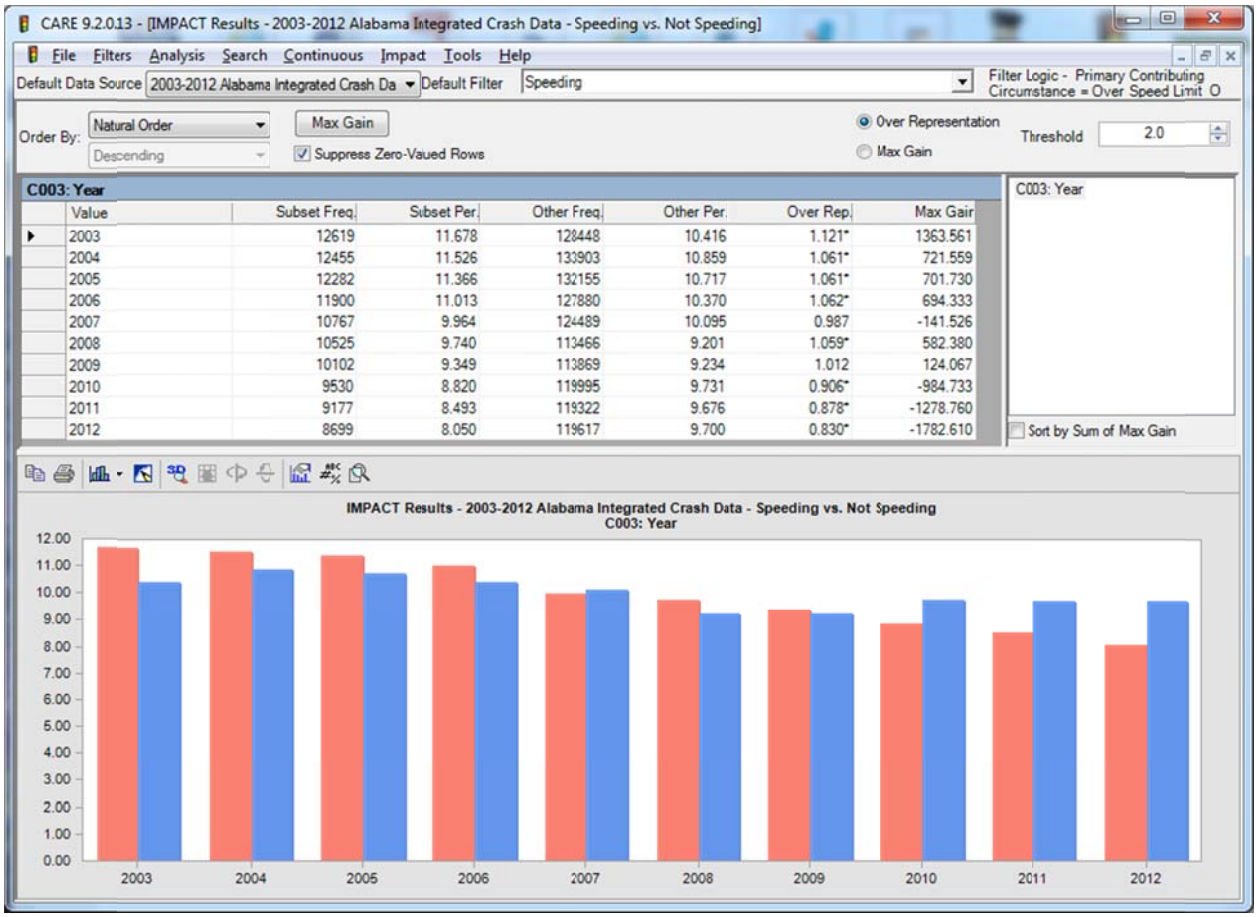
19
39
59
79
99 or Older



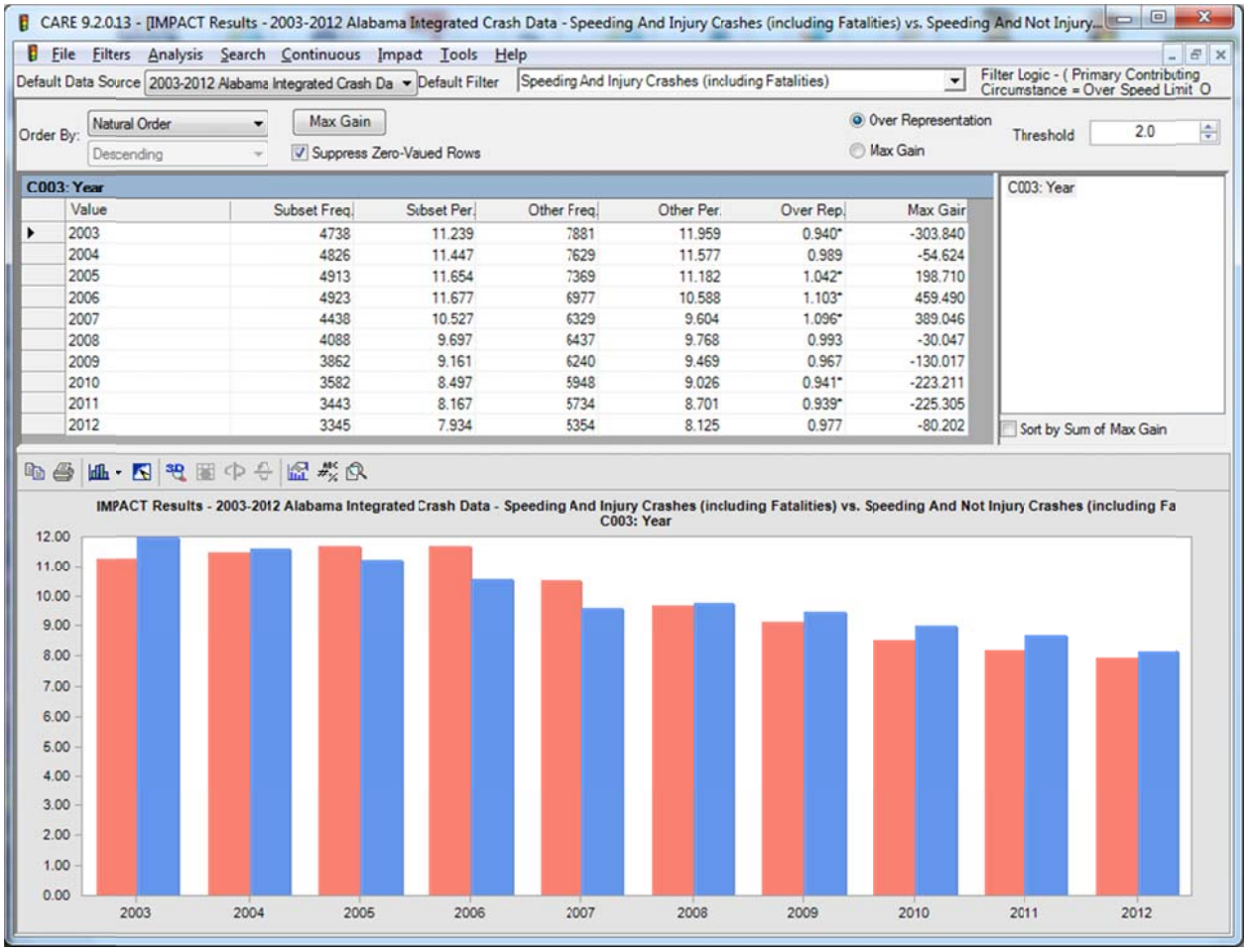

| Value | Subset Freq | Subset Per | Other Freq | Other Per | Over Rep | Max Gain |
|---|---|---|---|---|---|---|
| 31 | 2428 | 1.876 | 2255 | 1.939 | 0.967 | -81.764 |
| 32 | 2521 | 1.948 | 2229 | 1.917 | 1.016 | 40.174 |
| 33 | 2434 | 1.881 | 2090 | 1.797 | 1.046 | 107.877 |
| 34 | 2203 | 1.702 | 1989 | 1.711 | 0.995 | -10.712 |
| 35 | 2165 | 1.673 | 1963 | 1.688 | 0.991 | -19.774 |
| 36 | 2071 | 1.600 | 1769 | 1.521 | 1.052 | 102.143 |
| 37 | 2038 | 1.575 | 1823 | 1.568 | 1.004 | 9.042 |
| 38 | 2232 | 1.725 | 1711 | 1.471 | 1.172* | 327.696 |
| 39 | 2189 | 1.691 | 1745 | 1.501 | 1.127* | 246.855 |
| 40 | 2145 | 1.657 | 1772 | 1.524 | 1.088* | 172.804 |
| 41 | 2129 | 1.645 | 1800 | 1.548 | 1.063 | 125.641 |
| 42 | 2094 | 1.618 | 1738 | 1.495 | 1.083* | 159.645 |
| 43 | 2042 | 1.578 | 1649 | 1.418 | 1.113* | 206.700 |
| 44 | 1968 | 1.521 | 1509 | 1.298 | 1.172* | 288.517 |
| 45 | 1835 | 1.418 | 1569 | 1.349 | 1.051 | 88.739 |
| 46 | 1772 | 1.369 | 1555 | 1.337 | 1.024 | 41.320 |
| 47 | 1812 | 1.400 | 1567 | 1.348 | 1.039 | 67.965 |
| 48 | 1694 | 1.309 | 1614 | 1.388 | 0.943 | -102.345 |
| 49 | 1657 | 1.280 | 1516 | 1.304 | 0.982 | -30.274 |
| 50 | 1578 | 1.219 | 1574 | 1.354 | 0.901* | -173.826 |
| 51 | 1457 | 1.126 | 1497 | 1.287 | 0.874* | -209.127 |
| 52 | 1398 | 1.080 | 1449 | 1.246 | 0.867* | -214.704 |
| 53 | 1412 | 1.091 | 1537 | 1.322 | 0.825* | -298.646 |
| 54 | 1359 | 1.050 | 1485 | 1.277 | 0.822* | -293.771 |
| 55 | 1341 | 1.036 | 1375 | 1.182 | 0.876* | -189.344 |
| 56 | 1333 | 1.030 | 1323 | 1.138 | 0.905* | -139.469 |
| 57 | 1003 | 0.775 | 1353 | 1.164 | 0.666* | -502.858 |
| 58 | 989 | 0.764 | 1247 | 1.072 | 0.713* | -398.883 |
| 59 | 1041 | 0.804 | 1184 | 1.018 | 0.790* | -276.765 |
| 60 | 1018 | 0.787 | 1142 | 0.982 | 0.801* | -253.020 |
| 61 | 863 | 0.667 | 1079 | 0.928 | 0.719* | -337.903 |
| 62 | 819 | 0.633 | 1032 | 0.888 | 0.713* | -329.593 |
| 63 | 775 | 0.599 | 974 | 0.838 | 0.715* | -309.040 |

When comparing the age distribution of all crashes in 2003 against those in 2012, the significant over-representation in 2003 are in the 16-20 and 38-45 age groupings. The significant over-representation in 2012 are in the 25-30 and 50-65 age groupings. Drivers are getting older, and the aging of drivers, especially in the professional realm is a real concern. We should not lose sight of the raw frequencies, however, which demonstrate that the primary target for behavioral countermeasures has to be the youngest drivers.

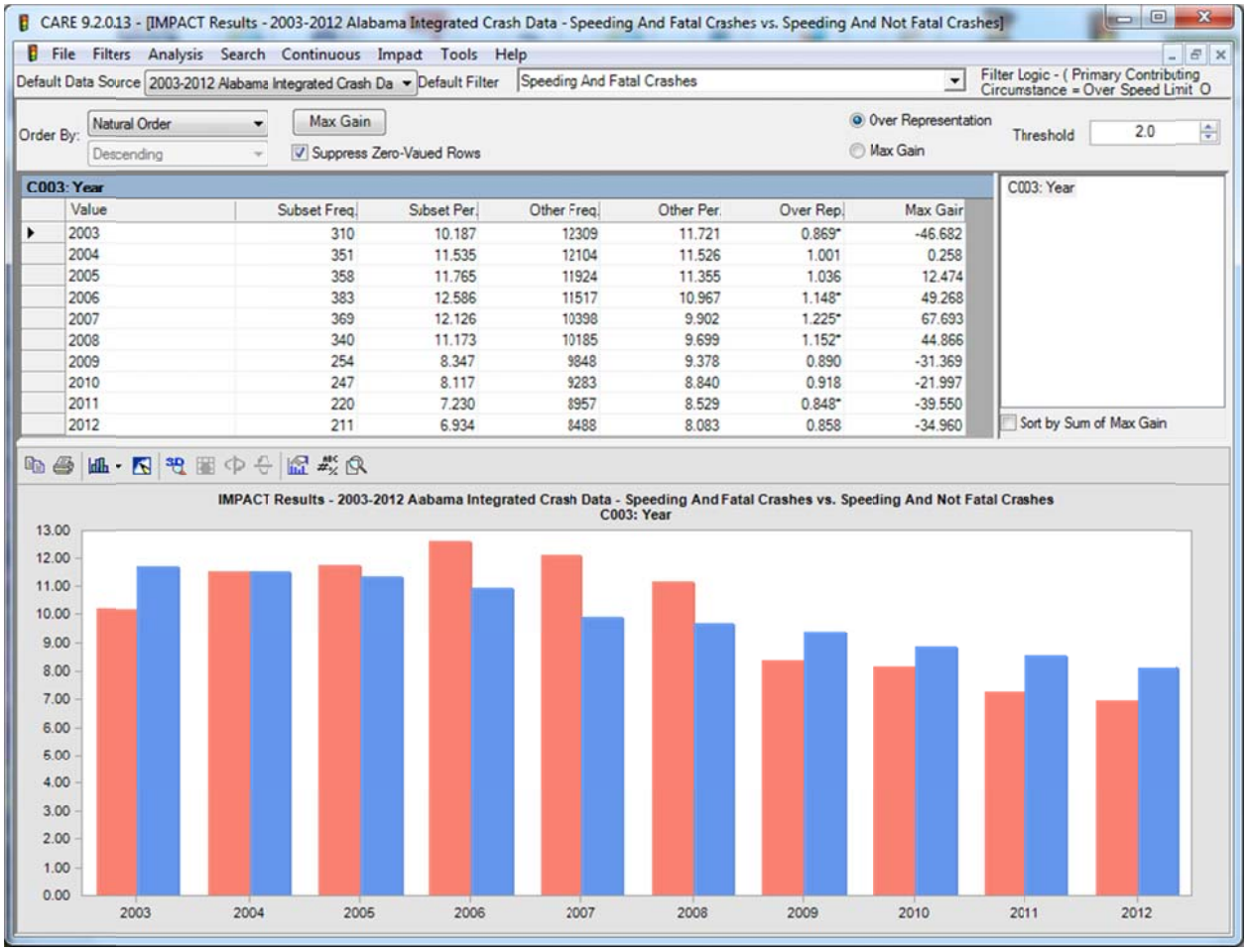
## Speeding Involved Crashes




This is one of the few extremely favorable and consistent trends – a smaller proportion of crashes are being caused by speeding. This will result in fewer fatalities in that a reduction in impact speed of 10 MPH will cut the probably of that crash causing a fatality in half. This is the effect of sustained selective enforcement that should not be curtailed in the future.

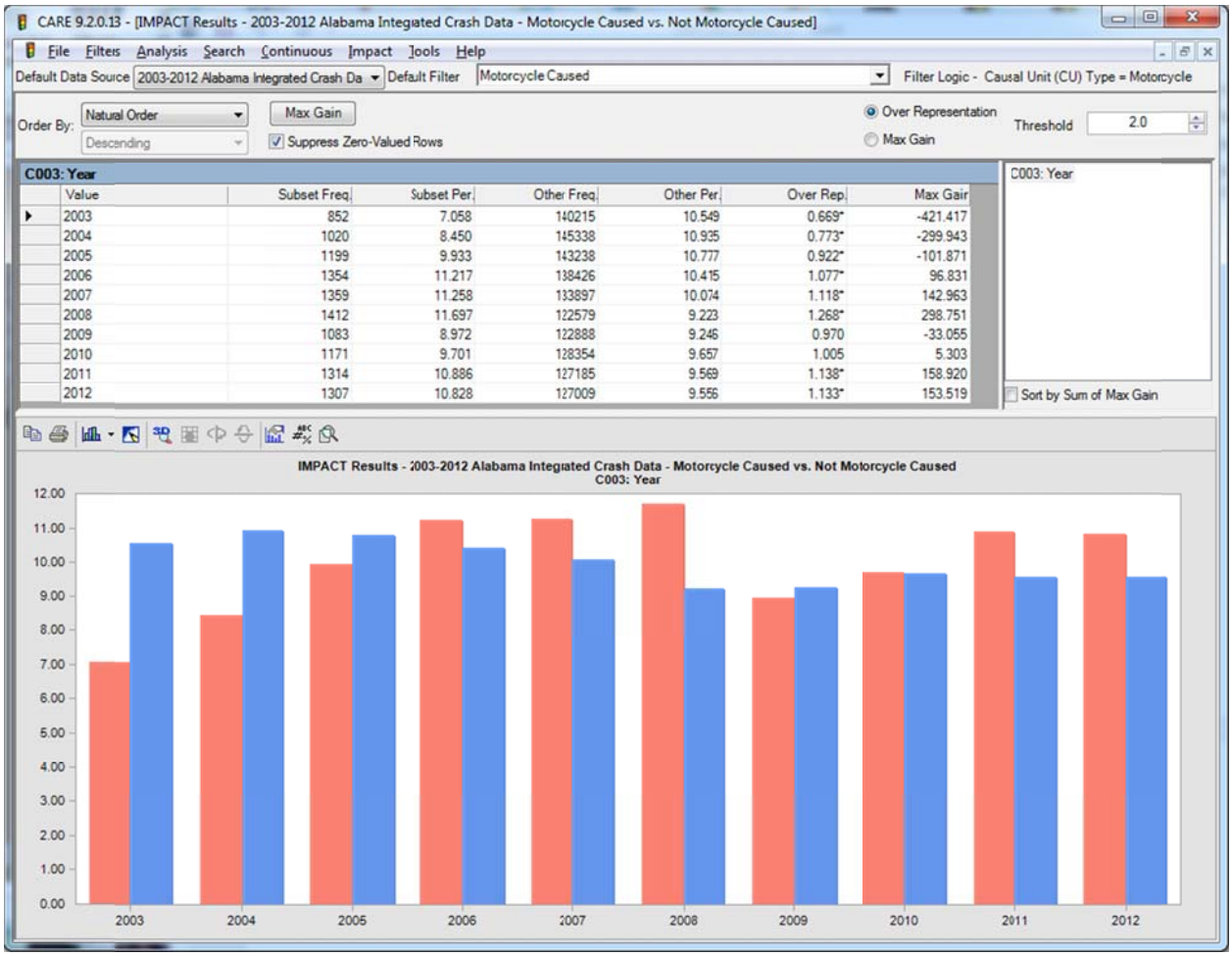



A comparison of the speed injury/fatal crashes (red bars) against all speed crashes (blue bars) shows that the severity of these crashes is also decreasing, as would be expected. Speed is entering in, but at a lower level of speeding, which too will save lives. To further establish this fact, speed related fatality crashes were compared with all other speed crashes.

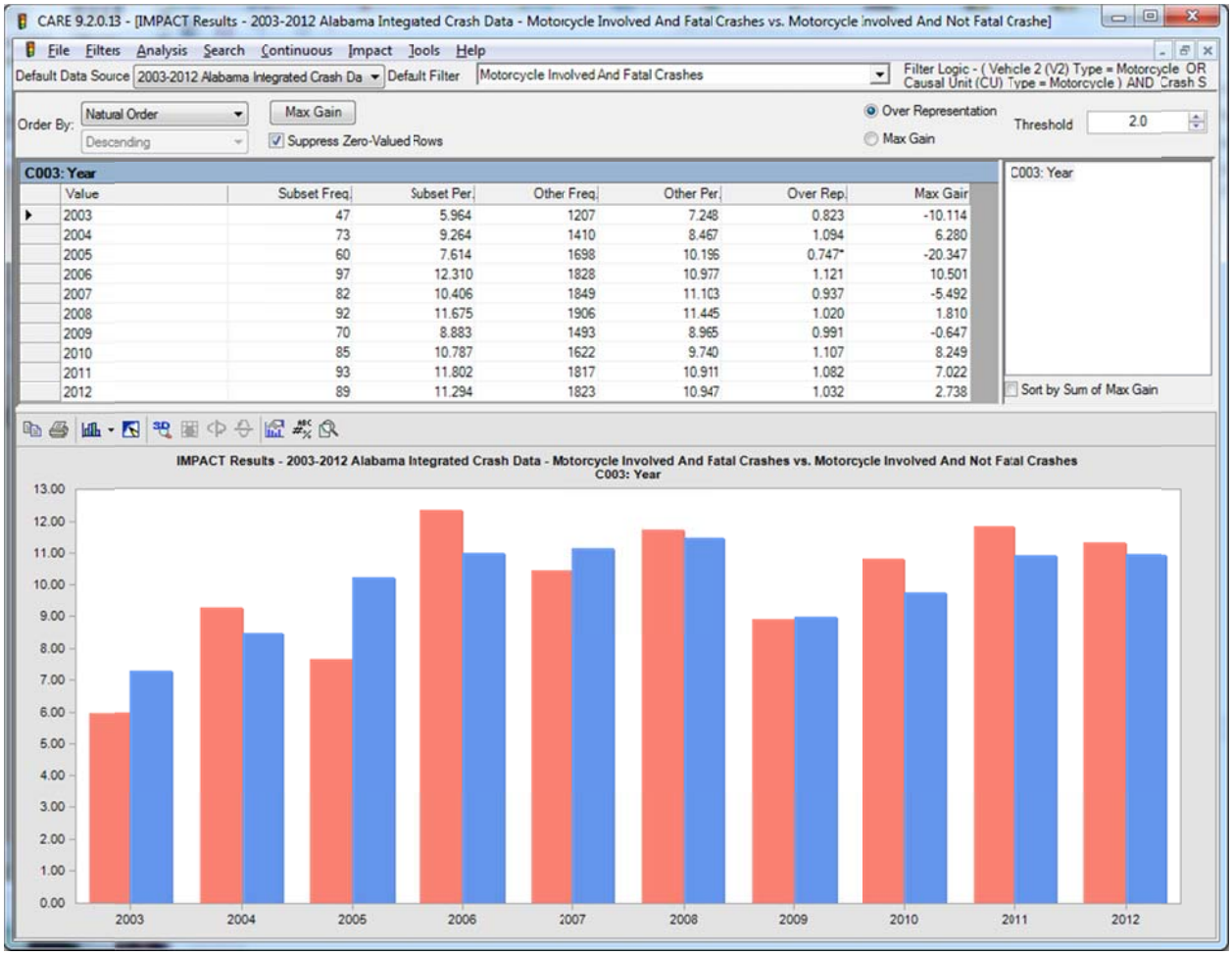



This confirms the previous finding and demonstrates that the lowered severity applies to speed fatal crashes as much, if not more, than to speed injury crashes.

## Motorcycle Caused and Involved Crashes

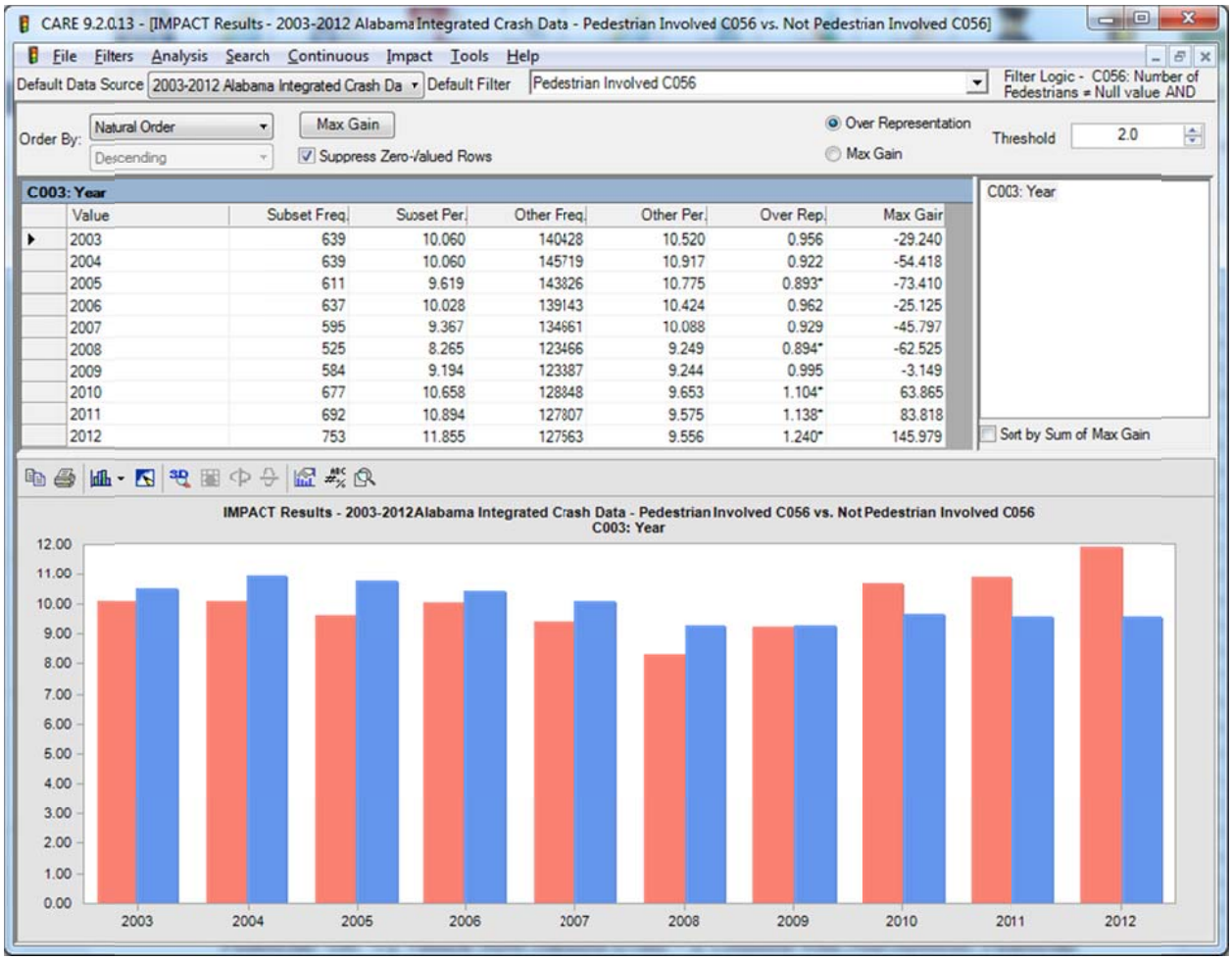



Note that this comparison is of motorcycle caused crashes, not all that they were involved in. All of these years have statistically significant differences with the only exceptions being 2009 and 2010, where the actual and expected were nearly identical. The trend over ten years is obviously up more for motorcycles than for all other motor vehicles (viewed collectively). We have no explanation for the 2009-2010 years. Clearly from 2003 through 2008 the trend in motorcycle use was up. When we see sharp drops in 2009-2010 we tend to suspect that moving to eCrash may have made some difference in reporting of motorcycle crash causation. The increased use of motorcycles as opposed to passenger vehicles in order to save on fuel costs cannot be ignored. If older drivers are taking up motorcycle usage, this would certainly compound the problem both from a skill and a survivability perspective. Clearly in the last three years the number of motorcycle caused crashes has been much higher than what would be expected in comparison with other types of crashes.

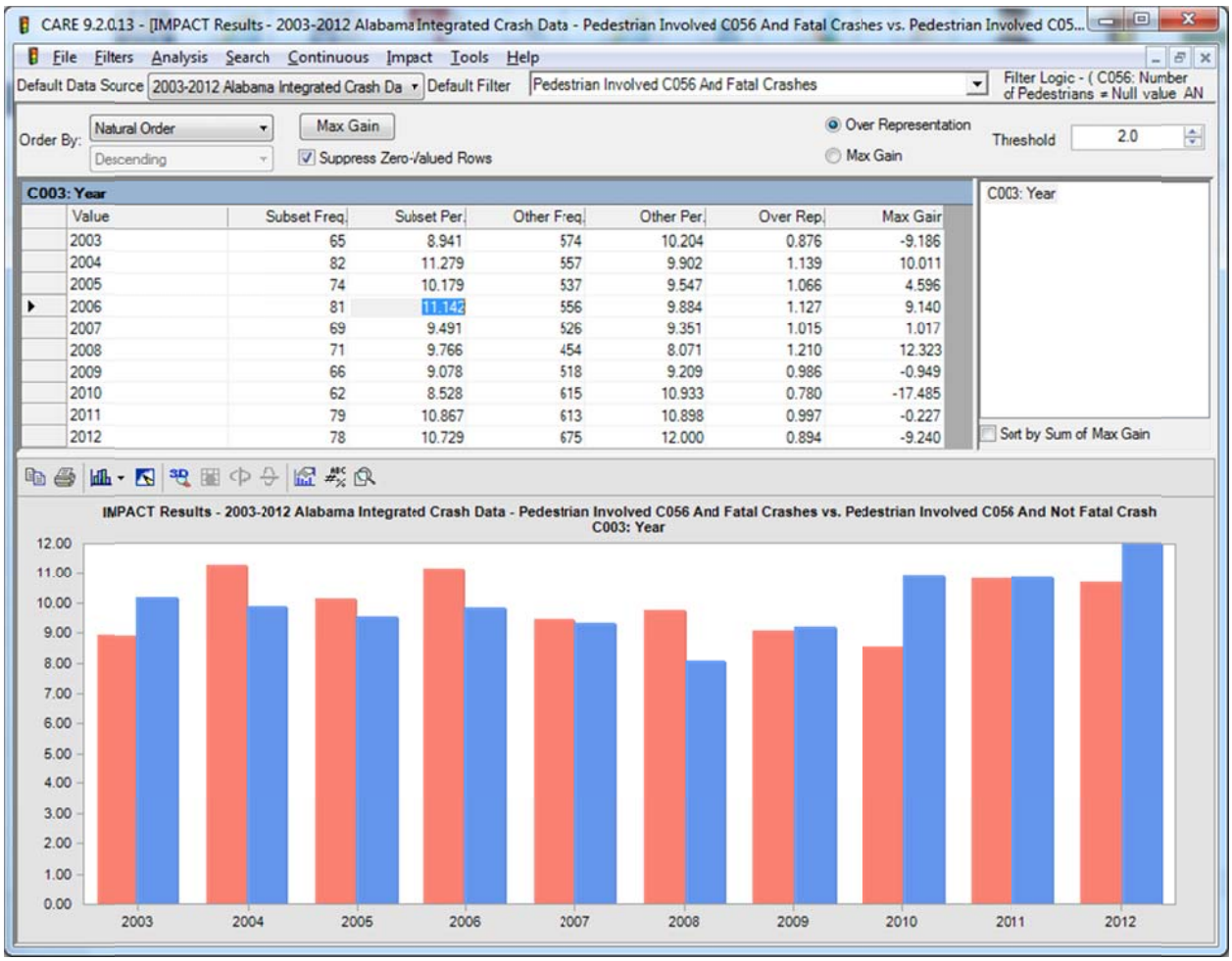



The comparison above is strictly within the motorcycle crash subset. It compares motorcycle fatal crashes (red bars) against motorcycle non-fatal crashes (blue bars). While this looks more choppy than the prior comparison, the low sample sizes result in only 2005 to be statistically significant. What this means is that while clearly the frequency of motorcycle crashes are grown, within themselves they are not becoming more lethal. Now there will be more fatalities reaulting from motorcycle crashes – that can be seen by just looking at the growth in the red bars over time. However, this increase proportionately does not vary from chance from what would be expected from the overall involvement. Note the general trend in the increase in the blue bars as well. While in any given year this is not significant, if we consider collectively the most recent three years (2010-2012), all three of these show proportionately more fatal crashes than crashes in general, and this would be an indication that the drivers who have recently turned to motorcycles might not be as proficient when it comes to crash survival.

## Pedestrian Involved



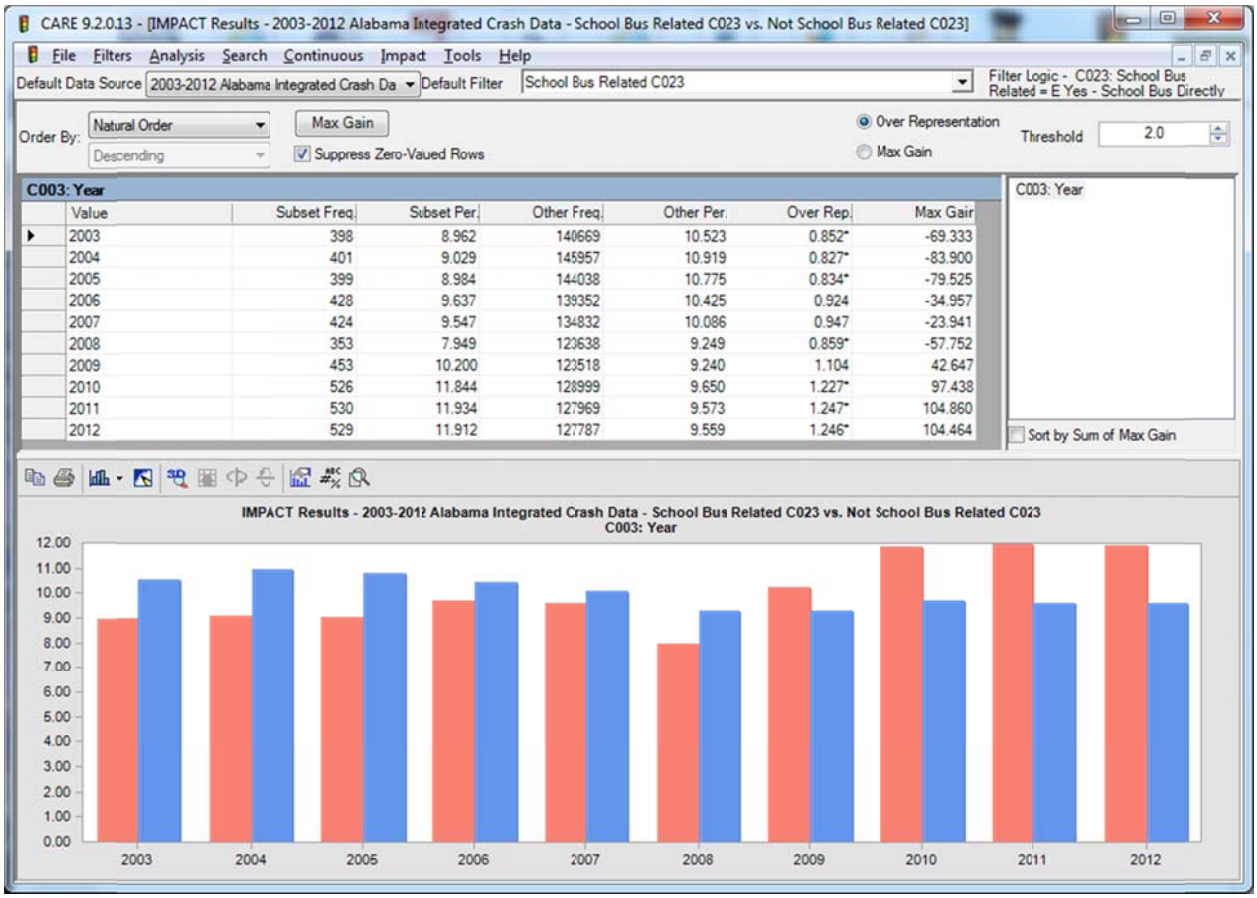

This compares pedestrian involved crashes with all other crash types that do not involve pedestrians. This is an interesting pattern definitely showing a general decrease in pedestrian collisions up until 2008, and then a dramatic increase after that to current. It is quite difficult at this time to compare the pre- and post-2009 results because of the change in the data collection variable structures. At best his needs to be tracked to assure that the increase is due to the change in reporting. The increase of 2012 over 2011 is of particular concern.



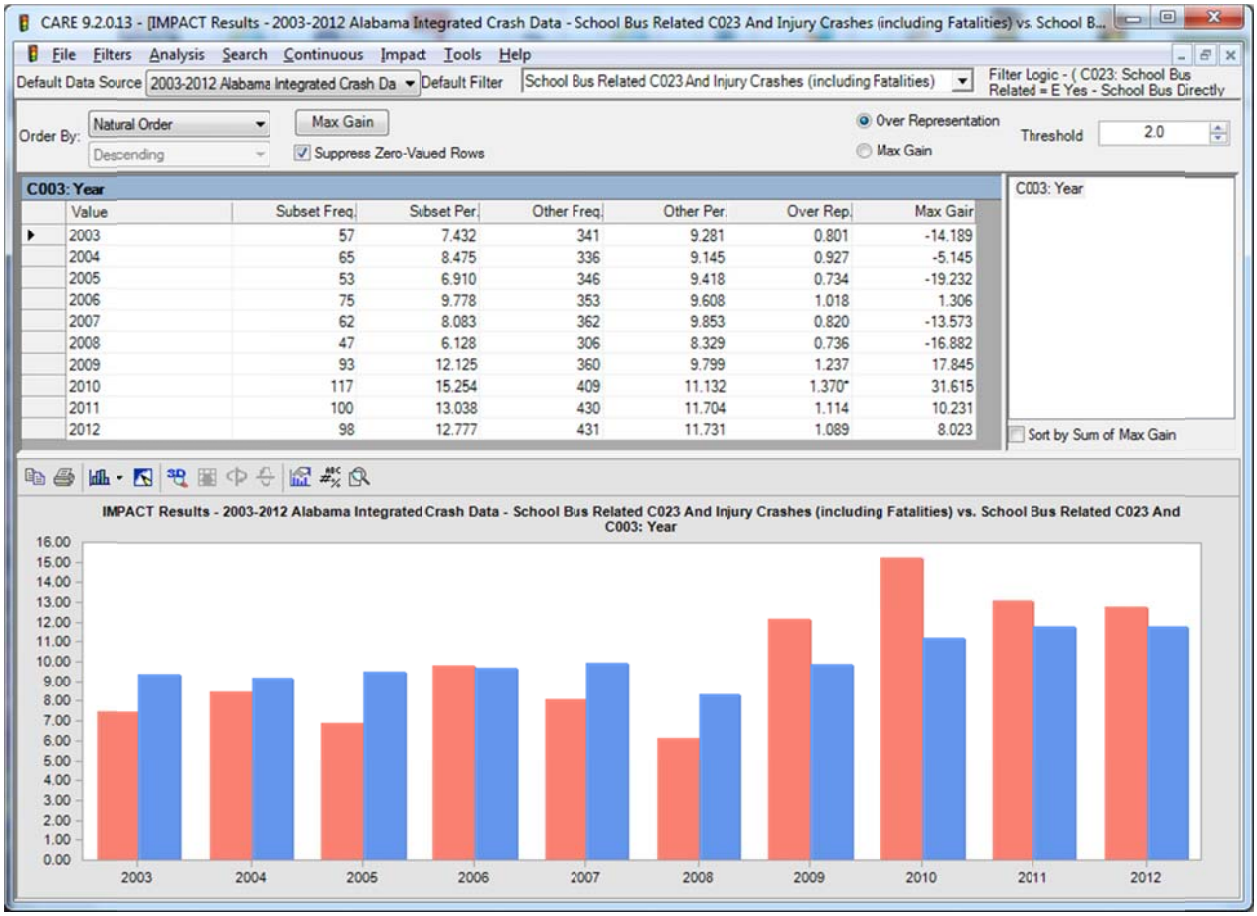

| Value | Subset Freq. | Subset Per. | Other Freq. | Other Per. | Over Rep. | Max Gain |
|---|---|---|---|---|---|---|
| 2003 | 65 | 8.941 | 574 | 10.204 | 0.876 | -9.186 |
| 2004 | 82 | 11.279 | 557 | 9.902 | 1.139 | 10.011 |
| 2005 | 74 | 10.179 | 537 | 9.547 | 1.066 | 4.596 |
| 2006 | 81 | 11.142 | 556 | 9.884 | 1.127 | 9.140 |
| 2007 | 69 | 9.491 | 526 | 9.351 | 1.015 | 1.017 |
| 2008 | 71 | 9.766 | 454 | 8.071 | 1.210 | 12.323 |
| 2009 | 66 | 9.078 | 518 | 9.209 | 0.986 | -0.949 |
| 2010 | 62 | 8.528 | 615 | 10.933 | 0.780 | -17.485 |
| 2011 | 79 | 10.867 | 613 | 10.898 | 0.997 | -0.227 |
| 2012 | 78 | 10.729 | 675 | 12.000 | 0.894 | -9.240 |

This is a comparison within the pedestrian subset to see if these crash types are getting more or less lethal. None of the differences within years is significant, and the number of pedestrian fatalities over the years has only varied due to chance (or, we can say that nothing other than chance can be assigned since there are no significant differences found). The blue bars here represent all pedestrian crashes, which seem to have considerably more variability than the number of pedestrian fatalities. The increase in the blue bars in 2010-2012 should warrant this crash type being watched carefully as more data are accumulated.

## School Bus Related




The chart above shows very definitively and with a majority of significant differences (2003-2005, 2008, 2010-2012) that the overall number of school bus crashes is increasing. While this might be attributed to the change in reporting that occurred in 2009, it is clear that this is a variable that needs to be watched closely.



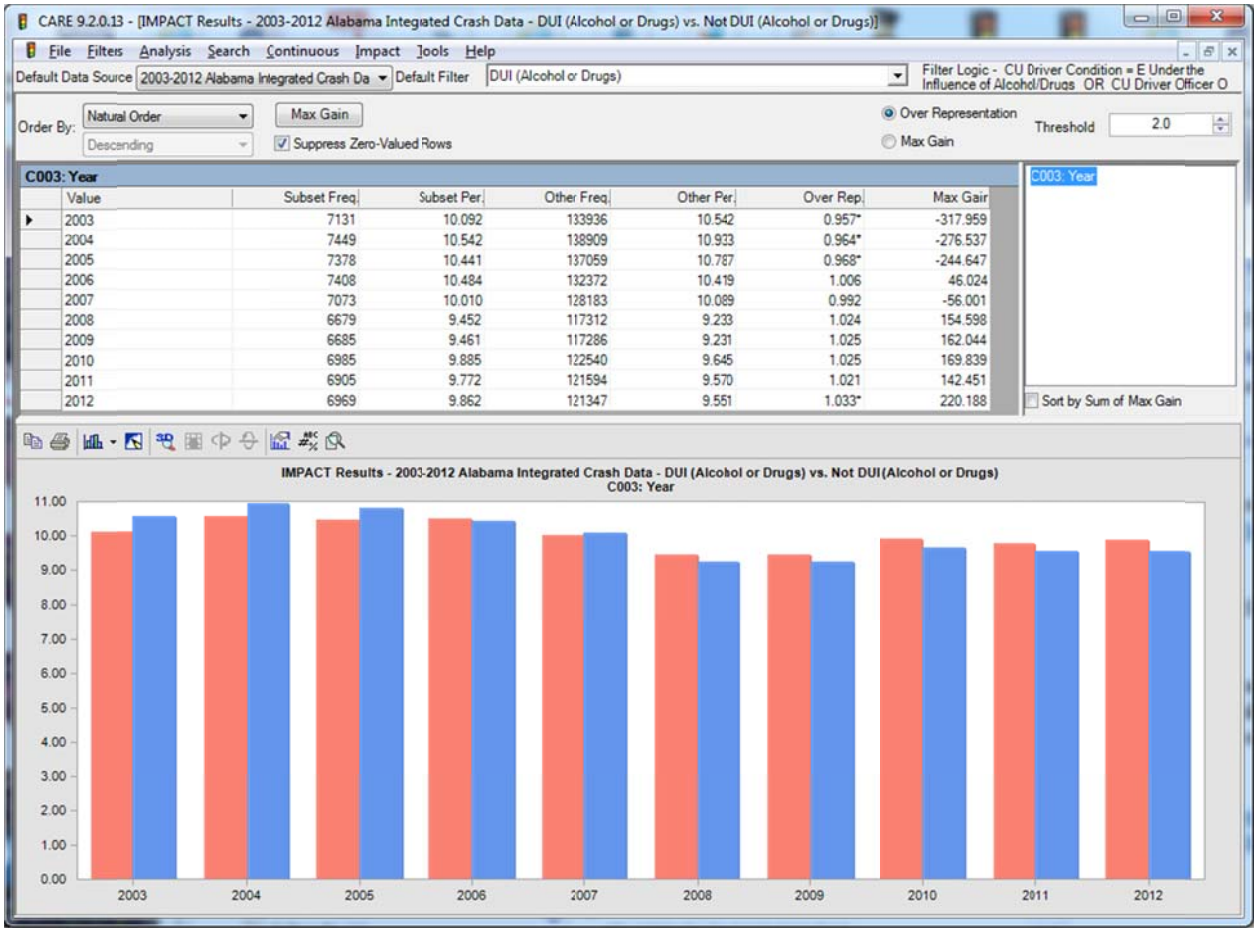

| Value | Subset Freq | Subset Per | Other Freq | Other Per | Over Rep | Max Gair |
|---|---|---|---|---|---|---|
| 2003 | 57 | 7.432 | 341 | 9.281 | 0.801 | -14.189 |
| 2004 | 65 | 8.475 | 336 | 9.145 | 0.927 | -5.145 |
| 2005 | 53 | 6.910 | 346 | 9.418 | 0.734 | -19.232 |
| 2006 | 75 | 9.778 | 353 | 9.608 | 1.018 | 1.306 |
| 2007 | 62 | 8.083 | 362 | 9.853 | 0.820 | -13.573 |
| 2008 | 47 | 6.128 | 306 | 8.329 | 0.736 | -16.882 |
| 2009 | 93 | 12.125 | 360 | 9.799 | 1.237 | 17.845 |
| 2010 | 117 | 15.254 | 409 | 11.132 | 1.370* | 31.615 |
| 2011 | 100 | 13.038 | 430 | 11.704 | 1.114 | 10.231 |
| 2012 | 98 | 12.777 | 431 | 11.731 | 1.089 | 8.023 |

There have been less than three fatality crashes per year involving school busses over the past year, most of which did not involve fatalities to the children on the bus. Rather than looking at fatal crashes for which no conclusions could be drawn, we consider above injury crashes involving school buses. This will provide a check on the above, since injury crashes are obviously investigated in much more detail than property damage only crashes. The above shows an alarming trend toward greater number of injury crashes involving school buses, especially when considering the composite 2009-2012 time frame in which 2010-2012 were significantly more than expected in comparison to the overall number of school bus crashes. So we conclude that school bus crashes and school bus injuries are on the increase and some definitive measures to curtail these increases are in order.

## Cross Over Crashes

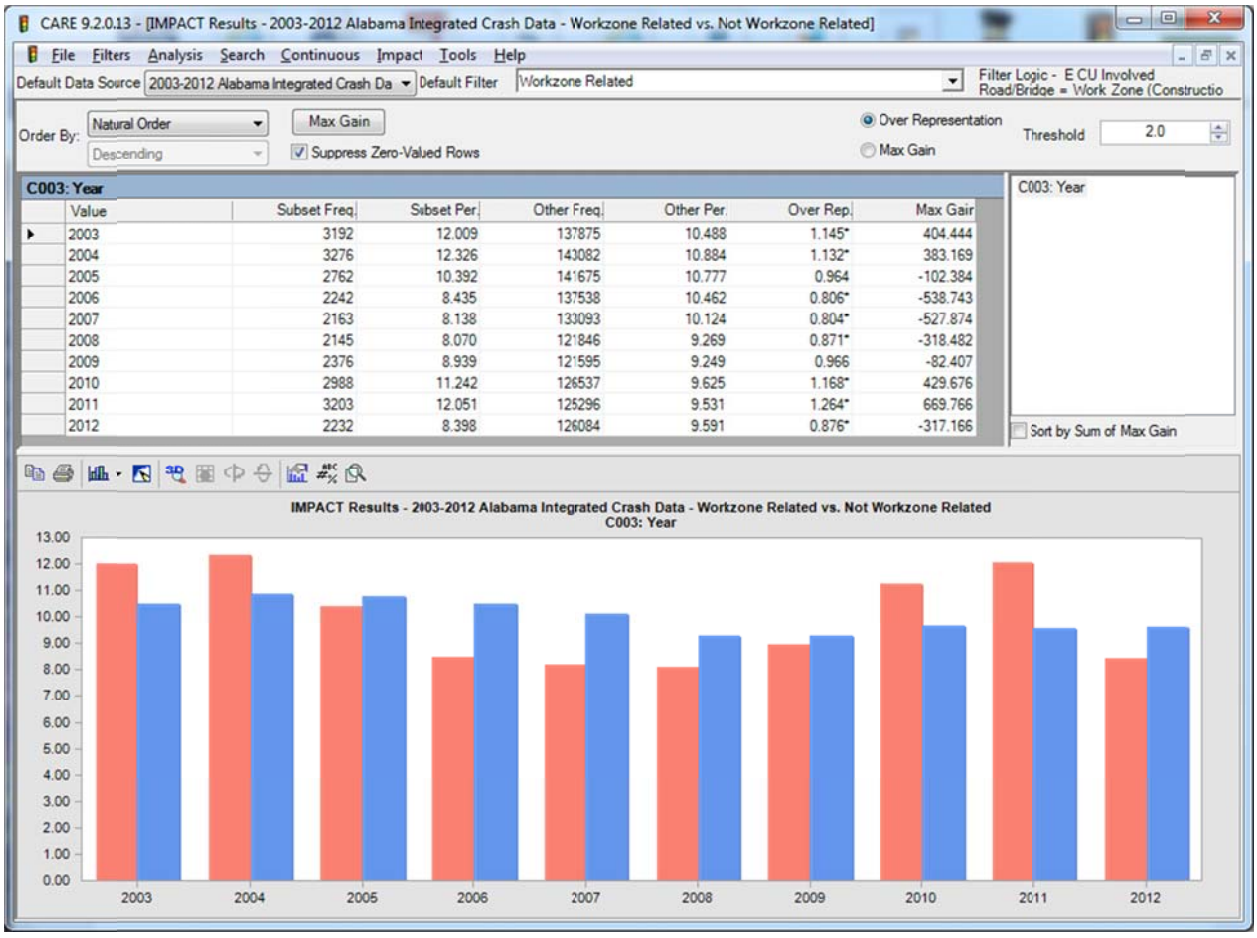
The following logic was applied to determine cross-over crashes on four lane routes:

(( CU Vehicle Initial Travel Direction = North AND V2 Vehicle Initial Travel Direction = South ) OR ( CU Vehicle Initial Travel Direction = East AND V2 Vehicle Initial Travel Direction = West ) OR ( CU Vehicle Initial Travel Direction = South AND V2 Vehicle Initial Travel Direction = North ) OR ( CU Vehicle Initial Travel Direction = West AND V2 Vehicle Initial Travel Direction = East )) AND CU Trafficway Lanes = Four Lanes




Cross-over crashes are quite important in that they are some of the most severe recorded. They involve vehicles crossing over a median and interacting with vehicle coming in the opposite direction on four lane roadways. Countermeasures to this that were implements in the 2006-2007 were instrumental in reducing the frequency of these crashes, and we can see this crash type to be significantly lower in 2008 and 2009. However, it regressed to almost its 2007 level during the last three years of the decade. Still, the last three years are below the first three years, indicating real improvement in these generally extremely severe crashes.

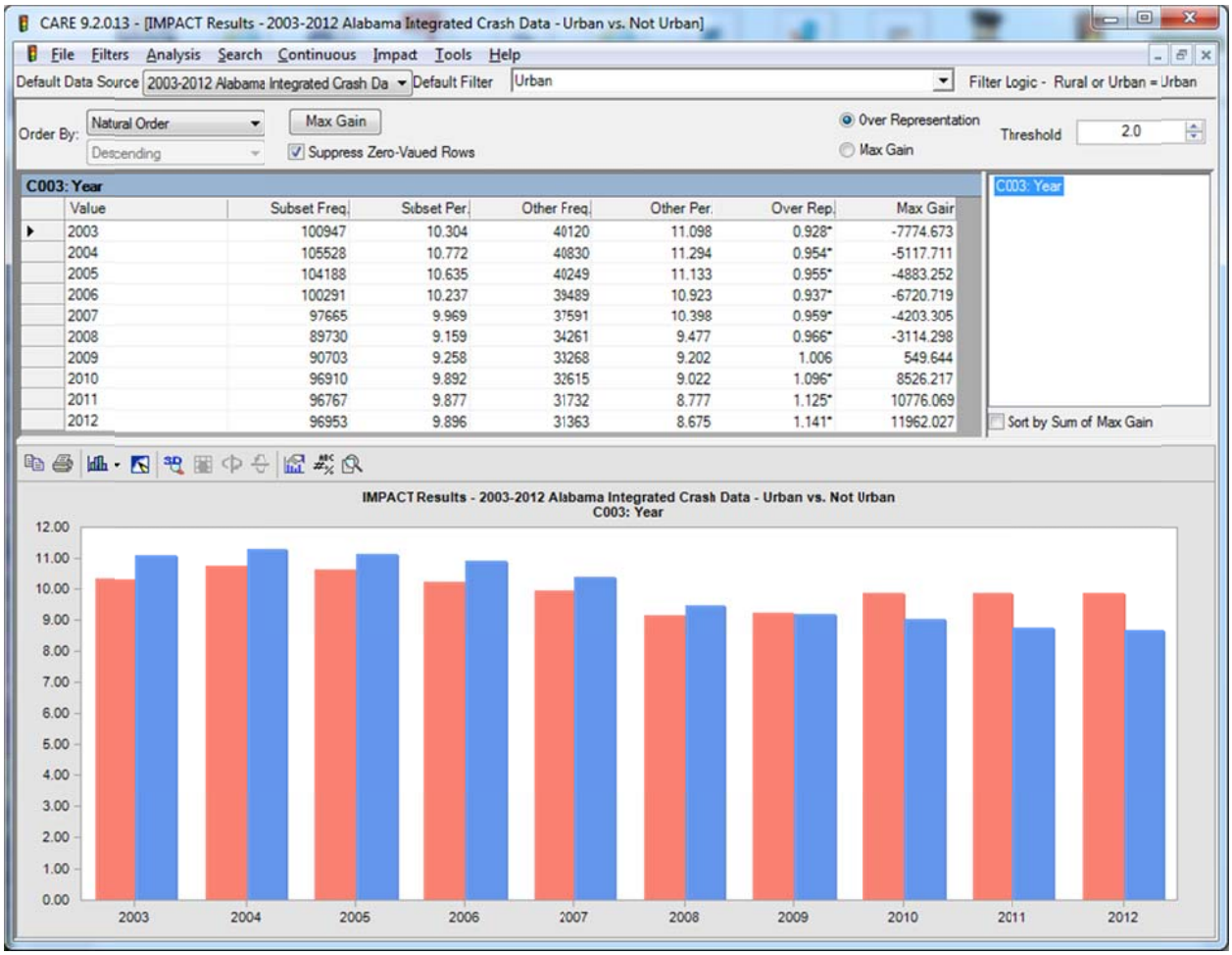
## Workzone Related Crashes



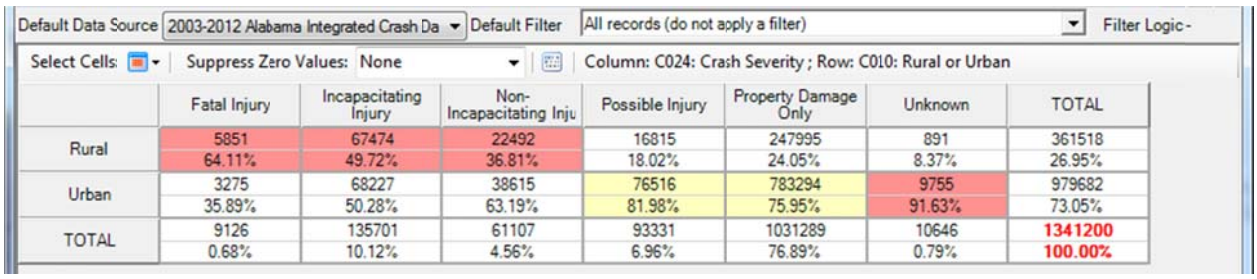

| Value | Subset Freq | Subset Per | Other Freq | Other Per | Over Rep | Max Gain |
|---|---|---|---|---|---|---|
| 2003 | 3192 | 12.009 | 137875 | 10.488 | 1.145* | 404.444 |
| 2004 | 3276 | 12.326 | 143082 | 10.884 | 1.132* | 383.169 |
| 2005 | 2762 | 10.392 | 141675 | 10.777 | 0.964 | -102.384 |
| 2006 | 2242 | 8.435 | 137538 | 10.462 | 0.806* | -538.743 |
| 2007 | 2163 | 8.138 | 133093 | 10.124 | 0.804* | -527.874 |
| 2008 | 2145 | 8.070 | 121846 | 9.269 | 0.871* | -318.482 |
| 2009 | 2376 | 8.939 | 121595 | 9.249 | 0.966 | -82.407 |
| 2010 | 2988 | 11.242 | 126537 | 9.625 | 1.168* | 429.676 |
| 2011 | 3203 | 12.051 | 125296 | 9.531 | 1.264* | 669.766 |
| 2012 | 2232 | 8.398 | 126084 | 9.591 | 0.876* | -317.166 |

This is a very mixed situation, which could be accounted for just by the amount of construction that was present in any given year. Construction due to the stimulus may have caused the two-year up-tick in 2010-2011. Quite favorably, this regressed to its 2006-2009 levels in 2012. While these variations cannot be attributed to randomness alone, it is difficult to draw any conclusions when there are no consistent patterns.

## Urban-Rural Comparisons




The red bars above represent urban crashes, while the blue are rural. This reflects the shift from discretionary driving to that which is mandatory (e.g., commuting). It also helps to account for the reduction in fatal crashes in general, since urban crashes are generally less severe. The following cross-tabulation shows that well over twice the expected number of fatal crashes occur in the rural areas, and the two highest injury categories are also dramatically over-represented.




| | Fatal Injury | Incapacitating Injury | Non-Incapacitating Inju | Possible Injury | Property Damage Only | Unknown | TOTAL |
|---|---|---|---|---|---|---|---|
| Rural | 5851<br>64.11% | 67474<br>49.72% | 22492<br>36.81% | 16815<br>18.02% | 247995<br>24.05% | 891<br>8.37% | 361518<br>26.95% |
| Urban | 3275<br>35.89% | 68227<br>50.28% | 38615<br>63.19% | 76516<br>81.98% | 783294<br>75.95% | 9755<br>91.63% | 979682<br>73.05% |
| TOTAL | 9126<br>0.68% | 135701<br>10.12% | 61107<br>4.56% | 93331<br>6.96% | 1031289<br>76.89% | 10646<br>0.79% | **1341200**<br>**100.00%** |