Chapter 3: Key Findings

The findings of this study provide an overview of all the police-reported car/bike collisions that occurred in the city in 1997 and 1998, as well as detailed information about the most frequent kinds of collisions. These findings indicate which collision types are reported most frequently, and which ones typically result in the most severe injuries. They also identify features that appear to be characteristic of particular types of collisions, such as the areas of the city in which they seem to occur most frequently, the age groups that tend to be most often involved, and some of the behavioural and environmental factors that appear to play contributing roles. The statistics for each separate year were practically identical, suggesting that they are not simply random, but represent meaningful findings.

Summary statistics pertaining to characteristics of the entire set of collisions in the study are presented below. This is followed by discussions of the key findings with respect to the most frequent crash types. Detailed findings specific to each and every crash-type, including diagrams, charts, tables and maps, are presented in the final chapter. These should be referred to as an aid to understanding the discussions of the key findings in section 3.3 and in Chapter 4.

3.1 Characteristics of the Cyclists and Motorists Involved

Cyclist's Age

The 2,574 collision-involved cyclists in this study comprise a "sample" of Toronto's entire cycling population. Information on this sample can be compared with existing information about the city's cycling population, to highlight any 'distinguishing features' of the group of cyclists involved in reported collisions. (Are they younger, on average, than the typical Toronto cyclist? Are more of them male?…) In a similar way, the group of cyclists involved in one particular group of collisions comprises a "sub-sample" of the larger sample. In many of the following discussions, the age distribution (or age profile) of the whole set of cyclists in the study is used as a 'base-line' against which the age distributions for various sub-groups of cyclists are compared. This base line can be related to characteristics of the local cycling population, about which we have information from other sources. This helps the investigator conceptualise the meaning of the study's findings in relation to our understanding of the characteristics of the local cycling population as a whole.

The age profile of the cyclists in the whole study sample is charted in discrete detail (one-year increments) in Figure 3.1. The vast majority of the cyclists involved in collisions with motor vehicles in Toronto are adults (average age: 29.6).

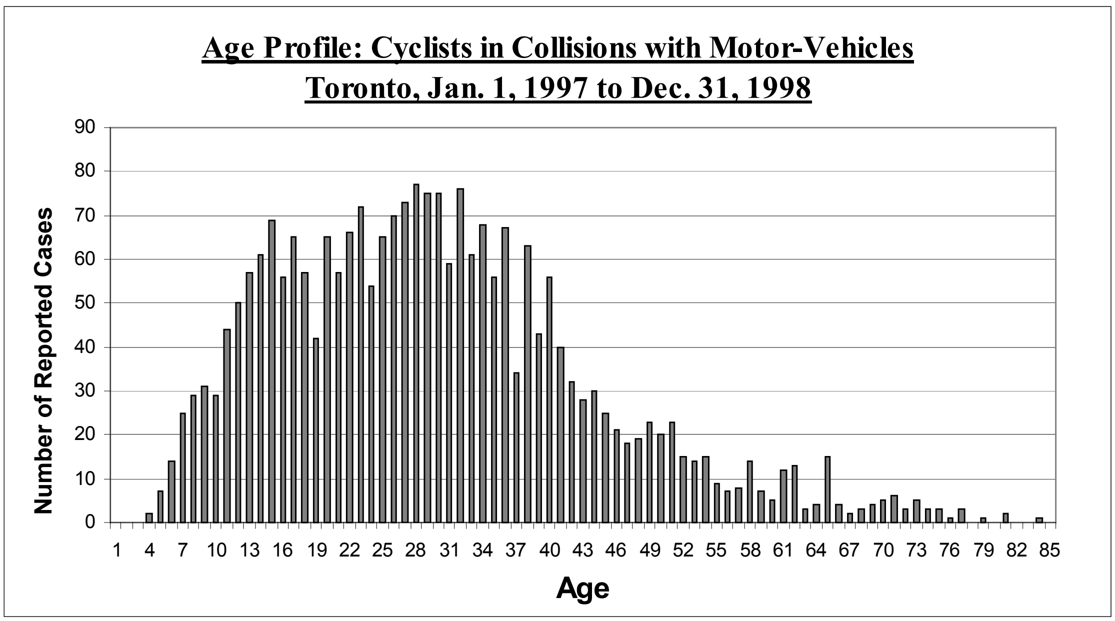


Figure 3.1

Information on Toronto's cycling population is periodically obtained by survey, with the most recent conducted in 1999. The Decima survey presents cyclist age data, sorted into five age categories, starting at age fifteen. When the age profile of the cyclists included in this study is compared with the age distributions of Toronto's cyclist population, it is apparent that young adult cyclists (age 18 to 34) are more likely to become involved in collisions than older cyclists (Figure 3.2). Teenage cyclists (age 15 to 17) are also slightly over-represented. While younger cyclists are often less experienced than older cyclists, and may also be more willing to take risks, the 18-34 age group probably cycles more frequently and/or farther than other groups. According to the Decima survey, Toronto's utilitarian cyclists tend to be younger than the recreational cyclists, on average. Utilitarian cyclists are more likely to ride in traffic, especially during rush hours, and hence they suffer greater exposure to the risk of collision.

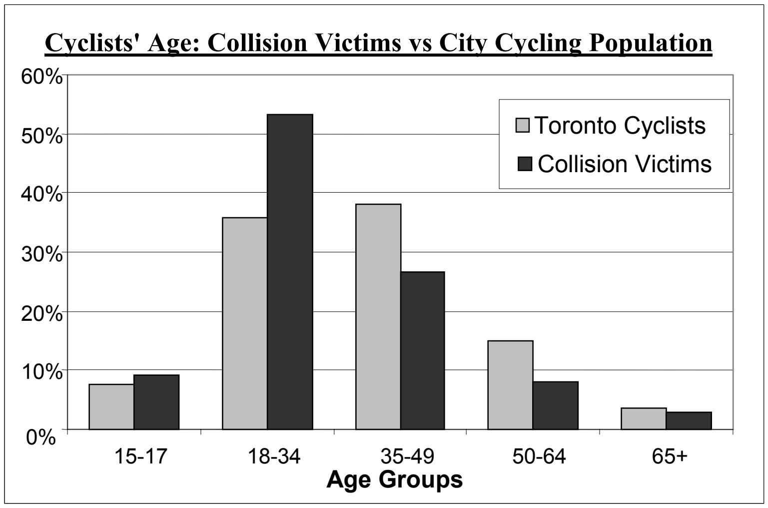


Figure 3.2

Cyclist's Sex

The sex of over ninety percent of the collision-involved cyclists in this study is known, and of these, 77% are males, 23% females. Recent surveys show that roughly half of Toronto's recreational cyclists and 60% of the utilitarian cyclists are male. The higher rate of collision involvement for males is very likely a function of exposure: surveys by Lisa Aultman-Hall and Decima Research both found that male commuter cyclists in Toronto ride farther and/or more often than females, on average, and therefore experience greater exposure to the risk of collision.

Helmet Use

Of 1,739 MVA reports containing information on helmet use, 541 (31%) indicated that the cyclist wore a helmet at the time of the collision. Of these, 71% are known to be male, (while males accounted for 77% of the entire sample) and 29% are female (while only 23% of the entire study sample are female). Helmet use was thus reported proportionally more often for females than for males. This may suggest that male cyclists are more tolerant of risk than females, on average, and could further account for their disproportionate involvement in collisions, mentioned above. Proportionally fewer teenage cyclists were reported to be wearing helmets (see Figure 3.3), even though helmets are required by law for cyclists under eighteen.

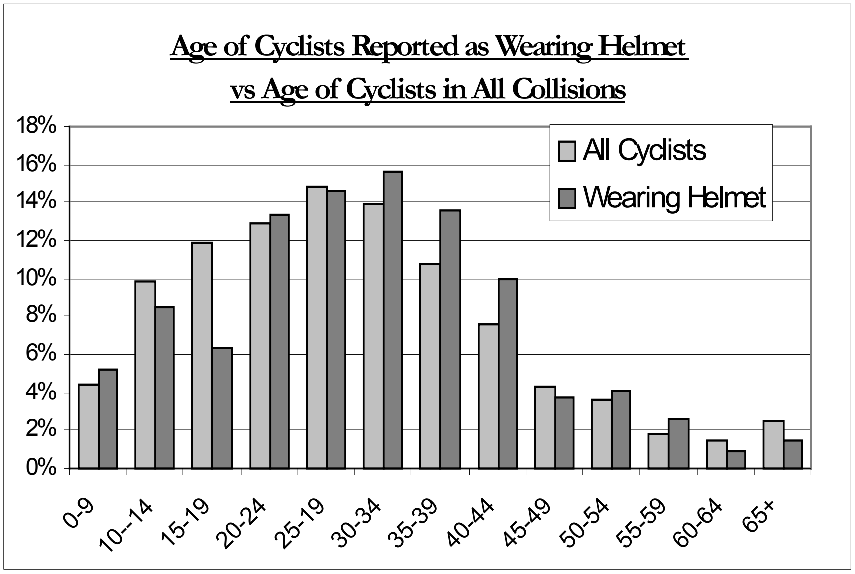


Figure 3.3

The rate of helmet use reported among the collision sample (31%) is lower than the rate suggested by a recent survey, in which 44% of Toronto cyclists indicated they "always wear a helmet."[24] While there are many possible explanations for the difference,[25] it may in part be a function of the way this information is entered in the MVA report forms. A box is available on the MVA form to indicate the type of safety equipment in use by each 'driver.' Options include lap belts, shoulder belts, air bags, child restraints, and helmets (represented by the code number "8"). Other codes that were sometimes entered in the safety equipment check-box include:

9 = Equipment not used but available
10 = No equipment available
00 = Use unknown
99 = Other safety equipment used

We are not confident that, when one of these four codes was entered or when the box was left blank, the cyclist was actually not wearing a helmet. Therefore, we are unable to report a reliable

[24] Decima, 2000

[25] Survey respondents may tend to over-report helmet-use; helmet-wearing cyclists may be more vigilant in avoiding risks of all kinds; recreational cyclists, who outnumber utilitarian cyclists, tend to use helmets more often, and to ride where they can enjoy less exposure to traffic (and most kinds of collisions).

figure representing the overall rate of helmet use. We were also unable to find a relationship between helmet use and injury severity. The effect of helmets in reducing head injuries is not apparent in our data, since the injury severity scheme used for MVA reports does not specify the type of injuries sustained.

Motorist's Age

The age profile of the set of motorists involved in car/bike collisions is plotted against that of motorists involved in all types of motor-vehicle collisions in Toronto in Figure 3.4. Car-bike collisions appear somewhat less likely to involve young drivers than motor vehicle collisions in general. While this under-representation might suggest that young drivers are better able to avoid collisions with cyclists (being perhaps more aware of cyclists' behaviour), it is more likely to be a result of their *over*-involvement in single-vehicle crashes.[26] In the absence of complete data on Toronto's motorist population, the age profile for all of Ontario's licensed drivers is included for comparison. Apart from the under-representation in collisions of license-holders under twenty and over fifty-five (who probably drive less than other motorists), there are no significant differences between the three profiles.

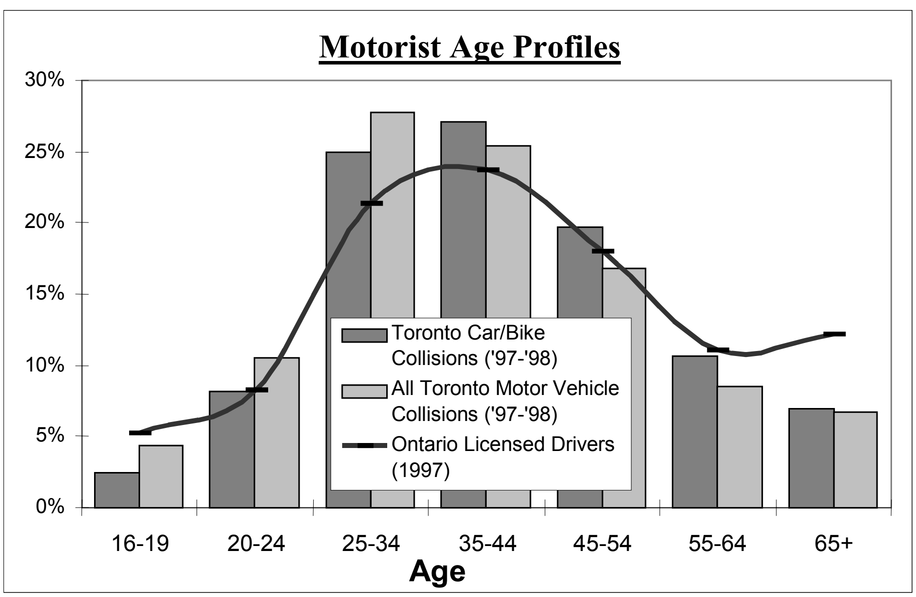


Figure 3.4

[26] Data from Toronto's Traffic Data Centre & Safety Bureau indicates that drivers age 25 to 34 are over-represented in single motor-vehicle crashes, compared to their involvement in collisions in general.

3.2 Characteristics of the Study Sample of Collisions

Statistical information concerning factors that may have contributed to the occurrence of collisions is most helpful in understanding the characteristics of different collision types, and is central to the discussions in section 3.3, below, regarding the most frequent collision types. Some of this information can also be used to characterise the whole sample of collisions. This section discusses the spatial and temporal distribution of the collisions in general, as well as apparent relationships between certain factors. In particular, relationships between sidewalk cycling, the age of the cyclists involved, and the location of the collisions (central or 'suburban') are discussed. The age distribution of cyclists in collisions that occurred at night is also presented, followed by a look at the type of motor vehicles most often involved in collisions with bicycles. Before going into detail with respect to the summary characteristics of individual types of collisions, the frequency distribution of collision types is presented, along with an analysis of the distribution of injuries among the various collision types. These provide a basis for evaluating the urgency of different safety issues and for prioritising potential countermeasures.

Temporal Distribution

Figure 3.5 depicts the relative frequency of collisions by time of day, along with hourly bicycle and motor-vehicle volumes, as recorded by a permanent traffic counter on Bloor Street East at Castle Frank Road. (Note that the vertical scale for collision frequency is arbitrary, representing the hourly distribution of all the collisions that occurred within the city from January 1, 1997 to December 31, 1998.) Collisions occur most frequently between 3:00 p.m. and 6:30 p.m. There is also a sharp peak around 8:00 a.m., and a small increase over the lunch hour. This is consistent with the daily pattern of bicycle and motor vehicle traffic volumes. It is also consistent with the daily pattern of motor vehicle collisions of all types (not shown). The chart does not show any increase in bicycle traffic at mid-day, which is probably a function of counter's location, at the western end of the Prince Edward Viaduct over the Don Valley. While there may be a general increase in bicycle traffic during lunch-time, there is apparently no such increase in bicycle trips across the viaduct. Unfortunately, the City does not yet maintain any other permanent traffic counters capable of detecting bicycles reliably.

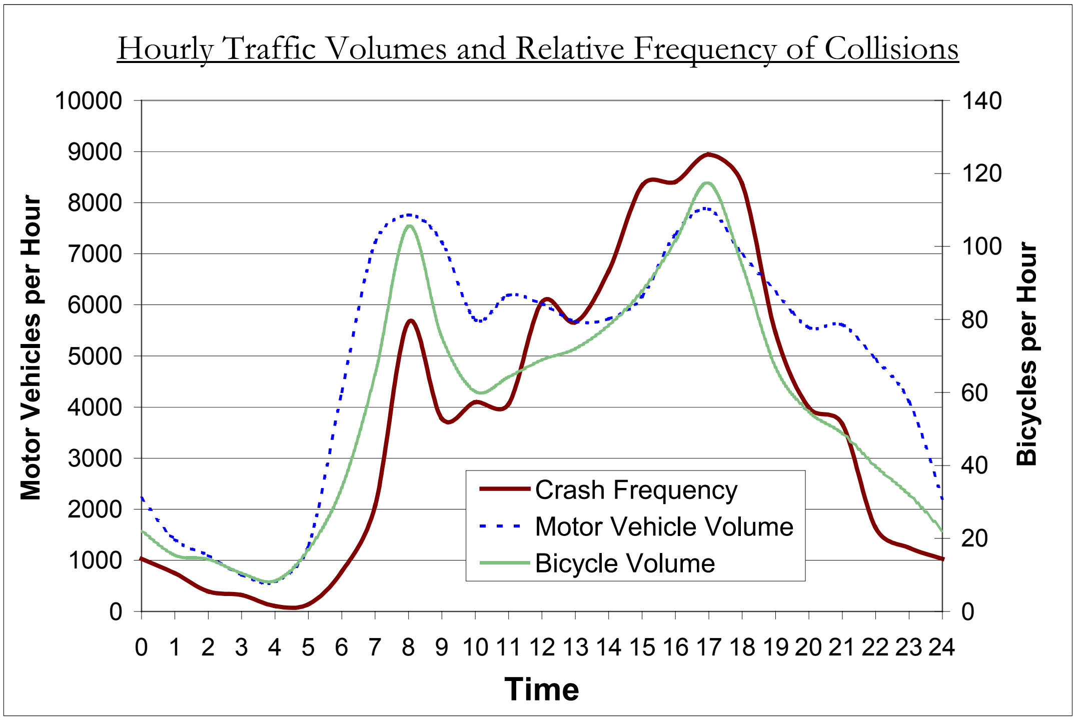


Figure 3.5

On average, there are nearly twice as many collisions per day during the week as on weekends, with Monday being the 'quietest' weekday (Figure 3.6).

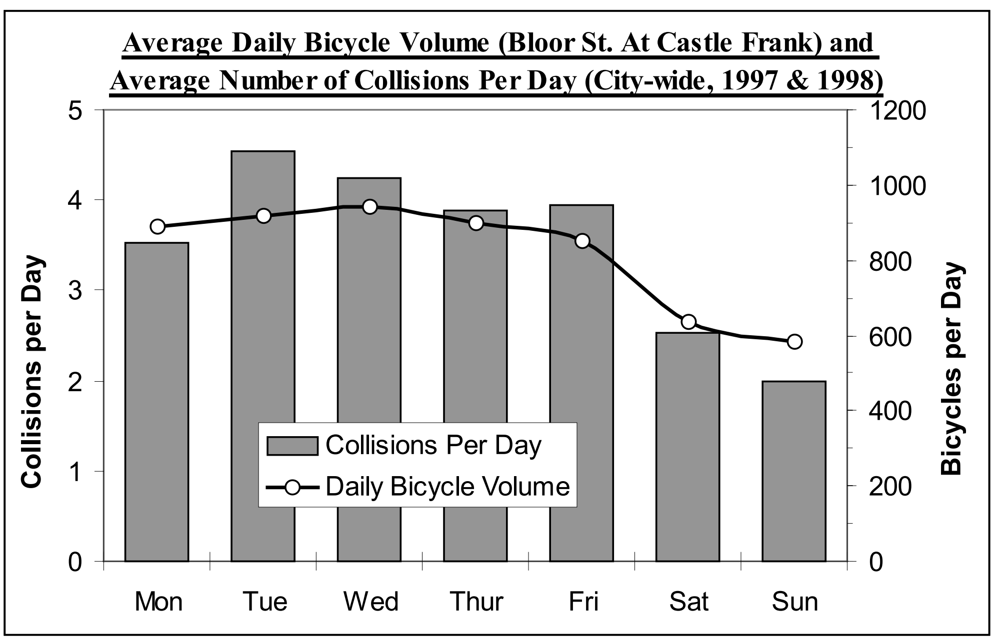


Fig. 3.6

The frequency of crashes also follows the general trend in cycling activity associated with seasonal weather patterns (Figure 3.7). The number of reported collisions rises from an average of about one per day in the winter, to around six or eight per day in the summer, with the highest number for this two-year period (twenty-two) occurring on July 2, 1997. According to various estimates, between 40% and 90% of car/bike collisions go unreported.[27] This would imply that anywhere from ten to eighty car/bike collisions occur in Toronto each summer weekday, perhaps well over a hundred on some days.

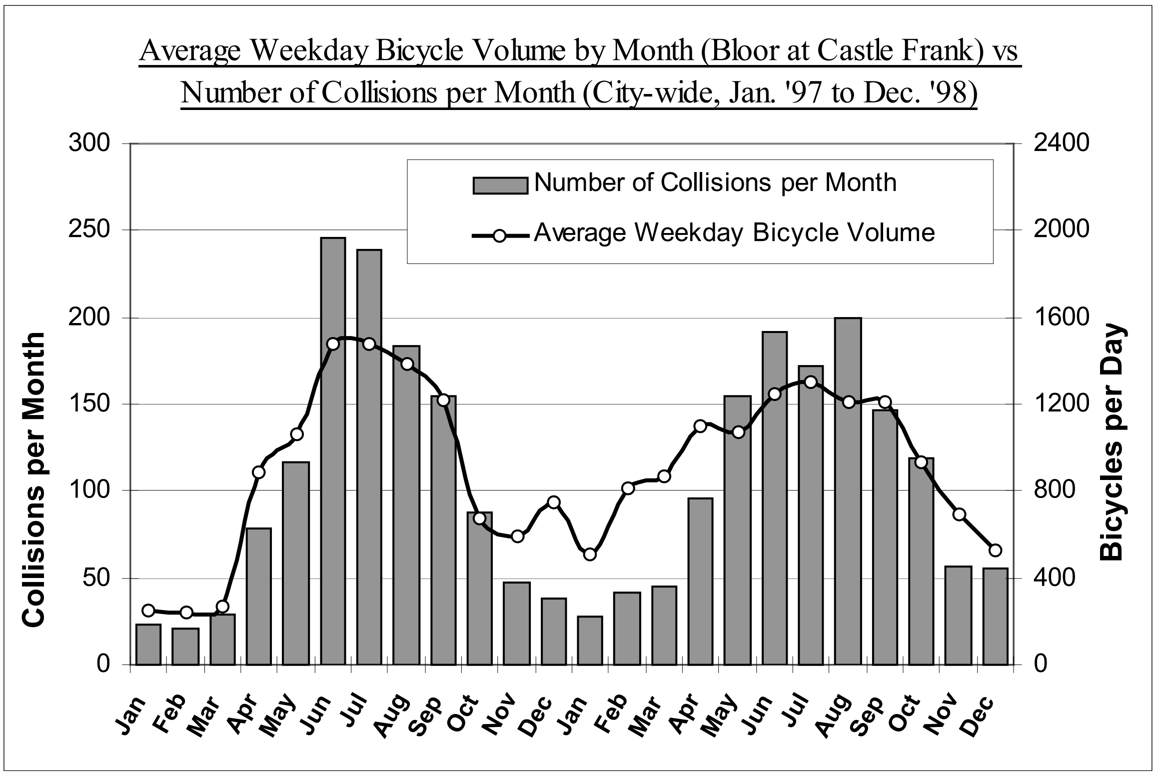


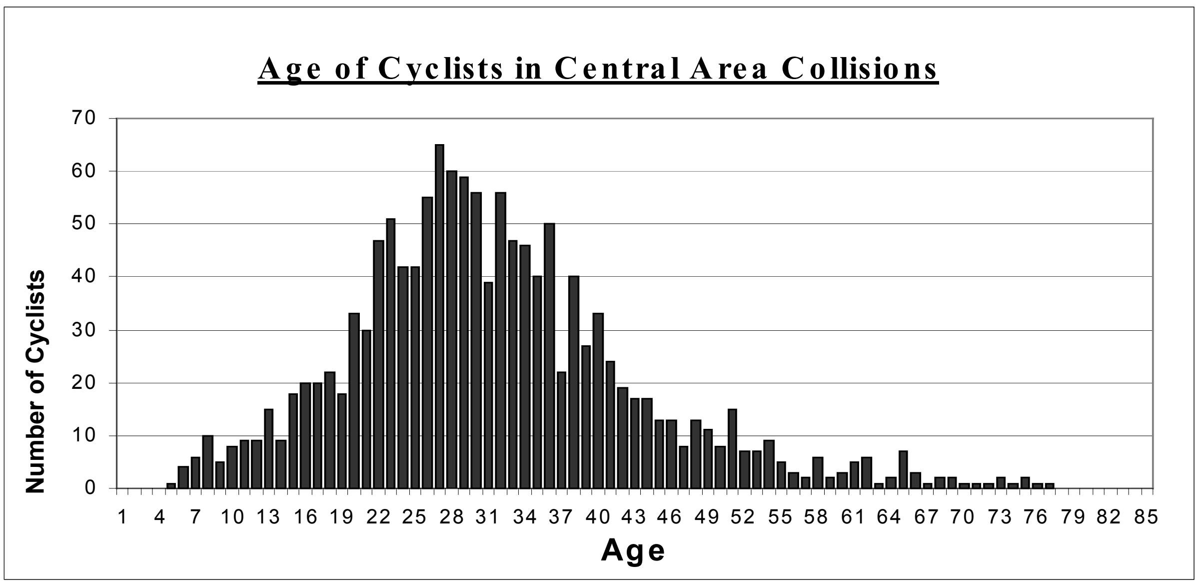
Figure 3.7

It is interesting to note that the frequency of collisions rises more sharply in summer and falls off more sharply in winter than does the bicycle volume. This might suggest that some cyclists who ride mainly in summer months are more likely to be involved in collisions than some of those who cycle during the winter. It may also suggest that some drivers tend to be more careful around cyclists in the winter.

[27] Stutts and Hunter, 1998

Spatial Distribution

All the collisions in the study are mapped in figure 3.9. The geographic distribution reflects the general pattern of cycling activity in the city. Collisions occur more frequently in the central area, where bicycle traffic volumes are highest, particularly on the east-west arterial roads. This may be due to the lack of minor east-west roads downtown, whereas there are many 'quiet' alternatives to the north-south arterial roads in this part of the city. Collisions are also relatively frequent along several arterial roads in outer areas. The cyclists involved in collisions in the outer areas are substantially younger, as a group, than those involved in collisions in the central part of the city (Figure 3.8).



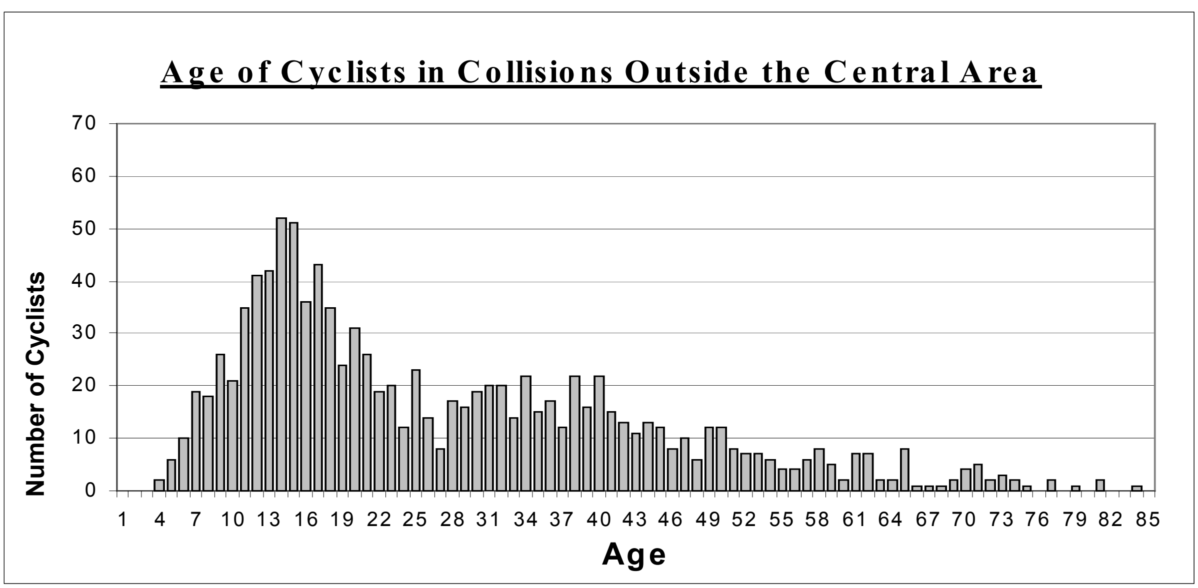


Figure 3.8

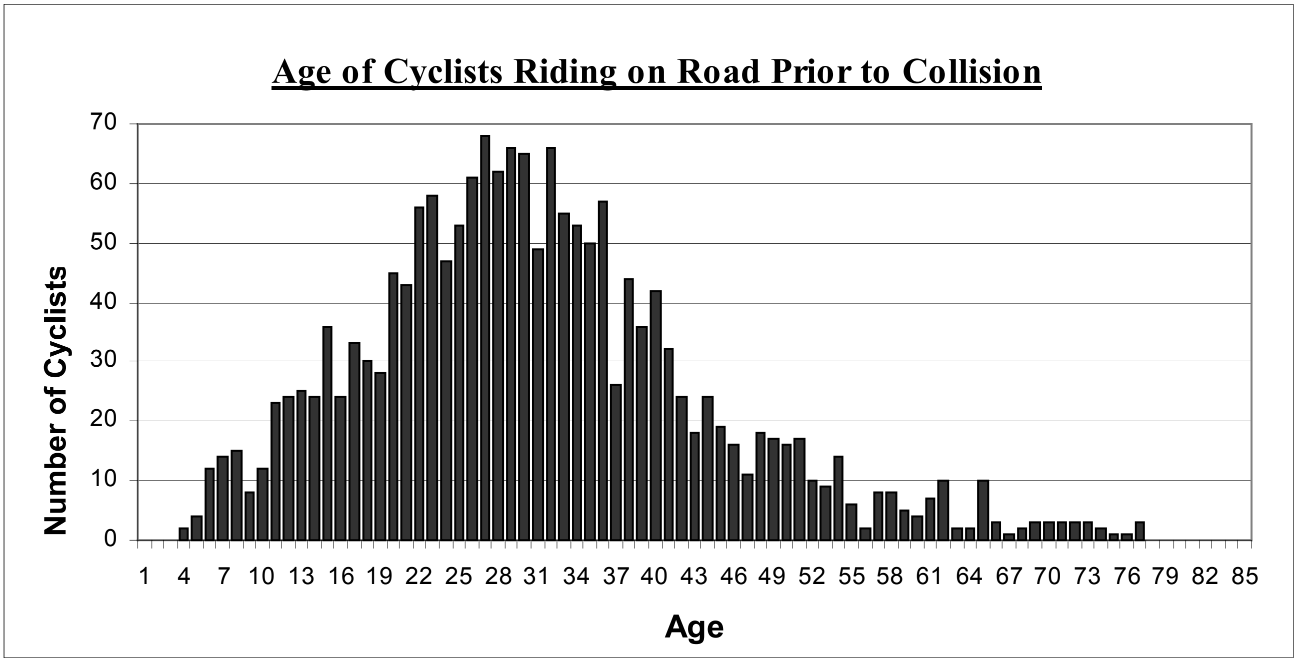
Figure 3.9: Locations of All Motor-Vehicle Collisions Involving Bicycles

Jan. 1, 1997 to Dec. 31, 1998.

(2558 Collision Locations Known)

Sidewalk Cycling

In almost thirty percent of all collisions, the cyclists were riding on the sidewalk immediately prior to the collision. Young cyclists were much more likely to have been riding on the sidewalk than were adults (Figure 3.10). In fact, over half (53%) of the collision-involved cyclists under age 18 were riding on the sidewalk, whereas only 21% of those 18 and over were.



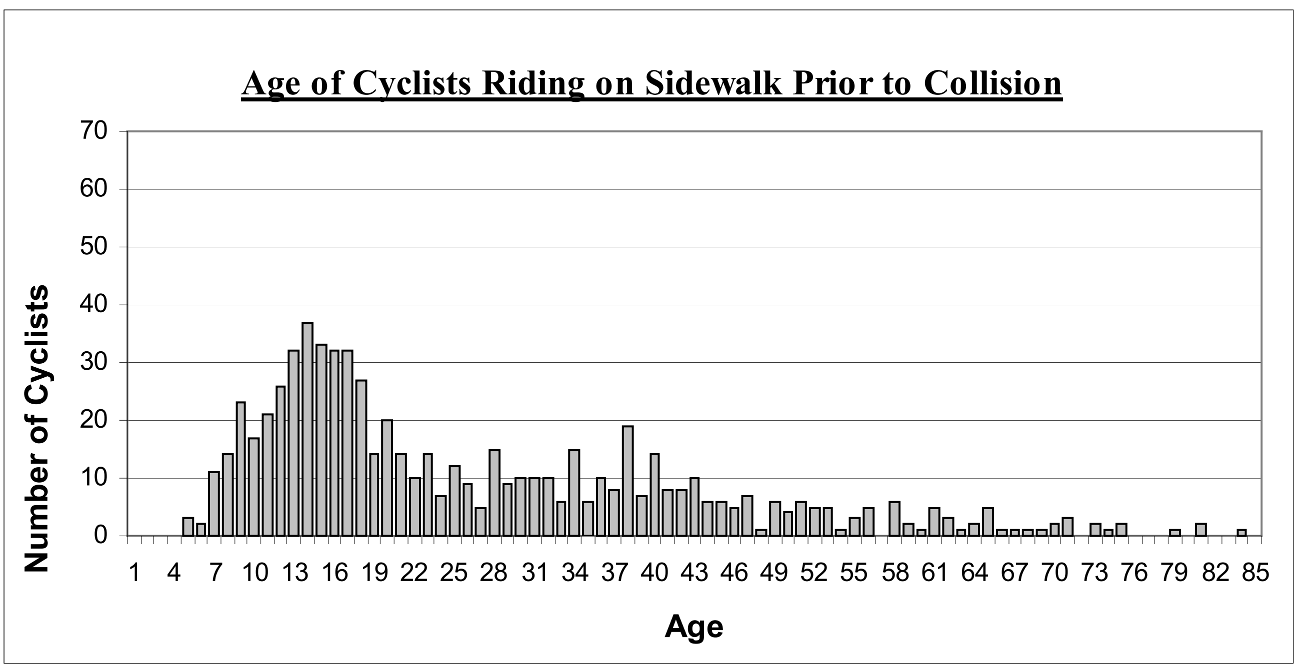


Figure 3.10

Forty-six percent of collisions in the outer areas of the city involved sidewalk cycling (522 cases), compared to only thirteen percent of the central area collisions (188 cases). This suggests that, in outer areas, either sidewalk cycling is much more prevalent or it is much more likely to lead to a collision than it is in the central area (Figures 3.11 and 3.12).

Fig. 3.11: Cyclist Riding on Road Prior to Collision (1848 Collisions)

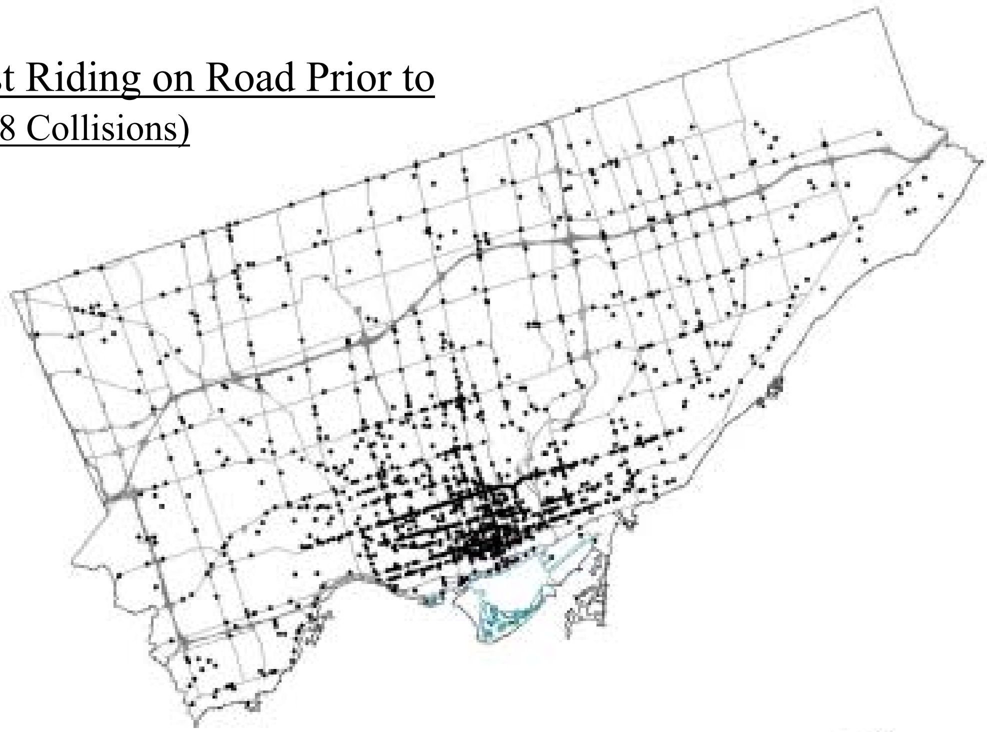


Fig. 3.12: Cyclist Riding on Sidewalk Prior to Collision
(710 Collisions)

Collisions in which the cyclists were riding on the roadway tended to result in slightly more severe injuries (and many more fatalities) than those in which the cyclists were riding on the sidewalk or within the crosswalk area (Fig. 3.13).

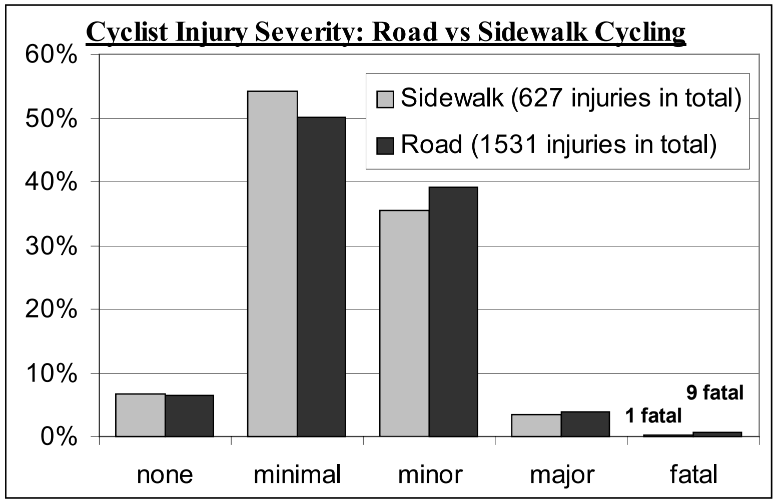


Fig. 3.13

Cycling in Darkness

Almost four hundred collisions occurred in darkness (15% of the total). Children under age fifteen were under-represented in night-time collisions, as might be expected. Cyclists between the ages of thirty-five and forty-five were more often involved, proportionally, than other age groups (see Figure 3.14). This could simply be a function of exposure, if cyclists in the latter age group ride at night more often than do other cyclists. There is some indirect evidence that this may be so: According to Decima survey data, almost fifty percent of the cyclists who indicated that they ride in winter months were within the thirty-five to forty-nine year age group. Winter bicycle-commuting often involves riding in the dark.

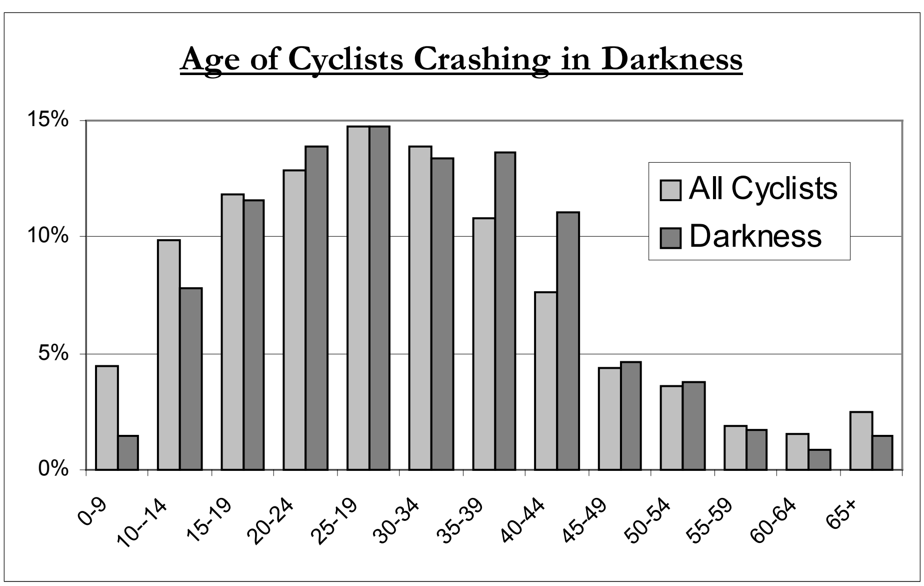


Figure 3.14

The following crash types occurred in darkness significantly more often than the norm, suggesting that darkness may have been a contributing factor in some cases:

Drive Out at Controlled Intersection	(18.3%)
Motorist Left Turn – Facing Cyclist	(20.2%)
Motorist Left Turn – In Front Of Cyclist	(33%)
Wrong Way Cyclist	(18.6%)
Drive Into or Out of On-Street Parking	(32%)

The geographic distribution of collisions that took place in darkness does not appear to differ from that of collisions that occurred in daylight.

Types of Motor Vehicles Involved

The type of motor vehicle involved was coded only for those collisions that occurred in 1998 (1237 in total, Table 3.1). Most were automobiles, with a few (38) large vehicles involved. Collisions involving trucks and buses apparently were more likely to result in major injuries and fatalities (Fig. 3.15). This is consistent with the Coroner's finding that large vehicles are over-represented in fatal collisions with cyclists.[28]

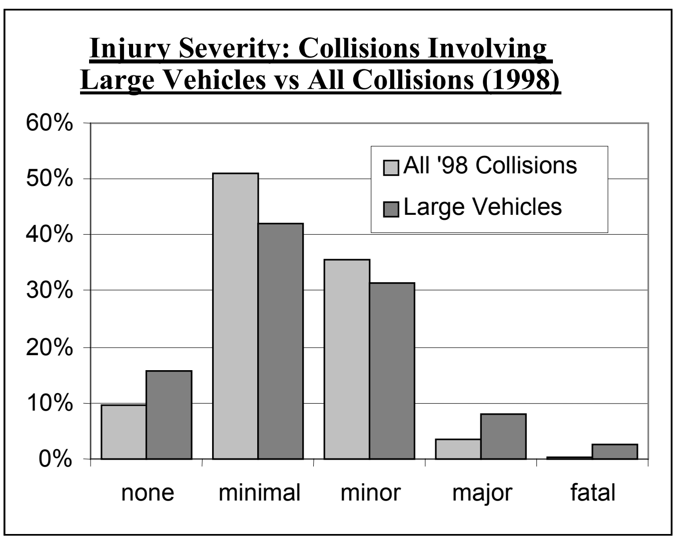


Figure 3.15

Table 3.1

Type of Vehicle	Number
Automobile	1014
Passenger van	79
Taxi	39
Pick-up truck	24
Delivery van	20
Municipal transit bus	17
Police vehicle	8
Truck – closed	7
Truck – tractor	6
Streetcar	4
Truck – dump	3
Motorcycle	2
Tow truck	2
School bus	2
Ambulance	2
Truck – open	1
Inter-city bus	1
Bus (other)	1
School van	1
Motor home	1
Off-road 3 wheels	1
Other	2

[28] Lucas, 1998

Frequencies of the Different Collision Types

The individual collision types are listed in table 3.2, in order of descending frequency. (The type-numbers refer to the order in which detailed findings are presented in Part II of this report.) The relative frequency of each type is also indicated, as a percentage of all collisions for which sufficient information was available to allow classification (2325 of 2572). The "other" category consists of incidents for which complete information was available, but which did not fit into any of the established types. The results were consistent for each of the two years studied, providing good assurance that these patterns are reliable and meaningful, not random.

Table 3.2

Crash Type	Frequency		
	Number of Cases	**%**	**Cumulative Percent**
1) Drive Out At Controlled Intersection	284	12.2%	12%
10) Motorist Overtaking	277	11.9	24
6) Motorist Opens Vehicle Door	276	11.9	36
8) Motorist Left Turn – Facing Cyclist	248	10.7	47
5) Motorist Right Turn (Not at Red Light)	224	9.6	56
4) Motorist Right Turn At Red Light	179	7.7	64
2) Drive Out From Lane or Driveway	179	7.7	72
12) Ride Out At Controlled Intersection	65	2.8	75
15) Wrong Way Cyclist	59	2.5	77
11) Ride Out At Mid-block	51	2.2	80
9) Motorist Left Turn – In Front Of Cyclist	48	2.1	82
13) Ride Out From Sidewalk	44	1.9	84
18) Cyclist Lost Control	44	1.9	85
16) Cyclist Left Turn In Front Of Motorist	41	1.8	87
7) Cyclist Strikes Stopped Vehicle	39	1.7	89
3) Motorist Reversing	37	1.6	90
20) Cyclist Overtaking	31	1.3	92
19) Cyclist Caught in Intersection	30	1.3	93
14) Ride Out From Lane or Driveway	29	1.3	94
21) Drive Into/Out of On-Street Parking	28	1.2	95
17) Cyclist Left Turn – Facing Traffic	11	0.5	96
22) Other (Not classified)	101	4.3	100
23) Unknown (Insufficient Information)	247		

Injury Severity

The most frequent types of collisions, identified in the previous section, clearly merit attention in the form of specific safety countermeasures. However, while a particular type of crash may be very common, it may not necessarily represent the most significant health risk to the local cycling population. Beyond the straightforward ranking of collision types by frequency, it is important to identify the types of collisions that cause the most serious injuries. From the standpoint of a municipal body trying to determine where to direct counter-measure resources, it may be more appropriate to focus on those types of collisions that result in the greatest number of fatalities and/or serious injuries each year. From the cyclist's perspective, it may be more important to know what types of collisions pose the greatest *risk* of serious injury, regardless of their frequency. Such information could be incorporated in cycling safety training courses, to highlight the kinds of situations that cyclists should be most careful to avoid.

In order to rank the different collision types this way, it is necessary to quantify injury severity somehow — perhaps the way insurance companies do, when determining accident compensation amounts. Of course, the question of what is an appropriate weight for each injury category cannot be answered definitively. In the MVA reports, injuries are described using the categories, "none," "minimal," "minor," "major," or "fatal" (see table 2.3). One might assign each of these a weight, representing the severity of each category relative to the others. To rate a given collision type, one would begin by multiplying the number of injuries in each category (within that type) by the appropriate weight. The sum of these products would provide a measure of both the number and severity of injuries resulting from collisions of that type. Dividing this sum by the number of collisions of that type would yield a relative measure of its 'average severity.'

For the purpose of this analysis, the "no injuries" category should be assigned a weight of zero. That is not to say such collisions are insignificant. Rather, it is likely that such incidents occur very frequently, even though few are reported to police.[29] In this study sample, therefore,

[29] Furthermore, some of these "property damage only" collisions appear to have been reported simply because they involved government vehicles (including transit buses) or damage to City property. In such cases, reporting to police is mandatory. Thus, the fact that such an incident was reported to police may not mean that it was a serious incident.

the number of collisions that involved no injuries probably does not reflect their actual prevalence. Collisions that *do* involve injuries are much more likely to be reported, and so our data can be expected to provide a good indication of the relative frequency of injuries of varying severity.

The collision types are listed again in order of decreasing frequency in Table 3.3, along with the distribution of injuries, so that the reader may evaluate the severity of the different types by any method.

Table 3.3

Collision Type	Injury Severity				
	No Injuries	Minimal Injuries	Minor Injuries	Major Injuries	Fatal
Drive Out At Controlled Intersection	15	159	85	8	0
Motorist Overtaking	20	137	96	7	4
Motorist Opens Vehicle Door	6	122	125	8	1
Motorist Left Turn – Facing Cyclist	13	91	116	11	0
Motorist Right Turn (Not at Red Light)	19	116	71	3	0
Motorist Right Turn At Red Light	7	95	59	4	0
Drive Out From Lane or Driveway	11	92	54	3	0
Ride Out At Controlled Intersection	4	27	21	3	2
Wrong Way Cyclist	1	36	16	2	0
Ride Out At Mid-block	4	22	19	4	1
Motorist Left Turn – In Front Of Cyclist	1	25	18	2	0
Ride Out From Sidewalk	3	22	13	5	0
Cyclist Lost Control	2	16	20	2	0
Cyclist Left Turn In Front Of Traffic	3	18	10	6	0
Cyclist Strikes Stopped Vehicle	4	17	12	1	0
Motorist Reversing	2	18	12	0	0
Cyclist Overtaking	2	10	15	0	0
Cyclist Caught in Intersection	1	19	9	0	0
Ride Out From Lane or Driveway	2	10	14	1	0
Drive Into/Out of On-Street Parking	0	16	10	0	0
Cyclist Left Turn – Facing Traffic	1	3	5	2	0
Other (Not classified)	10	33	31	9	2
Unknown (Insufficient Information)	20	80	46	4	0
Totals:	151	1184	877	85	10

Various weighting schemes were applied to the different injury categories, in an attempt to rank the collision types with respect to injury severity. When both frequency *and* injury severity are taken into account, we find little effect on the rank order of the most frequent types of collisions, except that “Drive-out at controlled intersection” drops from first to fourth. As more and more weight is given to the most severe injuries and fatalities, the “Motorist overtaking” category acquires higher priority. Only when the weight assigned to successive injury categories increases by a factor of ten or more do any of the less frequent collision types assume more importance. (“Ride out at controlled intersection” rises to third place and “Ride-out at mid-block rises to sixth.) We can therefore state with some confidence that the most frequent types of collisions result in the most significant impact on the well-being of the local cycling population. When allocating limited resources, these should be the primary focus of efforts to reduce cycling injuries. However, if the severity of injuries greatly outweighs the number of injured as a primary concern, priority should be given to the less frequent types of collisions mentioned above.

An attempt was also made to rank the collision types according to their ‘average severity,’ calculated by dividing the “score” for each collision type (described above) by its frequency. This number can be seen as a measure of the probability that a particular type of collision will result in serious injury. Cyclists might benefit from knowing what types of collisions should be especially avoided because of their high risk of injury. Once again, the results depended somewhat on the choice of weights assigned to the various injury classes. Several of the “cyclist error” collision types (“Cyclist left-turn…” and “Ride out…” types) appear[30] to be more likely to result in severe injuries than some of the more frequent “Drive-out” types. It is perhaps not surprising that crashes such as these, in which the cyclist crosses the path of motor vehicles moving ahead at normal speed tend to yield worse injuries than those in which the motorist is stopping, starting, or turning slowly. While educational approaches to reducing the more frequent types of collisions must necessarily focus on enabling cyclists to anticipate and avoid certain motorists’ errors, informed cyclists may be able to make choices about their own actions and avoid some of the less frequent but potentially more severe types.

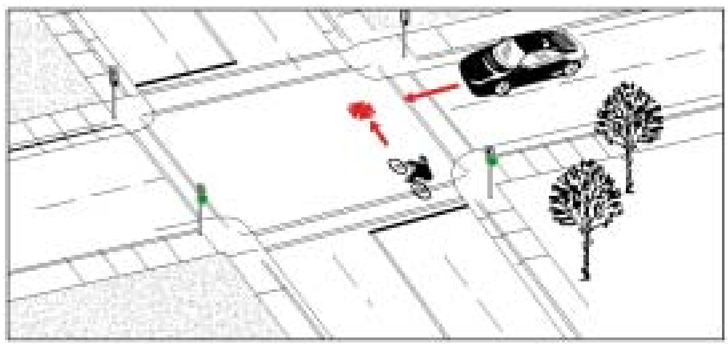
---

[30] The small sample sizes make statements about these collision types less certain. More data would be required to perform this kind of analysis with more confidence.

3.3 Characteristics of Particular Collision Types

The most frequent collision types occurred in sufficient numbers to allow the reporting of statistical characteristics with a good degree of reliability. In addition, some of the less frequent types exhibited peculiarities that were pronounced enough to be statistically significant, despite the small sample sizes. Particular age groups, environmental conditions, and other factors were found to be over- or under-represented in some types of collisions, providing clues about the underlying safety problems. The following discussions summarise the key findings for the most frequent types of collisions, and findings on two less frequent types that yield valuable lessons.

Type 1: Drive Out At Controlled Intersection



The most frequent type of crash involved a motorist approaching or proceeding into a controlled intersection and colliding with a cyclist who was crossing the intersection in a perpendicular direction. Roughly half of the cyclists in this category were riding on the sidewalk and collided with the motor-vehicle within the crosswalk area. The majority (75%) of the drivers were facing stop signs, while 18% were at red lights[31] and 7% at pedestrian crossovers. Injuries typically were less severe than average, probably because the motor-vehicle speeds were quite low. Young cyclists, between the ages of 10 and 20 years of age, were highly over-represented in this type of collision. Darkness, rain, and wet road surfaces were also over-represented, suggesting that poor visibility and/or impaired braking may have been contributing factors.

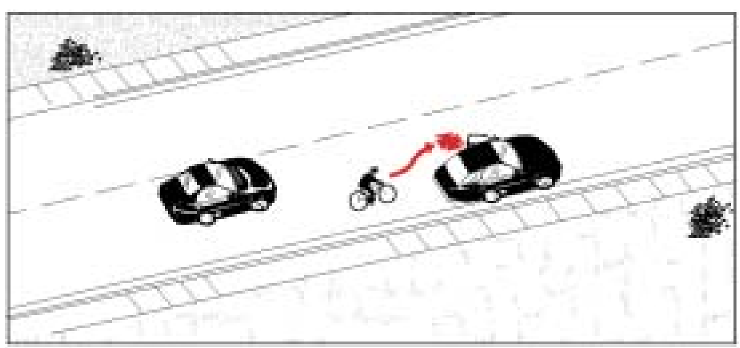
Over 30% of the collisions in which the cyclist was riding on the road took place in darkness, twice the average for all crashes (15%). On the other hand, only 12% of the crosswalk collisions took place during darkness. While darkness may have often made it difficult for

[31] Some of these drivers may have intended to turn right, but this could not be deduced from the MVARs.

motorists to detect cyclists riding on the road, other factors would appear to have contributed to most of the crosswalk collisions. Cyclists riding towards an intersection on the sidewalk, even at a moderate speed, can seem to appear quite suddenly and unexpectedly from outside the driver's field of view. This is especially problematic in situations where buildings abutting the sidewalk obstruct sight-lines, when drivers fail to stop before the stop line, and when cyclists ride onto the roadway without slowing down or stopping first.

These "sidewalk cyclists" clearly failed to stop and dismount at the intersection, as required by the Highway Traffic Act. Moreover, although young cyclists were over-represented, the majority (75%) of the 'sidewalk cyclists' in this type of crash were over the age of fourteen, and therefore likely to be riding adult size bicycles, in violation of a City by-law[32]. While cyclists in such cases may therefore be deemed at fault in law, it is probably not correct to suggest that sidewalk cycling was the sole 'cause' of these collisions. In many collisions of this type, it is quite likely that the motorist did not come to a complete stop before crossing the stop bar. While this HTA infraction is noted explicitly in only a few MVA reports, studies have shown that prior to making a right turn, many motorists "roll" past stop signs while looking mainly to their left for on-coming traffic.[33] The *combination* of these two factors (improper stopping by the motorist and sidewalk cycling) probably contributed to many of these collisions. (See also Types 2 and 4.)

Type 6: Motorist Opens Door In Cyclist's Path



Another very frequent type of crash involved a motorist opening a vehicle door into the path of a passing cyclist. Drivers in their thirties are significantly over-represented. Notably, darkness does not seem to increase the likelihood of this type of incident. In contrast, darkness

[32] Bicycles with wheels larger than 24 inches in diameter are not permitted on Toronto sidewalks.

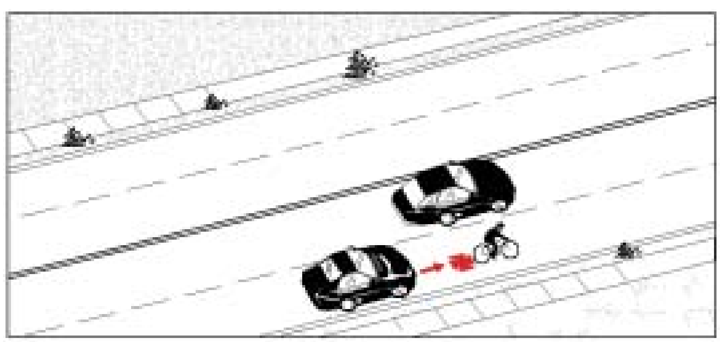
[33] Summala *et al*, 1996

was found to be a frequent factor in collisions in which the motorist was exiting on-street parking spot, which are very similar to these in configuration (see Type 21, below). This suggests that visibility is not always a critical factor, and that many motorists simply failed to ensure that opening their door would not endanger on-coming cyclists (as they are legally required).

Almost all cases occurred on arterial roads in central areas of the city, making "the Door Prize," as it has become known, the most frequently reported type of bicycle/motor-vehicle collision in central Toronto. In contrast to the previous type, the cyclists involved were typically adults between twenty and forty years of age. This age group can be expected to ride on the road, rather than the sidewalk, more often than children and the elderly, and therefore suffer greater exposure to the risk of this kind of collision. Since the injuries sustained were often more severe than average, this type of crash would appear to be a very serious concern for urban cyclists.

A portion (15%) of these crashes involved cyclists passing on the right of the vehicle. Many of these vehicles were taxis, sometimes discharging passengers in the second lane, where the curb lane was occupied by parked vehicles. Taxis accounted for 7.1% of the motor vehicles involved in this collision type, compared to 3.1% of all car/bike collisions, and 5% of the car/bike collisions that occurred in the central area.

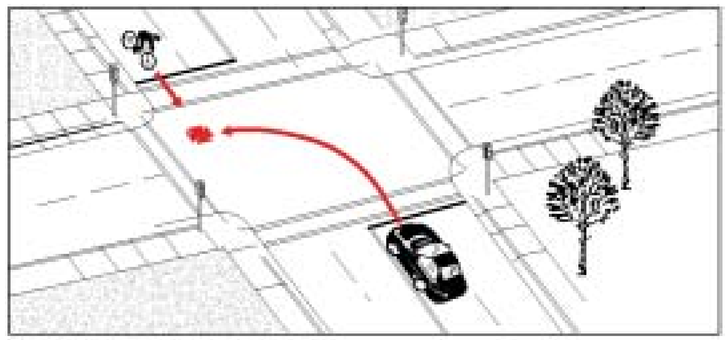
Type 10: Motorist Overtaking



Collisions involving motorists overtaking cyclists are among the top three most frequent collision types and, like the "Door Prize" (Type 6), they occur most often in the central area. These collisions also involved significantly more adult cyclists (age 25 to 40) than most other crash types. As with other types of crashes that occur only on roads, the over-representation of adults is probably a result of their higher exposure to this risk. Compared to "dooring" collisions, though, adults over age 36 were not as strongly over-represented.

In most cases, the injuries resulting from this type of collision were less severe than the average. On the other hand, four of the ten cyclist deaths in this two-year period resulted from motorists overtaking, indicating that this rather frequent type of collision can also be very dangerous. It would appear that most instances were minor impacts — 'glancing blows' that occurred when motorists attempted to pass cyclists — with the occasional disastrous result. Darkness and poor weather, which can affect visibility, were not frequent factors. Once again, taxis are over-represented, accounting for 7.6% of the motor vehicles involved in this crash type.

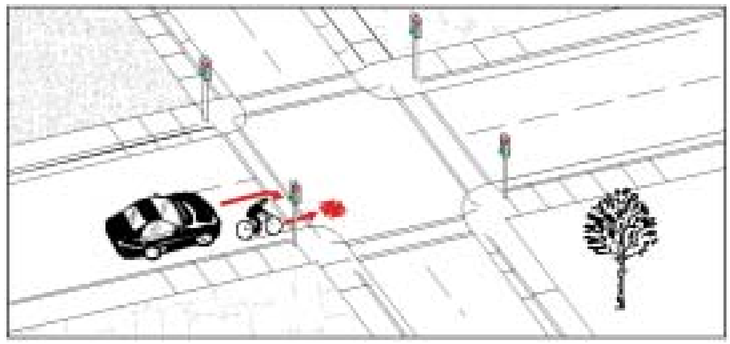
Type 8: Motorist Left Turn – Facing Cyclist



Collisions in which a motorist turned left across the path of an on-coming cyclist (who was approaching from the opposite direction) also involved more cyclists over twenty than the norm. Most occurred while the cyclist was riding on the road, with only 18% involving sidewalk cycling. Cyclists in their twenties are strongly over-represented, but older adults are not. In comparison with the "door-prize," which involves adult cyclists in a relatively wide range of ages, involvement seems to drop off even earlier (around age 30) than it does in the previous type (motorist overtaking). This might suggest that cyclists with more experience cycling (and driving) on busy roads can develop ways of anticipating and avoiding this type of collision.

Injuries in this category tended to be significantly more severe than average, which might be expected, since the relative speed of the two vehicles would often have been fairly high. Most of the collisions took place in the central area, at intersections controlled by traffic signals. Darkness was over-represented in this type of collision, suggesting that the driver's ability to detect the cyclist plays an important role. Drivers over age 60 were over-represented, but darkness was *not* a frequent factor in such collisions for this age group. This suggests that less acute vision and/or reflexes might have been more significant factors for these drivers.

Type 5: Motorist Right Turn

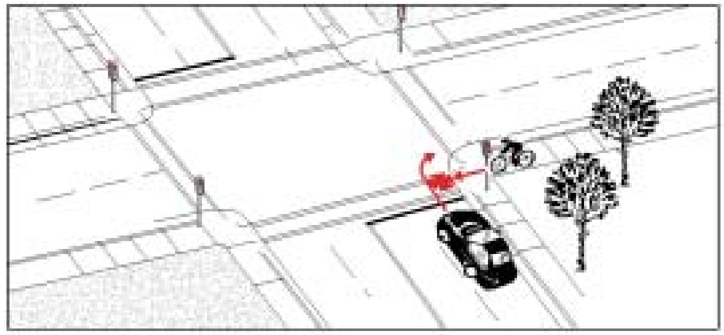


The cyclist age profile for collisions in which a motorist was making a simple right turn (not at a red light) revealed no unusually high involvement for any particular age group, although cyclists age fifteen to nineteen were slightly over-represented. Cyclists were riding on the sidewalk only slightly more often than the average (35%, compared to 31% overall). Half of the sidewalk riders were under age eighteen. Environmental conditions do not appear to have played a significant role. Injuries sustained by cyclists in these incidents were typically slight.

A few (3.6%) of the cyclists were noted to have been overtaking the motor vehicle (on the road) on the driver's right. Some cyclists are uncomfortable overtaking right-turning vehicles on the left, since it often requires swerving close to the path of through-vehicles in the adjacent lane. Even if they are aware that a motorist intends to turn, some cyclists attempt to pass on the right as the driver waits for pedestrians to cross.

Many of the motorists' and cyclists' statements that were available for this crash type expressed differing opinions as to who was passing whom. This relates to what is perhaps the main issue with this kind of incident: Drivers of motor vehicles usually do not have to think about sharing a lane safely with another vehicle. A motorist preparing for a right turn would have no reason to expect another driver to attempt to pass on the right, and might not feel there is any need to shoulder-check to the right. If a driver underestimates the speed of a cyclist, he or she may feel it is safe to pass the cyclist just before turning. Even if a driver has not overtaken, but is simply ahead of a cyclist, the cyclist can end up in a driver's "blind spot" as the driver slows in preparation for the turn. The driver may be unaware of the cyclist's presence, and the cyclist may not be able to see the driver's turn signal.

Type 4: Motorist Right Turn – At Red Light

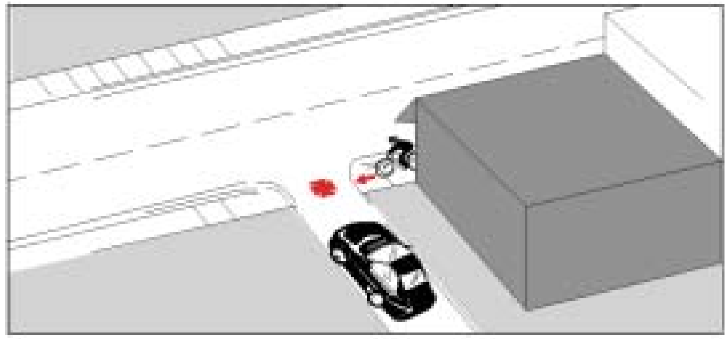


The characteristics of collisions involving motorists turning right at red lights are quite different from those of other kinds of motorist right-turn collisions. First, the two vehicles typically were travelling along perpendicular, rather than parallel paths (*i.e.,* the cyclist was proceeding on a green light or "walk" signal). In addition, while most (65%) of the cyclists in other right-turning motorist collisions were cycling on the road in the direction of traffic flow, in this type most (86%) of the cyclists were riding on the sidewalk just before the collision. (A further 3.4% were cycling on the wrong side of the road.) This represents the highest level of sidewalk cycling of any crash type.

Whereas no age group stood out in the previous type (Motorist Right Turn), cyclists age ten to twenty were strongly over-represented in this collision type, as were those over sixty. These age groups may be more likely to ride on the sidewalk than middle-aged adults. Also, the very young may not fully appreciate this kind of traffic hazard. Rainy weather appeared to play a role in some of these crashes, perhaps impairing visibility (especially for drivers) and/or braking ability (for cyclists). Three-quarters of "right-on-red" collisions occurred in the outer areas of the City, accounting for 13.7% of all outer-area collisions (compared to only 3.6% of the collisions in the central area.) This type of collision was much more likely to occur on roads with more than four lanes than were most other types.

The combination of sidewalk cycling and improper stopping by the motorist, as discussed above (see Type 1 – "Drive-Out at Controlled Intersection"), was probably a factor in many of these collisions, although the MVA reports provide little direct evidence of this. This kind of driving behaviour may be more common in outer areas, where drivers can expect to encounter fewer pedestrians (and cyclists) at intersections. Furthermore, where pedestrians are relatively infrequent and traffic speeds are quite high, cyclists may be more inclined to use the sidewalks.

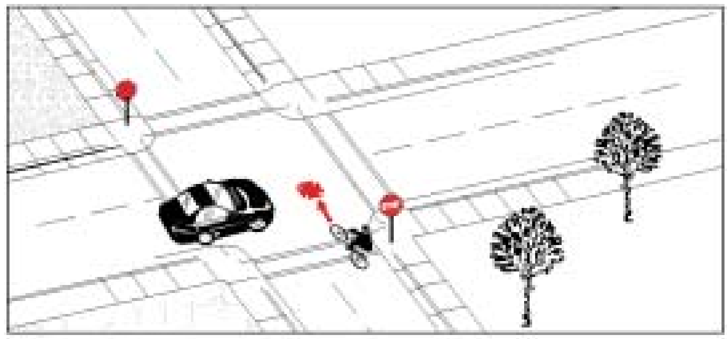
Type 2: Drive Out From Lane or Driveway



Of the cyclists who were struck by a vehicle emerging from a lane or a driveway, 81% were riding on the sidewalk at the time. Cyclists between the ages of ten and twenty were over-represented, and were even more likely to be cycling on the sidewalk (85%) than the older cyclists in this type of crash. Cyclists between the ages of twenty-five and forty, on the other hand, were much less frequently involved in this type of collision than in other types. Still, three out of four cyclists in that age group were riding on the sidewalk when they crashed. As with Type 1 (Drive Out at Controlled Intersection) and Type 4 (Right Turn at Red Light) collisions, the combination of sidewalk cycling and motorists not stopping before crossing the sidewalk seems to have contributed to a large proportion of these crashes.

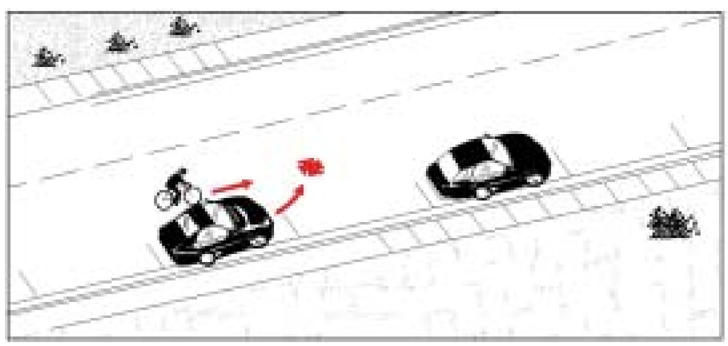
Most of these collisions occurred in outer areas of the city. This type of collision was much more likely to occur along roads with six lanes than were most other types, suggesting that the problem may be most acute at busy commercial driveways. Very few (3) cyclists involved in this kind of collision suffered any serious injuries, probably because the relative speed of the vehicles would have been quite low in most cases. Drivers age 40-55 and 70-80 were somewhat over-represented.

Type 12: Ride Out At Controlled Intersection



Just as "Drive Out at Controlled Intersection" was the most frequent type of collision defined by a motorist action, Ride-Out at Controlled Intersection was the most frequent type defined by a cyclist action. Although there were over four times as many is "drive out" as "ride out" collisions at controlled intersections, almost as many cyclists as motorists were found to have disobeyed traffic control (21 motorists and 18 cyclists). In both types, the majority of collisions occurred at intersections controlled by stop signs. Although there were only 65 cases, this type of collision resulted in 2 of the 10 cycling fatalities that occurred during this two-year period. Thus, while cyclists disobeying traffic controls were involved in relatively few collisions, some of them clearly suffered very serious consequences.

Type 21: Motorist Entering/Exiting On-Street Parking



While there were only twenty-eight collisions of this type, analysis of the data yielded a result that is significant in that it sheds light on a similar, much more frequent crash type. Collisions in this category fall into two groups, with rather different configurations: Collisions in which the motorist was *entering* an on-street parking space resemble "Motorist Right Turn" (Type 5) collisions, in which the cyclist is on the motorist's right. Collisions in which the motorist was *exiting* an on-street parking space are similar in some respects to "Motorist Left Turn in Front of Cyclist" (Type 9) collisions, where the cyclist is to the left of the motorist.

Unlike the first pair, a much larger-than-average portion of the other two types of collisions (Motorist Exiting Parking and Type 9) took place in darkness.[34] This contrasts with an important finding, discussed previously, regarding "Door Prize" collisions. For collisions in which a motorist opened the vehicle's door in a cyclist's path, darkness was *not* found to be a frequent factor, even though that configuration is very similar to the "Motorist Exiting On-Street Parking" collision.

In "Motorist Left Turn…" and "Motorist Exiting Parking" collisions, the motorist's intended manoeuvre involves crossing the path of on-coming vehicles. In such circumstances, the driver can be expected to scan for on-coming vehicles, and it is not surprising that darkness might play a role in making cyclists more difficult to detect. Conversely, in situations (such as the first pair of crash types mentioned above) where motorists typically would *not* expect to come into conflict with other moving vehicles and hence not feel a need to scan, we would not expect darkness to play any significant role in contributing to collisions. This suggests that, in "dooring" incidents, where darkness was not found to be a significant factor, the key problem may be that some drivers do not feel a need to look in their mirror for on-coming traffic before opening their vehicle door. While a headlight can offer a cyclist an advantage in situations where motorists are looking in their direction, it will not reduce the risk of being struck by a car door if drivers fail to scan for cyclists. These are important messages for both drivers and cyclists.

[34] Despite the small number of cases, this finding is statistically significant.