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RCIP Police Area Collision Profiles

Area: West Midlands

Dr. Craig Smith and Bruce Walton
Agilysis
March 2021

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Area: Dorset, Devon and Cornwall

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About the Authors

Dr. Craig Smith is a mathematician, with an established background in academic research. He studied for both his undergraduate master's degree and doctorate in mathematics at the University of Oxford. Since then, he has endeavoured to use his expertise to carry out robust and innovative analysis and research. As Agilysis' Data Scientist, Craig has extensive experience in handling a wide variety of data, and uses his background as a mathematician to explore the use of machine learning and artificial intelligence in advancing road safety research and unlocking the full potential of data.

Bruce Walton has been working with road safety data since 2002, coming from a background in analytical modelling, database design and IT training across several sectors. Since his appointment as project manager for the multi award-winning MAST Online project, Bruce has become recognised as expert in road casualty data, contributory factor analysis, resident risk, analytical architecture and enforcement data management. Bruce works with many road safety stakeholder organisations in the UK, and provides consultancy and training to international projects on road safety data architecture and reporting, such as the International Road Federation's 'World Road Statistics' programme. Bruce is also a member of the government's Standing Committee for Road Accident Statistics (SCRAS) in the UK.

Disclaimer

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ATS	automatic traffic signal
CF	contributory factor
DfT	Department for Transport
FSC	fatal and serious collision
IMD	Index of Multiple Deprivation
KSI	killed or seriously injured
LCV	light commercial vehicle
LSOA	Lower Layer Super Output Area
ONS	Office for National Statistics
PSV	public service vehicle
RCIP	Road Collision Investigation Project

1 Introduction

This report forms part of the Road Collision Investigation Project (RCIP). The purpose of RCIP is to establish whether there is a business case for putting more resource into the investigation of road crashes – and, if there is, to establish how best to take this forward. The project, implemented by the RAC Foundation with government funding, began in the summer of 2018. [1]

RCIP's aims include developing an analytical framework and protocols and testing them in real world environments. To address these aims, the RAC Foundation produced a research brief in February 2020. Agilysis successfully bid to undertake this research for three RCIP areas, with work commencing in April 2020. The project sought to apply deep learning models to road safety data to identify collision trends and types in a way which will provide value to the RCIP project.

This report is part of a series which delivers the results of this research. It contains a synthesis of the most significant findings of analysis carried out on data relating to one of the police force areas participating in RCIP. The intention is to test the validity and value of the methodology in a real-world environment.

An overview of RCIP and further explanation of how this report relates to the project is laid out in the accompanying methodology paper. That paper also contains a detailed description of the methodology used and lessons learnt from the process.

1.1 Delivery

The research addresses these objectives by delivering four key outputs:

- comparator identification;
- trend analysis;
- collision type analysis; and
- synthesis.

The process used to create each of these components is also described in the methodology paper. This report sets out the results for West Midlands Police. Appendix A includes a summary list of the input variables used, with an indication of how the model applied them when clustering collisions in West Midlands.

The comparator identification process, and the process used to arrive at it, is described in the methodology paper. This process identified that Greater Manchester Police as the force most comparable to West Midlands Police.

The trend analysis has been supplied to RCIP investigators primarily by means of online dashboards. The output from this analysis is extensive; this report contains some synthesised key findings for West Midlands. The collision type analysis output has been summarised in infographics which are also included in this report.

[1] www.racfoundation.org/collaborations/road-collision-investigation-project

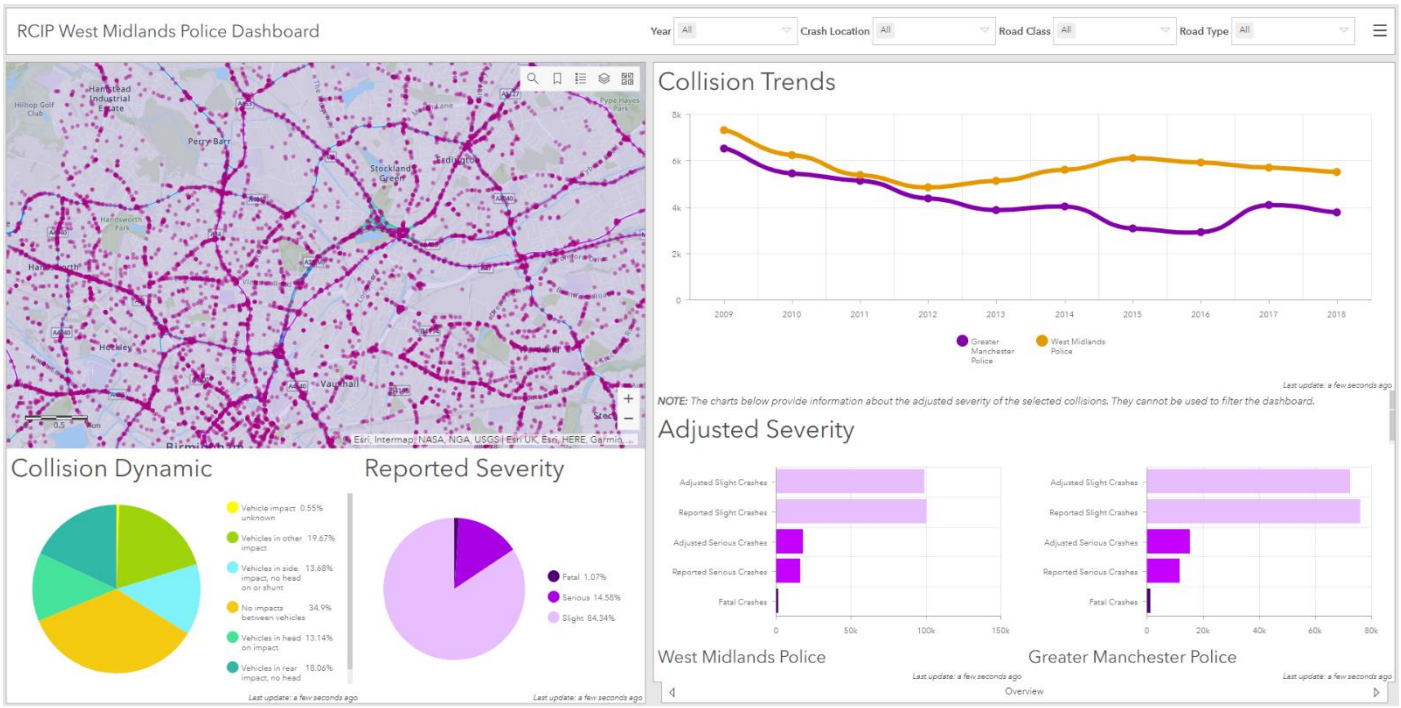
2 Area Profile of West Midlands Police

2.1 Dashboards

Primary delivery of the trend analysis results was through a series of dashboards realised in ArcGIS Online. These dashboards are available to RCIP collision investigators via their logins to CrashMap Pro, an ArcGIS application developed by Agilysis. Figure 2.1 shows an example of the dashboard for West Midlands Police, viewing the Collision Trends pane. Collision investigators with access to these credentials can view the dashboard containing results for West Midlands Police, as well as the comparator area of Greater Manchester Police, at the following URL:

https://agilysis.maps.arcgis.com/apps/opsdashboard/index.html#/17820bab4bff4009894bb5e9d781fbd2

Figure 2.1: Example view of the West Midlands Police dashboard



Source: Author's own

The dashboard provides complete interactive access to detailed analysis of all input variables. It allows investigators to filter collisions by any desired combination of variables and locate specific collisions which exhibit them on a map. The filter dropdown controls on the title bar apply overarching filters, which allow the subject and comparator areas to be examined either separately or together for any desired time period and/or road type. Individual collisions which fit the selected criteria can then be readily identified and examined in more detail if required. This allows investigators to view all reported collisions which exhibit a specific combination of characteristics.

The left pane of the dashboard maps all collisions, including those resulting in only slightly injured casualties. Each collision can be selected individually to show its ID (thereby facilitating further investigation of selected incidents in police records) and salient facts such as the number of casualties involved and types of vehicle conflict present. The map is accompanied by two pie charts showing the reported severity and collision dynamics of currently selected collisions. The map can be filtered using four drop down lists, covering year, location by area, class and type.

The right pane of the dashboard can be scrolled through several different views, most of which include multiple interactive controls used for filtering selected collisions (exceptions are noted in the list which follows, and also indicated on the dashboard itself). These controls are based on, but are more extensive in detail than, the input

variables used in the cluster analysis. For a listing of all input variables, along with how they were used in the West Midlands cluster analysis compared to the national analysis described in the methodology paper, see Appendix A.

The panes included in the dashboard, and the controls available on them, are as follows:

- Overview pane (overview charts are for information only, and cannot be used for filtering the map)
    - trends over time of the selected collisions
    - comparative breakdown of recorded severity compared with adjusted severity according to Department for Transport (DfT) record level statistical adjustments which account for discrepancies with injury-based recording systems)
- Location analysis pane
    - traffic where DfT count point data is available, classified as busy (upper quartile), normal, or quiet (lower quartile)
    - road rurality following ONS classifications of rural, town or urban area
    - road class
    - road type
- Times and days
- Pedestrian collisions
    - pedestrian casualties by age and deprivation
    - pedestrian movement
- Actors (profile of involved persons)
    - young and Older drivers
    - vulnerable vehicles (cycles and horses)
    - deprived drivers (lower quartile of home community Index of Multiple Deprivation (IMD), as defined by the ONS)
    - working drivers
    - hit-and-run drivers
- Casualties by road user type and severity
- Attendant circumstances
    - weather and light conditions
    - junction types
- Vehicles involved
    - manoeuvres (overtaking, turning, lane changes and slow traffic)
    - run-offs[2]
    - vehicle type (including motorcycles by size)
- Contributory factor groups, as a Venn diagram (for information only, cannot be used for filtering the map)
    - environmental factors (100, 700 and 900 series)
    - driver and Vehicle factors (200–600 series)
    - pedestrian (800 series)
- Contributory factor groups, as a bar chart (for information only, and cannot be used for filtering the map)
- Driver contributory factors, by vehicle type
- Driver contributory factors, by manoeuvre type

[2] Run-off-road collisions, referred to as 'run-offs' in this report, are collisions during which any involved vehicle leaves the carriageway , even if it later re-joins it.

3 Results of Collision Type Analysis

The process used to identify clusters of collisions which have characteristics in common is described in detail in the accompanying methodology paper. For West Midlands, these groups were arranged subjectively into four overarching groups, then the clusters within each group were organised into families within which sibling clusters could be identified on the basis of the characteristics they shared.

3.1 How to read the cluster diagrams

The clusters in each group are shown by the following diagrams. In each diagram:

- each coloured area shows a family of collisions within the group that have been grouped together based on similar characteristics;
- each of the inner boxes within that family represents sibling or 'Grandsibling' clusters that divide up these shared characteristics down to another level of separation; and
- all collision totals are additive, so percentages are based on the overall total for the entire group (and may not add up to 100% due to rounding).
- The key for the associated meanings represented by each infographic within the diagrams can be found in Appendix B.

3.2 Collisions involving pedestrian casualties

3.2.1 Cluster list

Table 3.1 summarises all clusters in this group textually.

Table 3.1: Textual summary of clusters, collisions involving pedestrian casualties

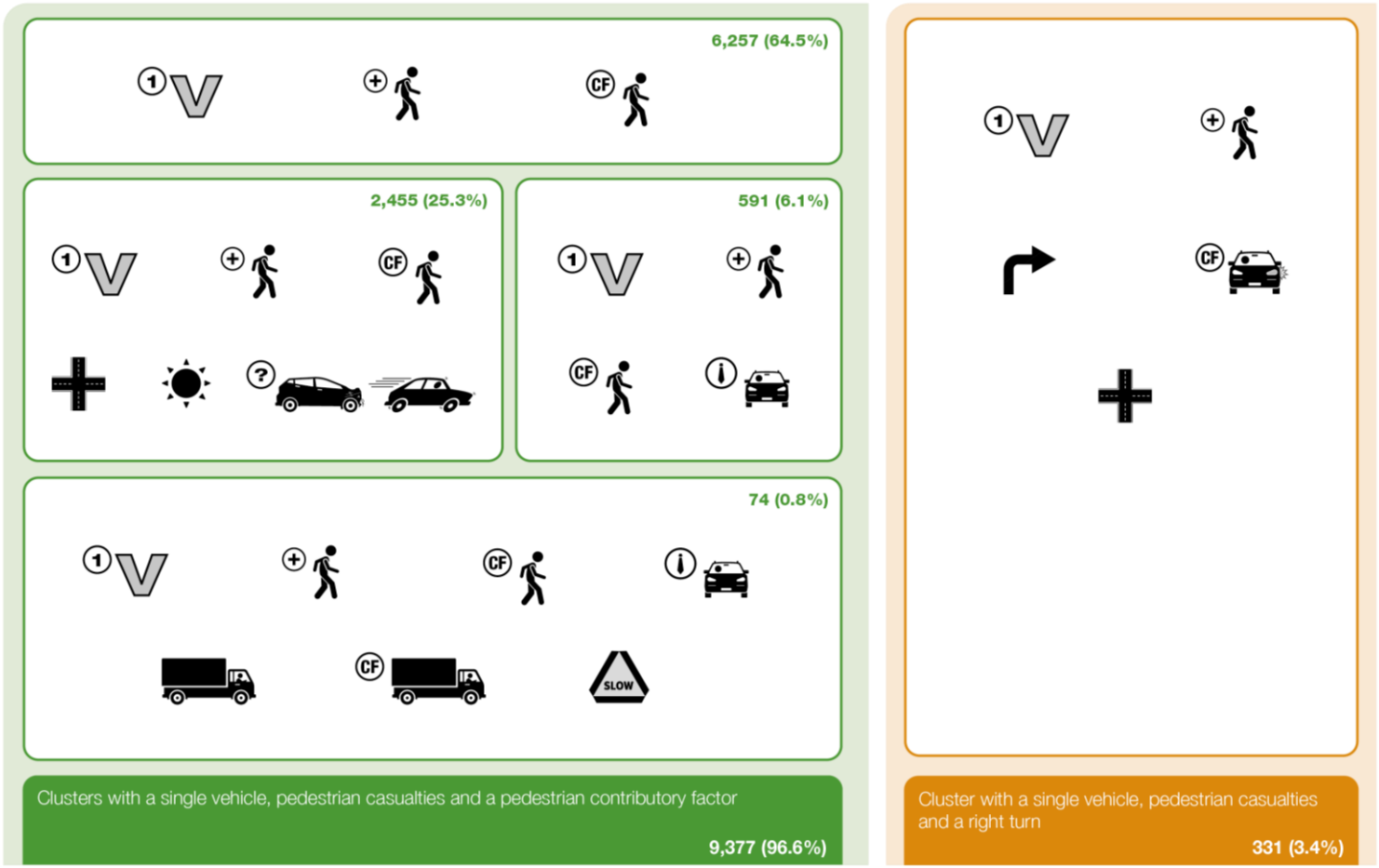
Family	Sibling	GrandSibling	Cluster ID	Count	Cluster FSCs as % of group
Single vehicle, pedestrian casualty, pedestrian contributory factor (CF)			WM2	6,257	64.5%
Single vehicle, pedestrian casualty, pedestrian CF	Uncontrolled junction, day (sometimes hit-and-run)		WM1	2,455	25.3%
Single vehicle, pedestrian casualty, pedestrian CF	Working driver		WM19	591	6.1%
Single vehicle, pedestrian casualty, pedestrian CF	Working driver	LCV/PSV, LCV/PSV CF, slow-vehicle manoeuvre	WM23	74	0.8%
Single vehicle, pedestrian casualty, right turn, driver turning CF, uncontrolled junction			WM22	331	3.4%

Source: Author's own

3.2.2 Cluster infographic

Figure 3.1 summarises all clusters in this group diagrammatically.

Figure 3.1: Cluster family diagram, collisions involving pedestrian casualties

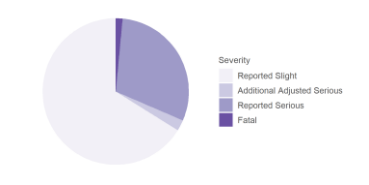
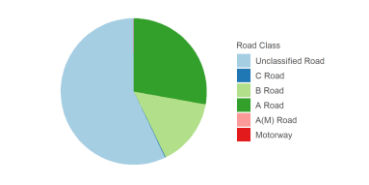
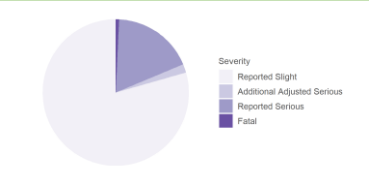
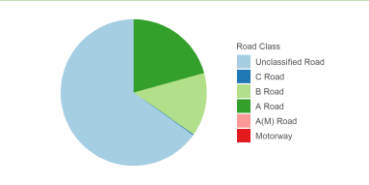
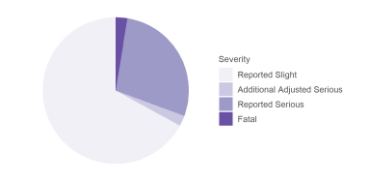
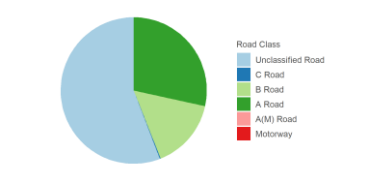
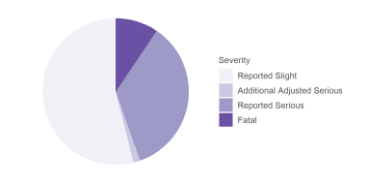
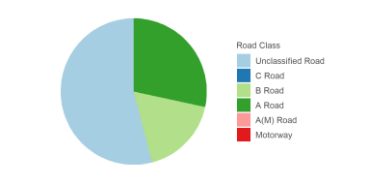
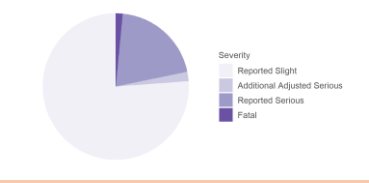
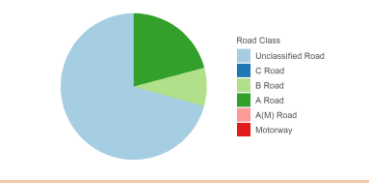


Source: Author's own

3.2.3 Cluster details

Table 3.2 summarises the most salient clusters in this group by severity and road class.

Table 3.2: Summary of clusters by severity and road class, collisions involving pedestrian casualties

	Collisions involving pedestrian casualties	
WM2	**Single vehicle, pedestrian casualty, pedestrian contributory factor (CF)**	
All collisions		**Percentage adjusted fatal and serious collisions (FSCs)**
6,257		64.5%
		
WM1	**Single vehicle, pedestrian casualty, pedestrian CF, uncontrolled junction, day (sometimes hit-and-run)**	
All collisions		**Percentage adjusted FSCs**
2,455		25.3%
		
WM19	**Single vehicle, pedestrian casualty, pedestrian CF, working driver**	
All collisions		**Percentage adjusted FSCs**
591		6.1%
		
WM23	**Single vehicle, pedestrian casualty, pedestrian CF, working driver, LCV/PSV, LCV/PSV CF, slow-vehicle manoeuvre**	
All collisions		**Percentage adjusted FSCs**
74		0.8%
		
WM22	**Single vehicle, pedestrian casualty, right turn, driver turning CF, uncontrolled junction**	
All collisions		**Percentage adjusted FSCs**
331		3.4%
		

Source: Author's own

3.3 Single-vehicle collisions

3.3.1 Cluster list

Table 3.3 summarises all clusters in this group textually.

Table 3.3: Textual summary of clusters, single-vehicle collisions

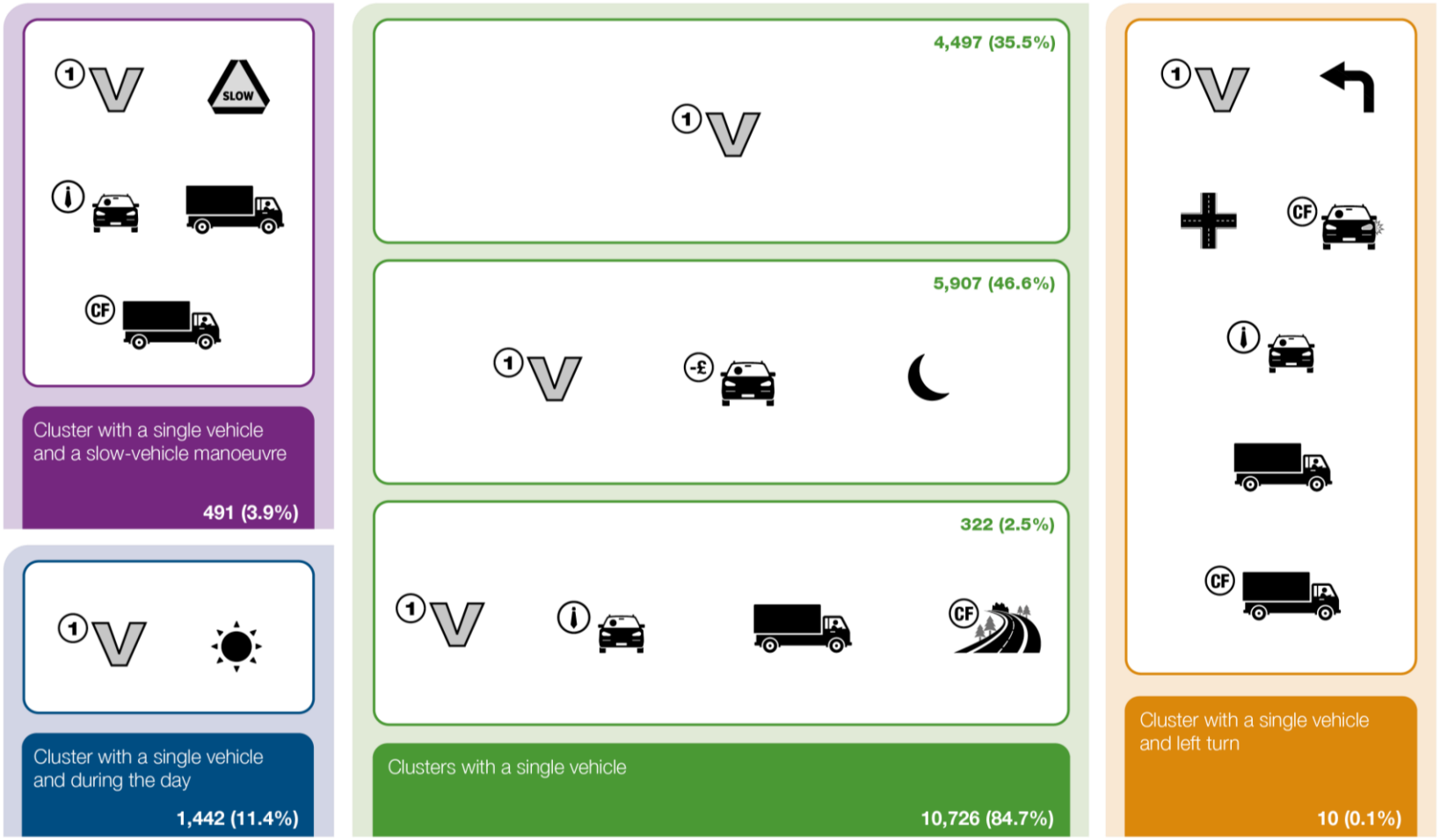
Family	Sibling	GrandSibling	Cluster ID	Count	Cluster FSCs as % of group
Single vehicle, slow-vehicle manoeuvre, working driver, LCV/PSV, LCV/PSV CF			WM17	491	3.9%
Single vehicle, day			WM9	1,442	11.4%
Single vehicle, not clustered further			WM13	4,497	35.5%
Single vehicle	Deprived driver, night		WM5	5,907	46.6%
Single vehicle	Working driver, LCV/PSV, environment contributory factor (CF)		WM15	322	2.5%
Single vehicle, left turn, driver turning CF, uncontrolled junction, working driver, LCV/PSV, LCV/PSV CF			WM24	10	0.1%

Source: Author's own

3.3.2 Cluster infographic

Figure 3.2 summarises all clusters in this group diagrammatically.

Figure 3.2: Cluster family diagram, single-vehicle collisions

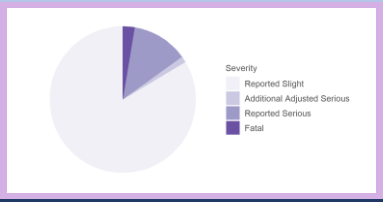
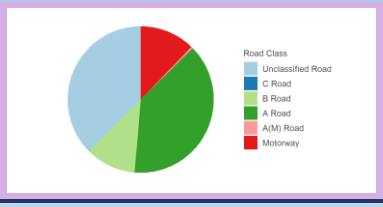
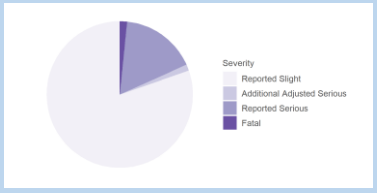
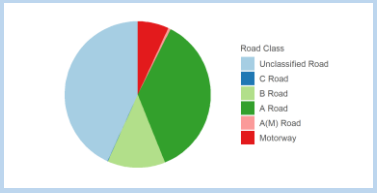
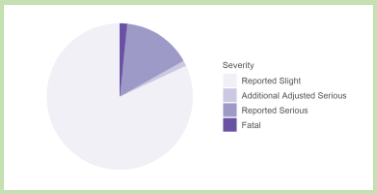
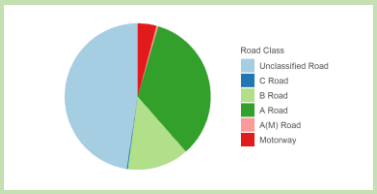
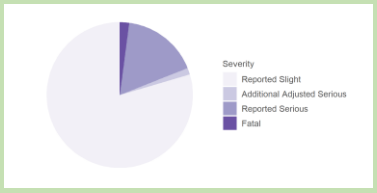
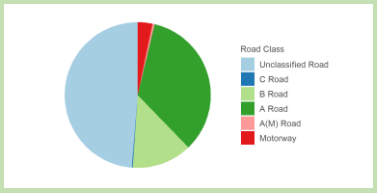
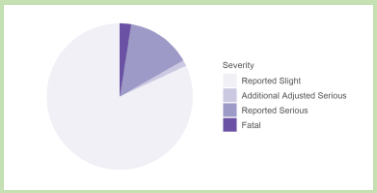
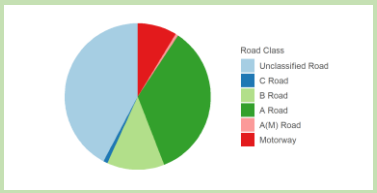


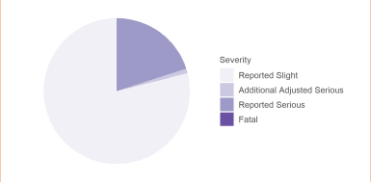
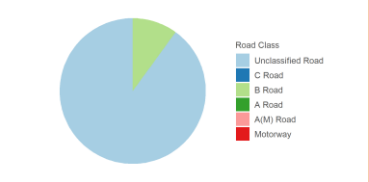
Source: Author's own

3.3.3 Cluster details

Table 3.4 summarises the most salient clusters in this group by severity and road class.

Table 3.4: Summary of clusters by severity and road class, single-vehicle collisions

	Single-vehicle collisions	
WM17	**Single vehicle, slow-vehicle manoeuvre, working driver, LCV/PSV, LCV/PSV CF**	
All collisions		**Percentage adjusted FSCs**
491		3.9%
		
WM9	**Single vehicle, day**	
All collisions		**Percentage adjusted fatal and serious collisions (FSCs)**
1,442		11.4%
		
WM13	**Single vehicle**	
All collisions		**Percentage adjusted FSCs**
4,497		35.5%
		
WM5	**Single vehicle, deprived driver, night**	
All collisions		**Percentage adjusted FSCs**
5,907		46.6%
		
WM15	**Single vehicle, working driver, LCV/PSV, environment contributory factor (CF)**	
All collisions		**Percentage adjusted FSCs**
322		2.5%
		
WM24	**Single vehicle, left turn, driver turning CF, uncontrolled junction, working driver, LCV/PSV, LCV/PSV CF**	
All collisions		**Percentage adjusted FSCs**

10	0.1%
	

Source: Author's own

3.4 Collisions involving turning

3.4.1 Cluster list

Table 3.5 summarises all clusters in this group textually.

Table 3.5: Textual summary of clusters, collisions involving turning

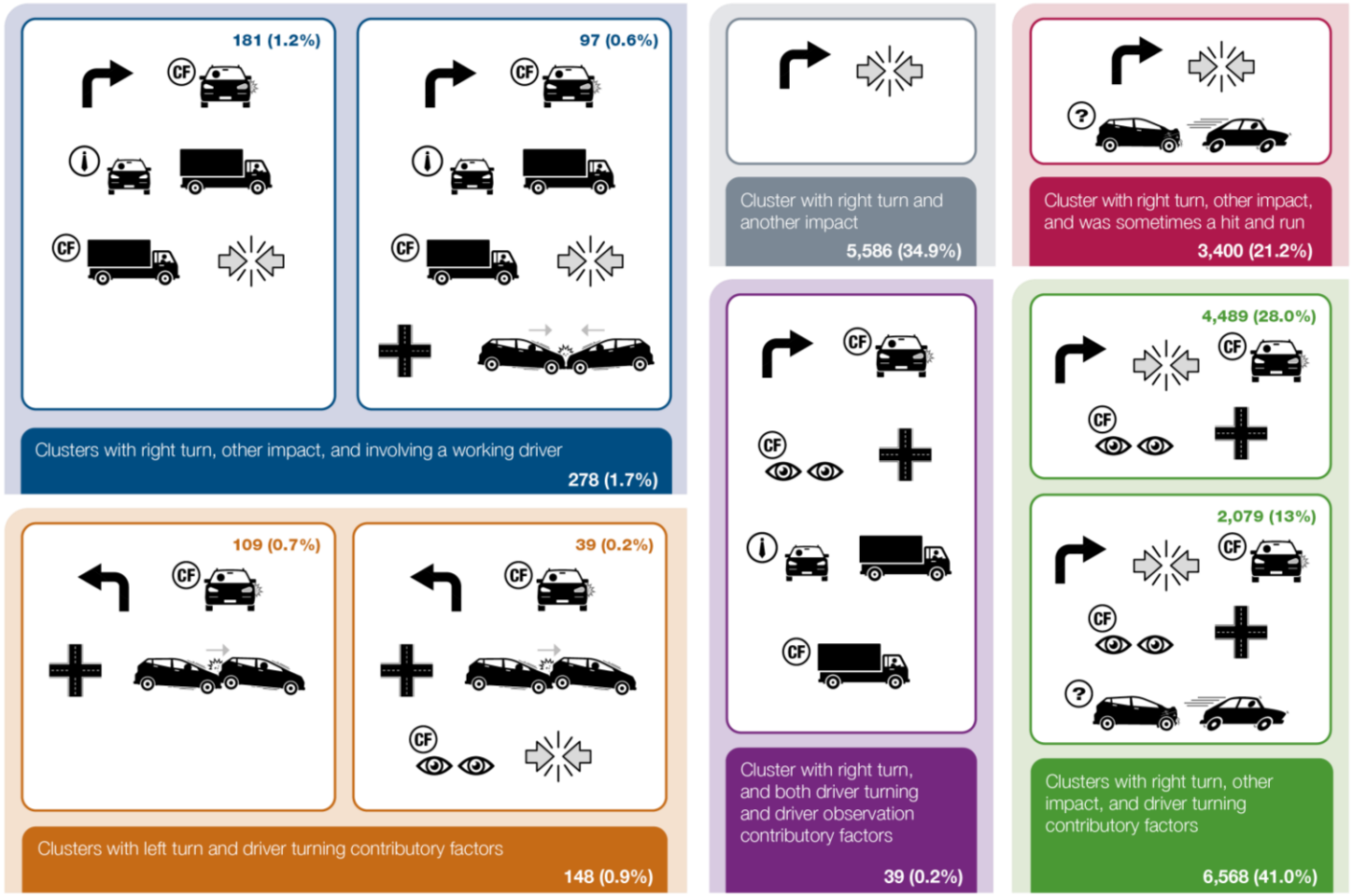
Family	Sibling	GrandSibling	Cluster ID	Count	Cluster FSCs as % of group
Right turn, driver turning CF, working driver, LCV/PSV, LCV/PSV CF, other impact			WM14	181	1.1%
Right turn, driver turning CF, working driver, LCV/PSV, LCV/PSV CF, other impact	Driver observation CF, uncontrolled junction, head on		WM20	97	0.6%
Left turn, driver turning CF, uncontrolled junction, shunt			WM26	109	0.7%
Left turn, driver turning CF, uncontrolled junction, shunt	Driver observation CF, other impact		WM27	39	0.2%
Right turn, other impact			WM3	5,586	34.9%
Right turn, driver turning CF, driver observation CF, uncontrolled junction, working driver, LCV/PSV, LCV/PSV CF			WM25	39	0.2%
Right turn, other impact (sometimes hit-and-run)			WM11	3,400	21.2%
Right turn, driver turning contributory factor (CF), driver observation CF, uncontrolled junction, other impact			WM7	4,489	28.0%
Right turn, driver turning CF, driver observation CF, uncontrolled junction, other impact	(Sometimes hit-and-run)		WM12	2,079	13.0%

Source: Author's own

3.4.2 Cluster infographic

Figure 3.3 summarises all clusters in this group diagrammatically.

Figure 3.3: Cluster family diagram, collisions involving turning

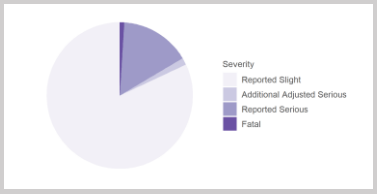
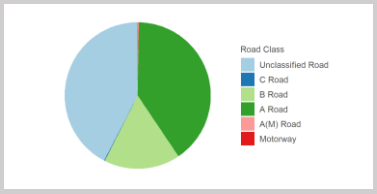
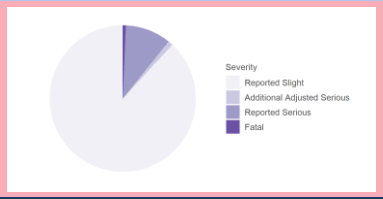
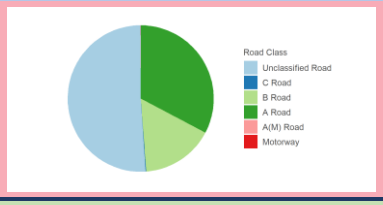
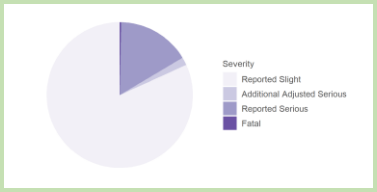
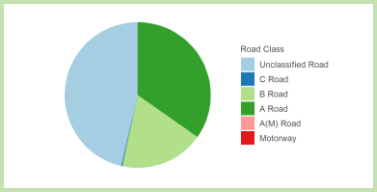
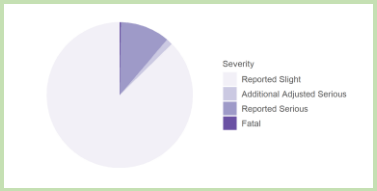
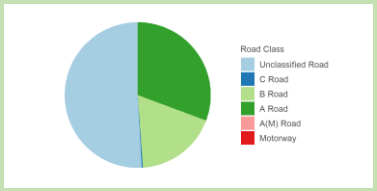
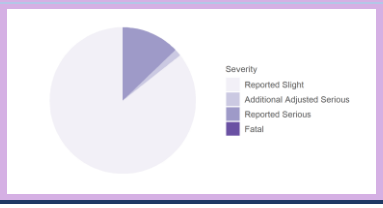
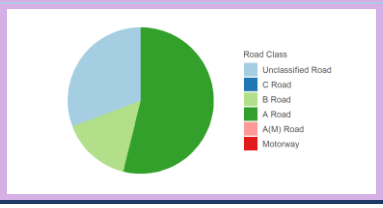


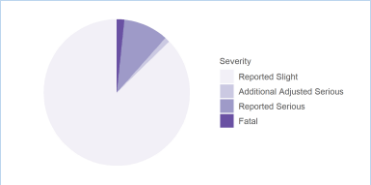
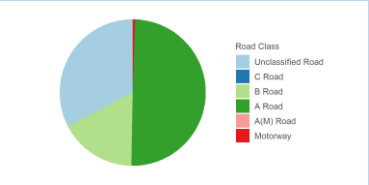
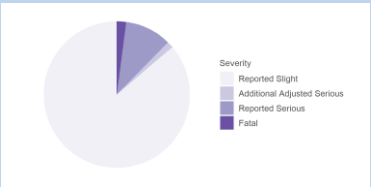
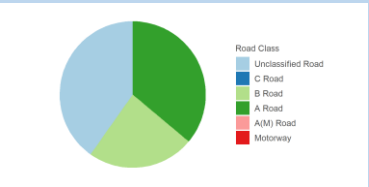
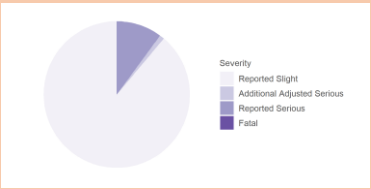
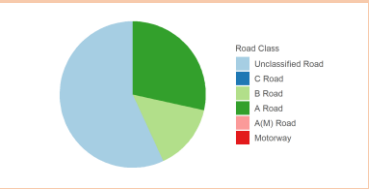
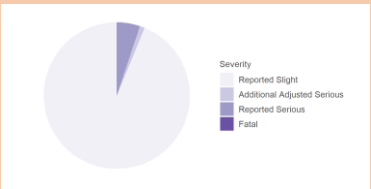
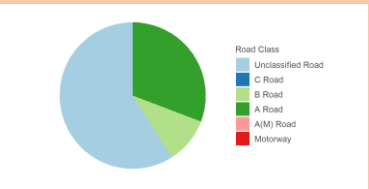
Source: Author's own

3.4.3 Cluster details

Table 3.6 summarises the most salient clusters in this group by severity and road class.

Table 3.6: Summary of clusters by severity and road class, collisions involving turning

	Collisions involving collisions involving turning
WM3	**Right turn, other impact**
All collisions	**Percentage adjusted fatal and serious collisions (FSCs)**
5,586	34.9%
	
WM11	**Right turn, other impact (sometimes hit-and-run)**
All collisions	**Percentage adjusted FSCs**
3,400	21.2%
	
WM7	**Right turn, driver turning contributory factor (CF), driver observation CF, uncontrolled junction, other impact**
All collisions	**Percentage adjusted FSCs**
4,489	28.0%
	
WM12	**Right turn, driver turning CF, driver observation CF, uncontrolled junction, other impact (sometimes hit-and-run)**
All collisions	**Percentage adjusted FSCs**
2,079	13.0%
	
WM25	**Right turn, driver turning CF, driver observation CF, uncontrolled junction, working driver, LCV/PSV, LCV/PSV CF**
All collisions	**Percentage adjusted FSCs**
39	0.2%
	

WM14	Right turn, driver turning CF, working driver, LCV/PSV, LCV/PSV CF, other impact
All collisions	**Percentage adjusted FSCs**
181	1.1%
	
WM20	**Right turn, driver turning CF, driver observation CF, uncontrolled junction, working driver, LCV/PSV, head on, other impact**
All collisions	**Percentage adjusted FSCs**
97	0.6%
	
WM26	**Left turn, driver turning CF, uncontrolled junction, shunt**
All collisions	**Percentage adjusted FSCs**
109	0.7%
	
WM27	**Left turn, driver turning CF, uncontrolled junction, driver observation CF, shunt, other impact**
All collisions	**Percentage adjusted FSCs**
39	0.2%
	

Source: Author's own

3.5 Collisions involving slow-vehicle manoeuvres

3.5.1 Cluster list

Table 3.7 summarises all clusters in this group textually.

Table 3.7: Textual summary of clusters, collisions involving slow-vehicle manoeuvres

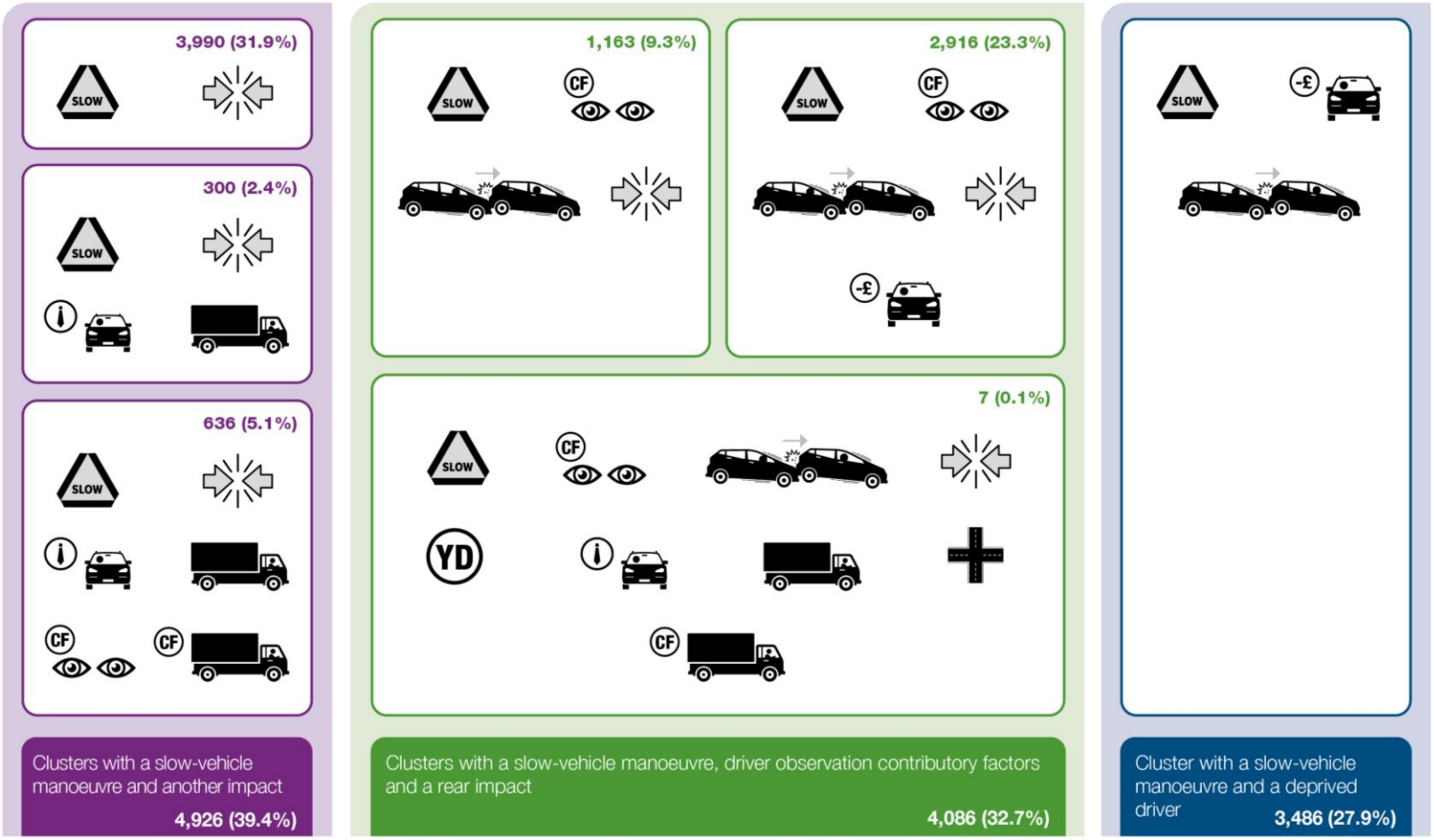
Family	Sibling	GrandSibling	Cluster ID	Count	Cluster FSCs as % of group
Slow-vehicle manoeuvre, other impact			WM8	3,990	31.9%
Slow-vehicle manoeuvre, other impact	Slow-vehicle manoeuvre, working driver, LCV/PSV, other impact		WM21	300	2.4%
Slow-vehicle manoeuvre, other impact	Slow-vehicle manoeuvre, driver observation contributory factor (CF) working driver, LCV/PSV, LCV/PSV CF, other impact		WM16	636	5.1%
Slow-vehicle manoeuvre, driver observation CF, shunt, other impact			WM18	1,163	9.3%
Slow-vehicle manoeuvre, driver observation CF, shunt, other impact	Slow-vehicle manoeuvre, driver observation CF, deprived driver, shunt, other impact		WM10	2,916	23.3%
Slow-vehicle manoeuvre, driver observation CF, shunt, other impact	Slow-vehicle manoeuvre, driver observation CF, working driver, young driver, LCV/PSV, LCV/PSV CF, uncontrolled junction, shunt, other impact		WM28	7	0.1%
Slow-vehicle manoeuvre, deprived driver, shunt			WM6	3,486	27.9%

Source: Author's own

3.5.2 Cluster infographic

Figure 3.4 summarises all clusters in this group diagrammatically.

Figure 3.4: Cluster family diagram, collisions involving slow-vehicle manoeuvres

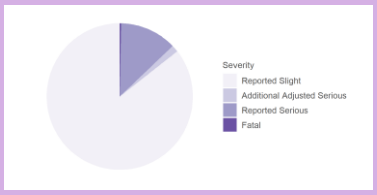
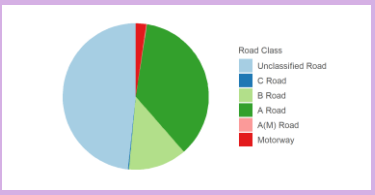
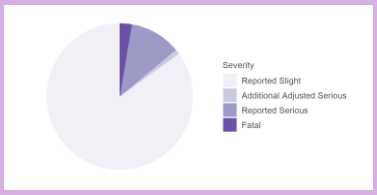
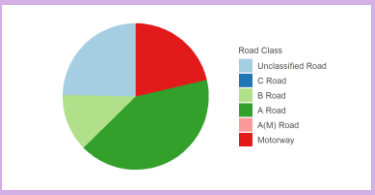
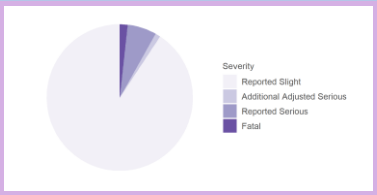
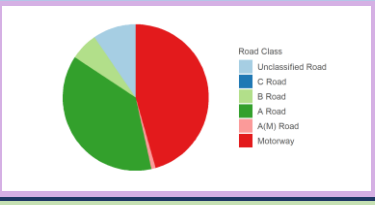
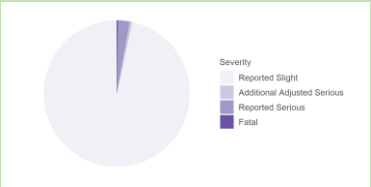
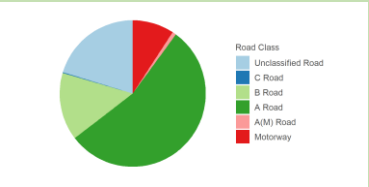
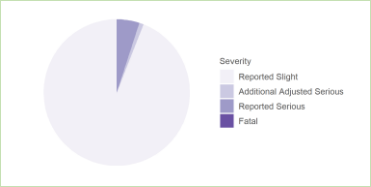
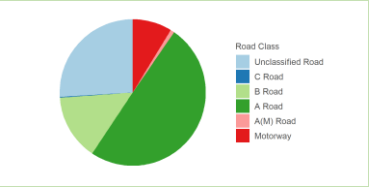


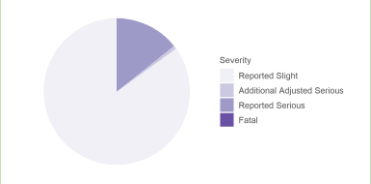
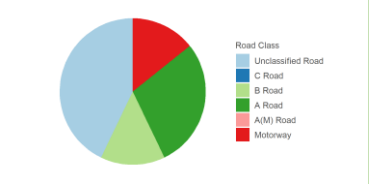
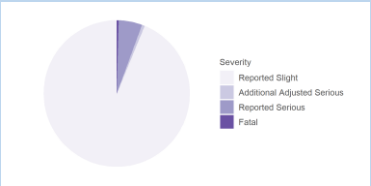
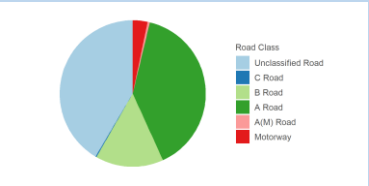
Source: Author's own

3.5.3 Cluster details

Table 3.8 summarises the most salient clusters in this group by severity and road class.

Table 3.8: Summary of clusters by severity and road class, collisions involving slow-vehicle manoeuvres

	Collisions involving slow-vehicle manoeuvres	
WM8	**Slow-vehicle manoeuvre, other impact**	
All collisions		**Percentage adjusted fatal and serious collisions (FSCs)**
3,990		31.9%
		
WM21	**Slow-vehicle manoeuvre, working driver, LCV/PSV, other impact**	
All collisions		**Percentage adjusted FSCs**
300		2.4%
		
WM16	**Slow-vehicle manoeuvre, driver observation contributory factor (CF) working driver, LCV/PSV, LCV/PSV CF, other impact**	
All collisions		**Percentage adjusted FSCs**
636		5.1%
		
WM18	**Slow-vehicle manoeuvre, driver observation CF, shunt, other impact**	
All collisions		**Percentage adjusted FSCs**
1,163		9.3%
		
WM10	**Slow-vehicle manoeuvre, driver observation CF, deprived driver, shunt, other impact**	
All collisions		**Percentage adjusted FSCs**
2,916		23.3%
		
WM28	**Slow-vehicle manoeuvre, driver observation CF, working driver, young driver, LCV/PSV, LCV/PSV CF, uncontrolled junction, shunt, other impact**	

All collisions	Percentage adjusted FSCs
7	0.1%
	
WM6	**Slow-vehicle manoeuvre, deprived driver, shunt**
All collisions	**Percentage adjusted FSCs**
3,486	27.9%
	

Source: Author's own

3.6 Other collisions

Unlike the cluster analyses in other participating RCIP areas, there was a single substantial cluster of collisions in West Midlands for which the model was unable to identify any pronounced characteristics. Because of this absence of distinguishing features, this cluster (WM4, comprising 6,708 collisions) has not been subjected to further analysis in this report. Further research would be required to identify a reason for the model's inability to cluster these collisions meaningfully. It may be attributable to data recording issues, for example incomplete reporting of details in STATS19 data.

4 Synthesis of Key Findings From Collision Type Analysis

Since the full analytic output is available to investigators interactively, this report will concentrate on identifying and summarising key findings. Informed by the main clusters of collisions which have been identified by the collision type analysis, a detailed analysis of all input variables for West Midlands was undertaken. The objective was to identify key commonalities and key differences between collision patterns in West Midlands and its identified comparator area of Greater Manchester, while also considering the national context.

During this process, in view of the importance placed on collisions resulting in fatalities or very serious injury in the work of RCIP, this analysis considered only collisions involving killed and/or seriously injured casualties. However, all collisions, including those resulting in only slightly injured casualties, are reported in the dashboard. This allows investigators to view all reported collisions which exhibit a specific combination of characteristics.

In addition, the analysis applied DfT severity adjustment data[3] at individual casualty level where appropriate, to ensure that recent changes in data collection procedures did not distort the results or the validity of comparisons. Consequently, in police force areas which have not yet applied injury-based reporting practices, some casualties originally reported as slight have been split probabilistically between the serious and slight injury categories.

4.1 General observations

Overall, the output clusters for West Midlands differed from both the comparator force and the national picture in noticeable respects.

Two input variables featured particularly prominently in collision clusters in West Midlands. One of these was collision involvement of drivers who live in deprived communities (defined as in the lower quartile of IMD as defined by the ONS). Although the overall frequency of deprived driver involvement does not seem disproportionate given the overall deprivation difference between communities in or near West Midlands and the country as a whole, it did recur in multiple clusters. Deprived drivers are involved in collisions in both West Midlands and Greater Manchester with similar frequency, namely about twice as frequently as is the case nationally. However, the way these deprived driver clusters are distributed in West Midlands differs markedly from Greater Manchester.

A similar pattern of recurrence was observed for hit-and-run collisions in West Midlands. Although hit-and-run drivers form a larger proportion of collision involvement in Greater Manchester than in West Midlands, they occurred as features of collisions more frequently in the latter area. Both areas exhibit higher levels of hit-and-run drivers than the national norm.

4.2 Collisions involving pedestrian casualties

Collisions resulting in pedestrian casualties in West Midlands are dominated by one huge cluster consisting of single-vehicle collisions where one or more contributory factors were applied to pedestrians. The corresponding cluster in national collisions is far smaller (11% of the total compared to 97% here). The corresponding collection of clusters in Greater Manchester is also far larger than nationally, suggesting that pedestrian error is identified by attending officers much more frequently in conurbations than is the case elsewhere; but this still does not match the size of the West Midlands cluster. This suggests that pedestrian behaviour, particularly in the vicinity of uncontrolled junctions, is a highly prominent feature in West Midlands pedestrian casualty collisions.

[3] Severity adjustments are explained in https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/743845/severity-reporting-methodology-report.odt and available for download from https://data.gov.uk/dataset/cb7ae6f0-4be6-4935-9277-47e5ce24a11f/road-safety-data

Other notable aspects of these clusters in West Midlands were daytime occurrences, the presence of working drivers, and hit-and-run incidents. A more detailed analysis of casualties was undertaken to investigate the actual prominence of these features relative to the comparator and the national trend. Casualties resulting from single-vehicle collisions with a contributory factor assigned to a pedestrian were compared across the three areas.

These incidents do occur slightly more frequently in daylight in West Midlands than is the case in Greater Manchester and nationally. Working drivers were frequently involved in such collisions everywhere, but more often in West Midlands, where there was a particular correlation with working drivers and night-time collisions. This may suggest a relationship with the night-time economy in West Midlands, as the corresponding Greater Manchester cluster was smaller than in West Midlands. On detailed examination, the frequency of hit-and-run drivers in these collisions appears to be a feature shared by West Midlands and Greater Manchester, as both areas had higher casualty proportions involving hit-and-run incidents than the national norm.

4.3 Single-vehicle collisions

The group of clusters categorised as single-vehicle collisions in both West Midlands and Greater Manchester exhibit notable differences to the analogous national group of clusters. Most notably, the strong relationship between environmental contributory factors and the frequency with which the corresponding national clusters involved vehicle run-offs is absent from single-vehicle collision clusters in both West Midlands and Greater Manchester. This is likely to reflect differences in the urban road environment, which make these features less prevalent.

However, some similarities between single-vehicle collisions in West Midlands and the national clusters do exist. Both have prominent clusters of single-vehicle collisions which occurred at night, although in both West Midlands and Greater Manchester these clusters were more prominent than is the case nationally. Involvement of working drivers also appears in sibling groups in all three analyses, although this is markedly less notable in West Midlands.

The presence of large vehicles (heavy goods vehicles or buses) in single-vehicle collisions, and the involvement of deprived drivers, was explored in more detail. Deprived drivers are far more frequently involved in such collisions in both conurbations, but further examination showed that this prevalence is no greater than the general difference between collision-involved drivers in West Midlands and the national norm resulting from underlying demographic differences. Similarly, large vehicles were no more often involved in single-vehicle collisions than they were nationally.

It appears that single-vehicle collisions remain a problem in urban road environments despite more engineered and lit environments. The frequency of these collisions at night is more marked in West Midlands than it is nationally, although not to as much of a degree as in Greater Manchester.

4.4 Collisions involving turning

As is the case nationally, there are several large clusters of collisions in West Midlands which all involved vehicles making right turns. Also, like both the national clusters and those in Greater Manchester, a preponderance of these were associated with attending officers assigning both poor turning and poor observation contributory factors to involved drivers.

While it is not surprising that collisions result from crossing traffic streams when drivers make errors of this kind, these clusters in West Midlands did exhibit a feature which differs noticeably from both the national and comparator areas, namely an increased likelihood of hit-and-run vehicles being involved. Further analysis showed that both West Midlands and Greater Manchester had a higher frequency of this type of hit-and-run incident than the national norm. To some extent, the model also associated poor right-turn manoeuvres with large vehicles in West Midlands, although the absolute number of KSI casualties resulting from such collisions was low. Unlike elsewhere, there were no clusters involving a particular driver demographic or time of day in collision clusters of this kind.

4.5 Collisions involving slow-vehicle manoeuvres

It should not be presumed that collisions involving slow-vehicle manoeuvres, such as stopping, starting or waiting, are always low-speed events; moreover, they do not necessarily result in only slight injuries. The presence of one slow-moving vehicle does not imply that all involved vehicles were moving slowly, and in fact slow-moving vehicles can cause serious injury to vulnerable road users. In West Midlands they are often clustered with 'shunt' (front-to-rear) collisions. This correlation is even more widespread in clusters in Greater Manchester. They are also often associated with officers assigning a poor observation contributory factor to the driver, as is the case nationally as well. This latter correlation is not seen in clusters from Greater Manchester, which may to some extent reflect recording differences between the forces. Further analysis revealed that observation factors are more commonly recorded in slow traffic collisions nationally than in both West Midlands and Greater Manchester.

The most frequent element in these clusters which appears unique to West Midlands is the involvement of drivers from deprived backgrounds. Further detailed analysis again revealed that, as is the case with the single-vehicle collision clusters described above, the prevalence of deprived drivers in these collisions does not appear any greater than would be expected given the demographic profile of West Midlands drivers compared to the national norm. However, the existence of two substantial clusters both featuring this attribute remains striking. Other demographic features, such as several clusters in Greater Manchester which involve working drivers, was not manifest in West Midlands clusters.

Appendix A: Input Variables

For an explanation of how these input variables were applied during machine learning, see section 2.2 Input data in the accompanying methodology paper.

Table A.1: Collision input variables

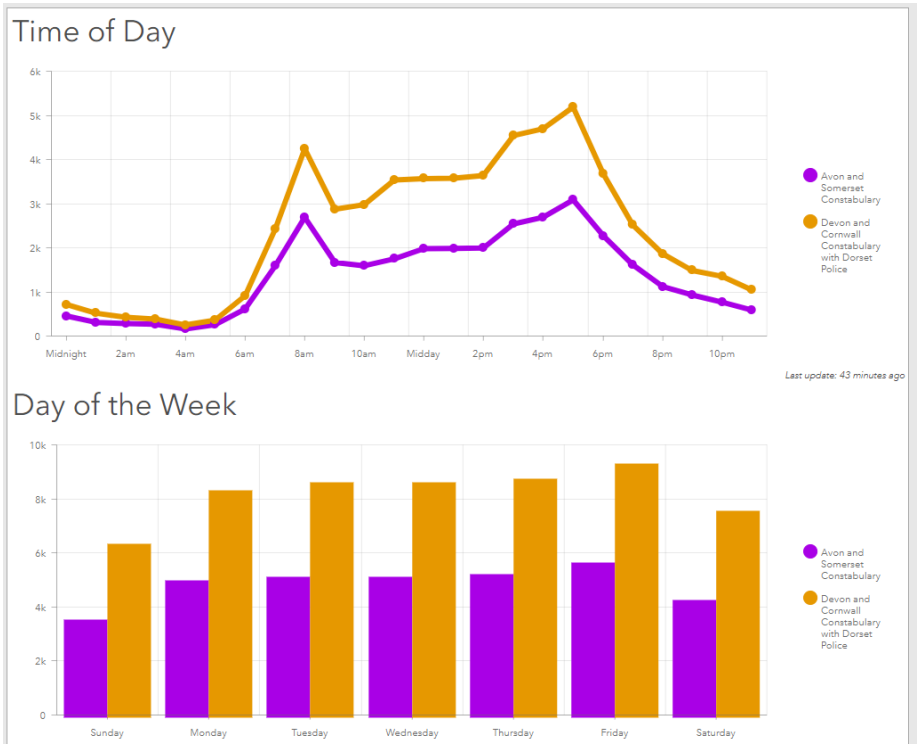
Group	Title	Type	Definition	Model usage
101a	Severity_Fatal	Boolean	True: at least one casualty was killed	Used subtly
101b	Severity_Serious_Adjusted	Continuous	Probability that at least one casualty would have been classified as serious if injury-based reporting had been in place	Used subtly
102a	Junction_Controlled	Boolean	True: junction with ATS (automatic traffic signal) or authorised person	Used subtly
102b	Junction_Uncontrolled_Roundabout	Boolean	True: junction with roundabout or mini-roundabout	Used subtly
102c	Junction_Uncontrolled_Other	Boolean	True: junction with Give Way or Stop (not at roundabout)	Used extensively
103	Weather_Adverse	Boolean	True: any inclement weather conditions (rain, snow, fog, other with or without high winds)	Used moderately in West Midlands, but subtly nationally
104a	Date_PH	Boolean	True: was a weekday public holiday (Christmas, Easter or bank holiday)	Ignored as irrelevant
104b	Date_Weekend	Boolean	True: was a Saturday or Sunday	Ignored as irrelevant
105a	Time_Rush_AM_7to9	Boolean	True: was at or after 7 a.m. and before 9 a.m.	Used subtly in West Midlands, but used moderately nationally
105b	Time_Night_7to7	Boolean	True: was at or after 7 p.m. and before 7 a.m. the following day	Used extensively in West Midlands, but moderately nationally
106a	Night_Streetlights	Boolean	True: was dark, and streetlights were present and lit	Used extensively
106b	Night_NoStreetlights	Boolean	True: was dark, and no lit streetlights were present	Ignored as irrelevant in West Midlands, but used moderately nationally
107	Vehicles_Single	Boolean	True: only one vehicle was involved	Used extensively
108	Population_Density_Raw	Continuous	Population per square km of Lower Layer Super Output Area (LSOA) / data zone in mid-2018	Ignored as irrelevant

109	Dynamics_HeadOn	Boolean	True: at least one vehicle had a front impact; *and* at least one other vehicle travelling in the opposite direction also had an impact	Used extensively in West Midlands, but moderately nationally
110	Dynamics_Shunt	Boolean	True: at least one vehicle had a rear impact; *and* at least one other vehicle travelling in the same direction also had an impact	Used extensively
111	Dynamics_SideImpact	Boolean	True: at least one vehicle had a side impact; *and* at least one other vehicle travelling in an adjacent direction also had an impact	Used moderately
112	Dynamics_OtherImpact	Boolean	True: at least two vehicles had impacts	Used extensively
113	Vehicles_Count	Continuous	Number of vehicles involved	Used subtly
114	Casualties_Count	Continuous	Number of casualties resulting (of all severities)	Used subtly

Source: Author's own

Figure A.1 shows some collision variables applied to trend analysis in an area dashboard.

Figure A.1: Collision variables applied to trend analysis in an area dashboard



Source: Author's own

Table A.2: Vehicle input variables

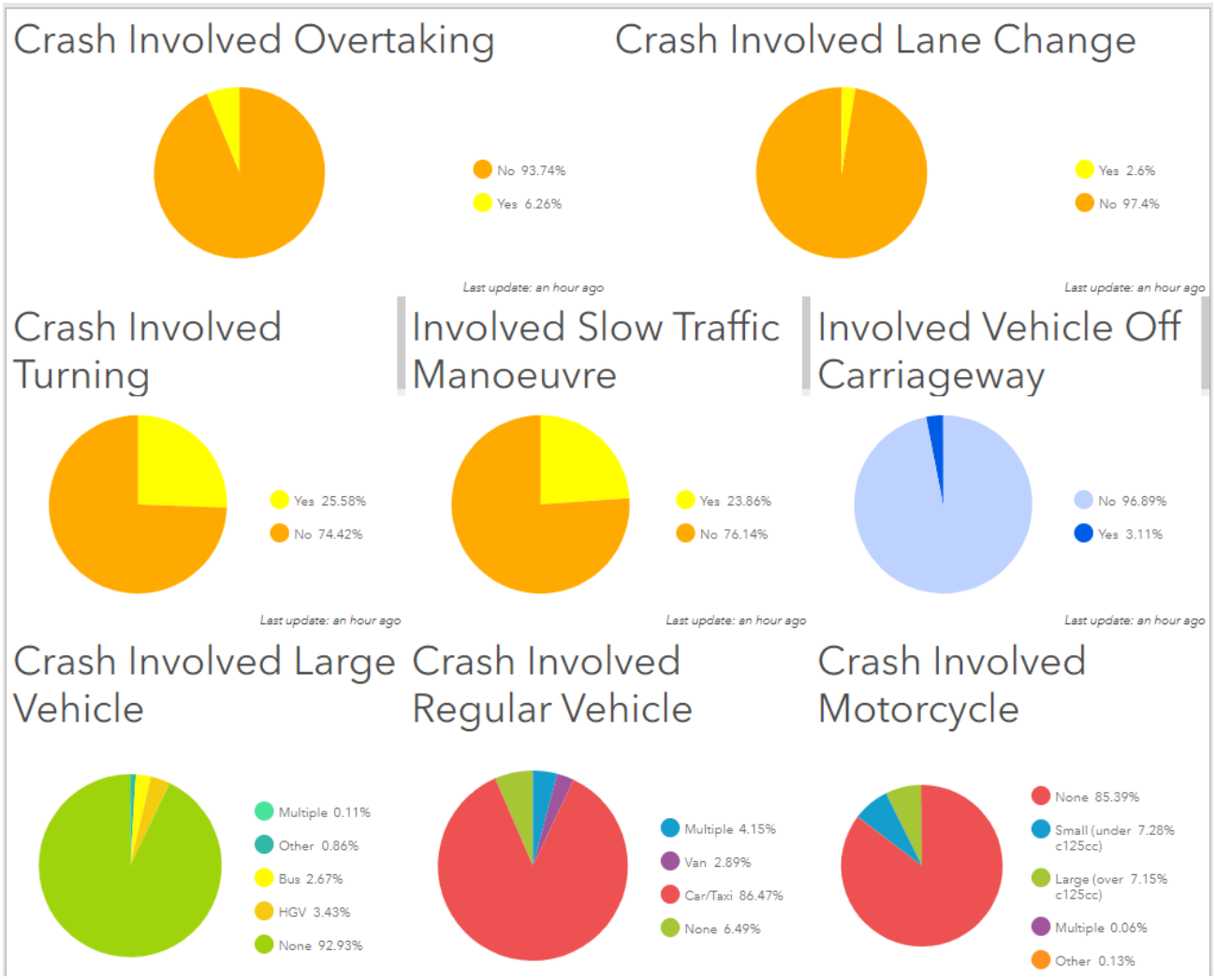
Group	Title	Type	Definition	Model usage
201a	Runoff_Nearside	Boolean	True: vehicle left carriageway to the nearside (whether rebounded or not)	Used moderately in West Midlands, but used extensively nationally
201b	Runoff_Other	Boolean	True: vehicle left carriageway in any other fashion	Used moderately
202	Vehicle_HitRun	Boolean	True: vehicle was hit-and-run (excluding non-stop vehicles not hit)	Used moderately in West Midlands, but subtly nationally
203	Vehicle_NotInMainCway	Boolean	True: any vehicle on a footway; any vehicle on, entering or leaving a hard shoulder; a vehicle other than a bus in a bus lane or busway; or any vehicle other than a tram on a tram track	Used subtly in West Midlands, but ignored as irrelevant nationally
204a	Vehicle_Overtaking	Boolean	True: vehicle was overtaking (offside or nearside)	Used subtly
204b	Vehicle_LeftTurn	Boolean	True: vehicle was turning left, or waiting to do so	Used moderately
204c	Vehicle_RightTurn	Boolean	True: vehicle was turning right, or waiting to do so	Used extensively

204d	Vehicle_SlowManeouvre	Boolean	True: vehicle was stopping, stationary or moving off	Used moderately in West Midlands, but used extensively nationally
204e	Vehicle_LaneChange	Boolean	True: vehicle was changing lane (to left or right)	Used subtly
205a	Vehicle_Moped	Boolean	True: vehicle was a motorcycle with engine size 50cc or under	Ignored as irrelevant
205b	Vehicle_MC_MidSize	Boolean	True: vehicle was a motorcycle with engine size over 50cc up to 500cc (includes vehicles which were electric or of unknown engine size)	Used subtly
205c	Vehicle_MC_Large	Boolean	True: vehicle was a motorcycle with engine size over 500cc	Used subtly
205d	Vehicle_Large_GV_PSV	Boolean	True: vehicle was a bus, coach or tram; or a goods vehicle over 3.5 tonnes mgw or of unknown weight	Used moderately in West Midlands, but used extensively nationally
206a	Driver_Young_Under25	Boolean	True: driver/rider of motor vehicle was aged 16–24 inclusive	Used moderately
206b	Driver_Old_70Plus	Boolean	True: driver/rider of motor vehicle was aged over 69	Used extensively
207	Driver_Deprived_BottomQuintile	Boolean	True: driver's home postcode was in a LSOA classified by the ONS in the most deprived quintile of the Index of Multiple Deprivation	Used moderately
208	Driver_Working	Boolean	True: driver was recorded as working; and/or was driving a large vehicle; and/or was on a commuting journey in a taxi or light goods vehicle	Used moderately in West Midlands, but used extensively nationally

Source: Author's own

Figure A.2 shows some of these vehicle variables applied to trend analysis in an area dashboard.

Figure A.2: Vehicle variables applied to trend analysis in an area dashboard



Source: Author's own

Table A.3: Casualty input variables

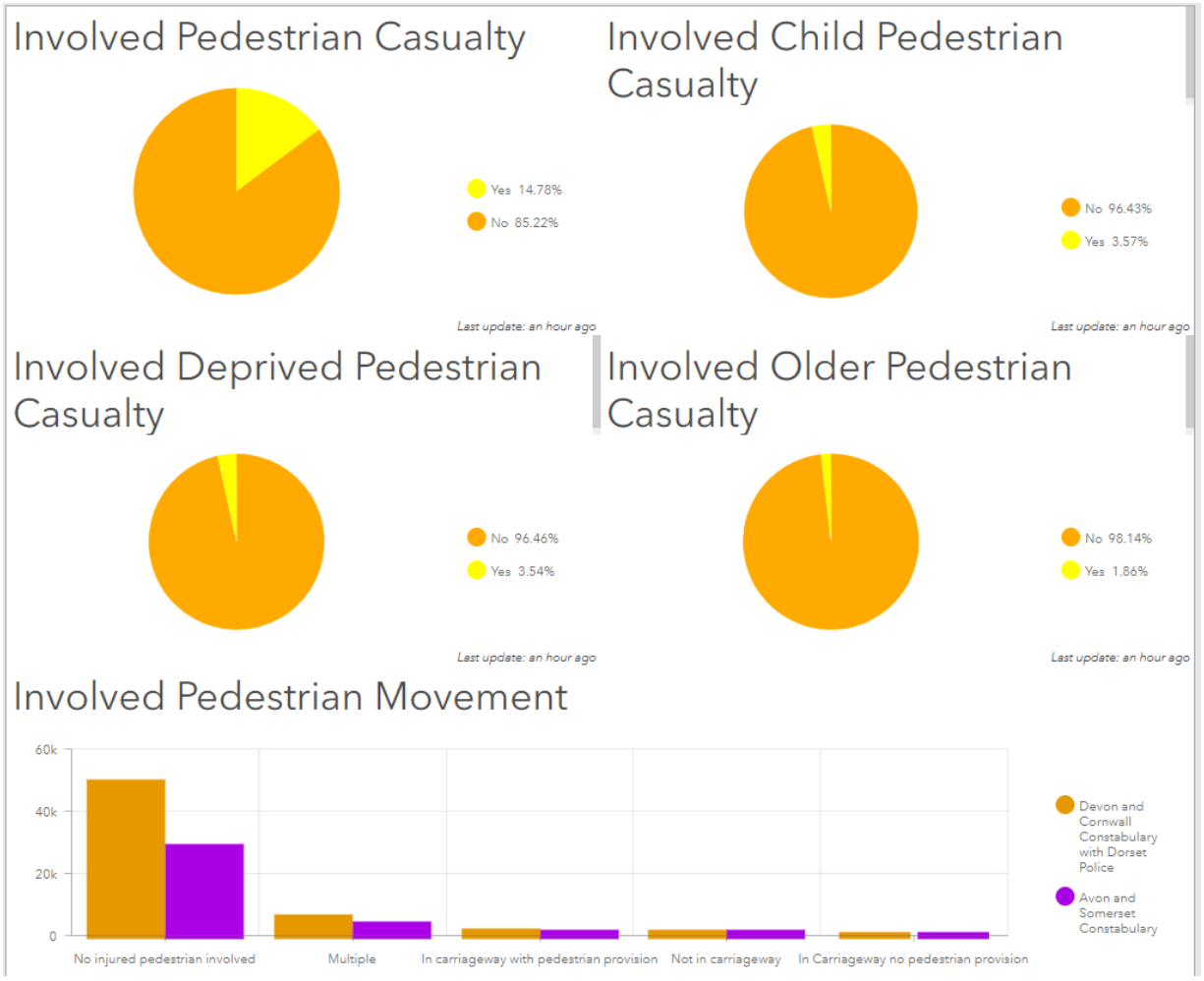
Group	Title	Type	Definition	Model usage
301a	Casualty_PCUser	Boolean	True: casualty was rider or pillion passenger on a cycle	Used moderately in West Midlands, but used extensively nationally
301b	Casualty_HorseRider	Boolean	True: casualty was rider or pillion passenger on a horse	Ignored as irrelevant
301c	Casualty_MobilityScooterUser	Boolean	True: casualty was rider or pillion passenger on a mobility scooter	Ignored as irrelevant
302	Casualty_Pedestrian	Boolean	True: casualty was a pedestrian	Used extensively

303a	Casualty_ChildPedestrian_Under16	Boolean	True: casualty was a pedestrian aged under 16	Used extensively
303b	Casualty_OldPedestrian_70Plus	Boolean	True: casualty was a pedestrian aged over 69	Used moderately
304a	Casualty_Pedestrian_CrossingOrRefuge	Boolean	True: casualty was a pedestrian on a crossing, refuge or central island	Used moderately
304b	Casualty_Pedestrian_Footway	Boolean	True: casualty was a pedestrian on a footway	Used moderately in West Midlands, but subtly nationally
305	Casualty_Pedestrian_InCway_Masked	Boolean	True: casualty was a pedestrian anywhere in the carriageway who was masked by a stationary or parked vehicle	Used moderately in West Midlands, but subtly nationally

Source: Author's own

Figure A.3 shows some casualty variables applied to trend analysis in an area dashboard.

Figure A.3: Casualty variables applied to trend analysis in an area dashboard



Source: Author's own

Table A.4: Contributory factor input variables

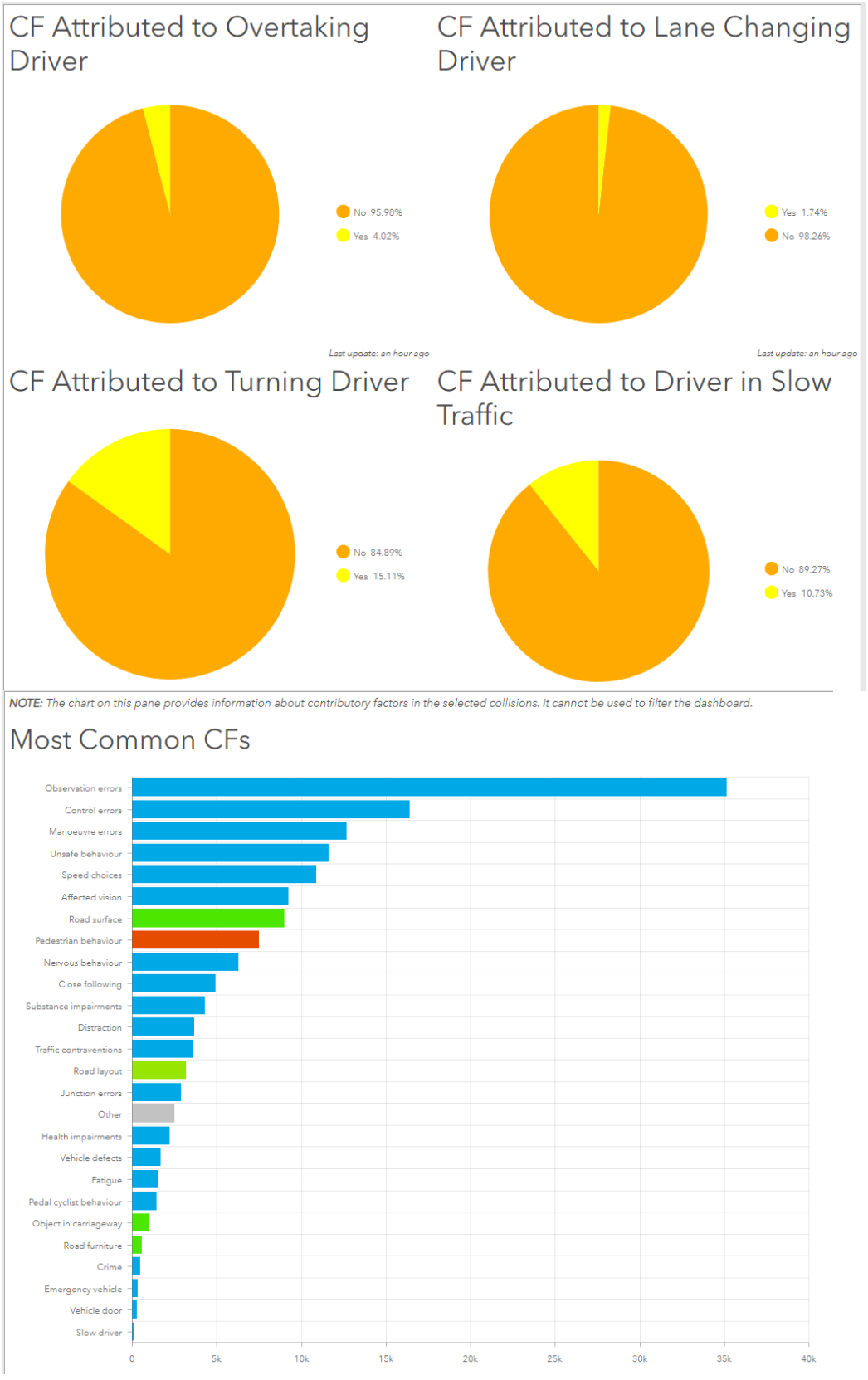
Group	Title	Type	Definition	Model usage
401a	Pedestrian_Casualty_Contributed	Boolean	True: any injured pedestrian or vehicle passenger had a pedestrian contributory factor (CF) assigned to them	Used extensively
401b	Pedestrian_Uninjured_Contributed	Boolean	True: any uninjured pedestrian had a pedestrian CF assigned to them	Ignored as irrelevant
402a	Driver_Contributed_Overtaking	Boolean	True: any overtaking driver or rider had any driver/rider CF assigned to them	Used subtly
402b	Driver_Contributed_Turning	Boolean	True: any turning driver or rider had any driver/rider CF assigned to them	Used extensively
402c	Driver_Contributed_LaneChange	Boolean	True: any lane-changing driver or rider had any driver/rider CF assigned to them	Used subtly
403a	Cyclist_Contributed	Boolean	True: any cyclist had any CF assigned to them	Used moderately in West Midlands, but used extensively nationally
403b	P2W_Rider_Contributed	Boolean	True: any motorcyclist had any CF assigned to them	Ignored as irrelevant in West Midlands, but used subtly nationally
403c	Large_GV_PSV_Driver_Contributed	Boolean	True: any large vehicle driver had any CF assigned to them	Used moderately in West Midlands, but used extensively nationally
404	Environmental_Factor_Contributed	Boolean	True: any participant had an environmental, vision-affected or other specific CF assigned to them	Used moderately in West Midlands, but used extensively nationally
405	Vehicle_Factor_Contributed	Boolean	True: any driver or rider had a vehicle defect CF assigned to them	Ignored as irrelevant
406	Driver_Crime_Contributed	Boolean	True: any driver or rider had a crime-related CF assigned to them	Ignored as irrelevant
407	Driver_Intoxicated_Contributed	Boolean	True: any driver or rider had an intoxication CF assigned to them	Ignored as irrelevant
408	Driver_SpeedChoice_Contributed	Boolean	True: any driver or rider had a speed choice CF assigned to them	Ignored as irrelevant in West Midlands, but used subtly nationally
409	Driver_MobilePhone_Contributed	Boolean	True: any driver or rider had mobile phone CF assigned to them	Ignored as irrelevant

410	Driver_CloseFollowing_Contributed	Boolean	True: any driver or rider had close following CF assigned to them	Used subtly
411	Driver_Disobeyed_Contributed	Boolean	True: any driver or rider had any 'disobeyed sign or marking' CF assigned to them	Used subtly
412	Driver_Observation_Contributed	Boolean	True: any driver or rider had any observation CF assigned to them	Used extensively
413	Driver_Fatigue_Contributed	Boolean	True: any driver or rider had fatigue CF assigned to them	Ignored as irrelevant
414	Driver_Distracted_Contributed	Boolean	True: any driver or rider had any distraction CF assigned to them	Ignored as irrelevant
415	Driver_Careless_Contributed	Boolean	True: any driver or rider had aggressive and/or careless CF assigned to them	Used subtly in West Midlands, but ignored as irrelevant nationally

Source: Author's own

Figure A.4 shows some contributory factor (CF) variables applied to trend analysis in an area dashboard.

Figure A.4: Contributory factor (CF) variables applied to trend analysis in an area dashboard

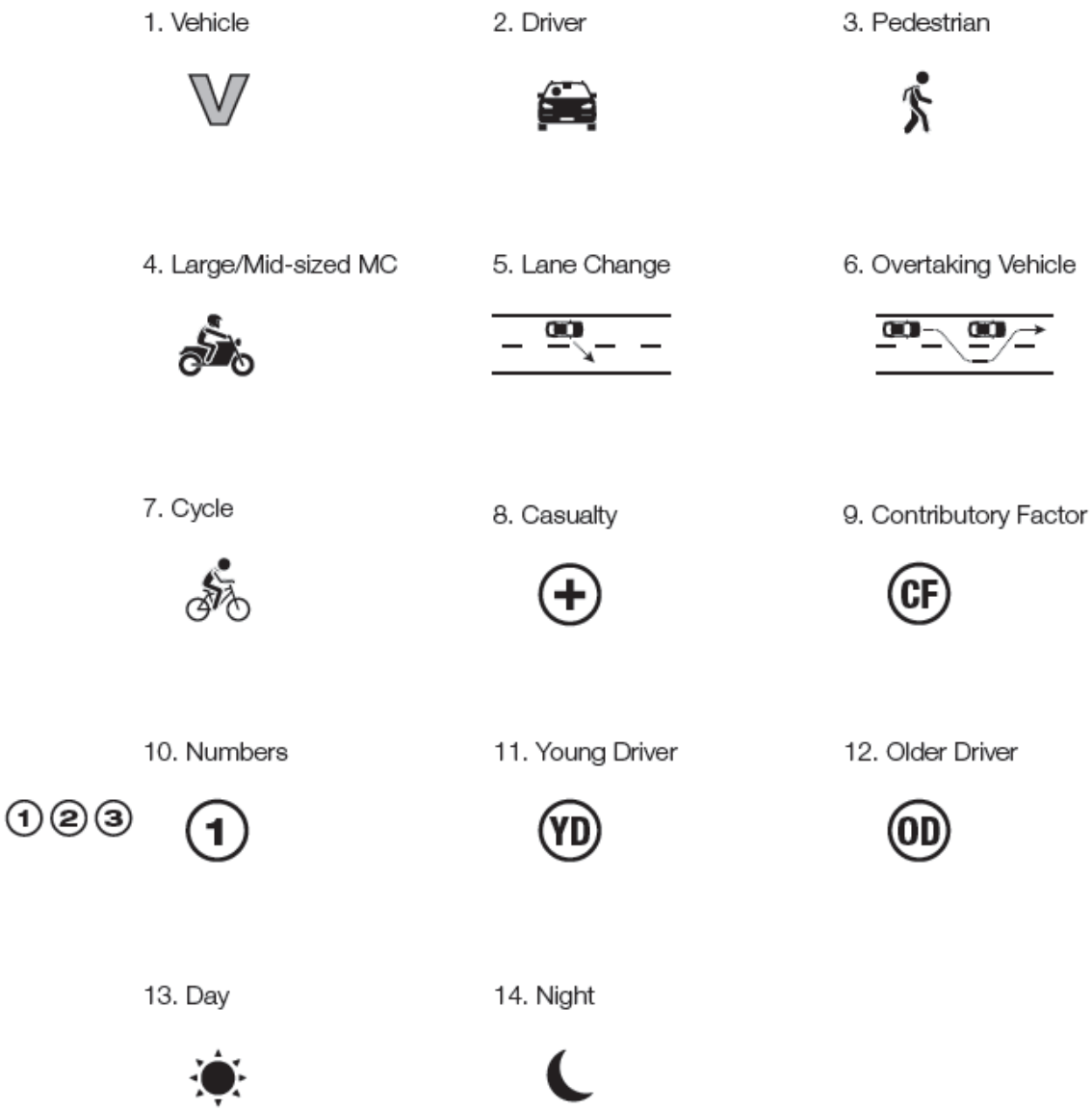


Source: Author's own

Appendix B: Infographics Key

Figure A.5 shows the icon definitions

Figure A.5: Icon directory (source: author's own)



15. Other Impact

16. Driver Observation CF

17. Shunt

18. Uncontrolled Junction

19. Right Turn

20. Driver Turning CF

21. Environment CF

22. Runoff (nearside)

23. Young Driver

24. Older Driver

25. Night (streetlights)

26. Night (no streetlights)

27. Runoff (other)

28. Pedestrian footway

29. Slow Vehicle Manouever

30. Working Driver

31. Head On

32. Roundabout

33. Cyclist Casualty

34. Pedestrian Casualty

35. Deprived Driver

36. Hit and Run

37. LGV/PSV

38. Side Impact

39. Vehicle not in Carriageway

40. Pedestrian CF

41. Single Vehicle

42. Child Pedestrian Casualty

43. LGV/PSV CF

44. Driver Overtaking CF

45. P2W rider CF

46. Large MC

47. Mid-sized MC

48. Moped

49. Left Turn

50. Controlled Junction

51. Pedestrian on Crossing

52. Adverse Weather

53. Weekend

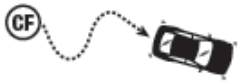
54. Close following CF

55. No distinguishing Features

56. Speed Choice CF

57. Lane Change CF

58. Careless driver CF



59. More likely hit and run

60. Cyclist CF

61. Working Young or Old

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