Domestic Abuse

Digital Analytics Lab

September 2020

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1 Summary

This report looks at the factors that influence domestic violence (note that this term is used interchangeably with domestic abuse (DA) and intimate partner violence (IPV) in this report). The impact of these crimes cannot be overstated. The number of cases reported and recorded through to a crime is small around at about 7 ½% of the reported Intimate Partner Violence. The main factor is the lack of support of the victims; it is well known that it is very difficult (but not impossible) to drive a prosecution forward in such a situation. In light of this, a consideration of the factors that influence a victim withdrawing or there being evidential difficulties is also undertaken.

There are a number of findings that suggest that there are areas where the Service can consider a different resourcing approach to these incident classes. As might be expected, victim *and* perpetrator histories are important in the conversion of incidents to a successful outcome. The influences of these are varied and are dependent upon the histories presented.

These histories include the personal, for example incidents involving ex-partners are more likely to end in a positive outcome as are male victims, whereas the oldest and youngest victims are not. The criminal histories (especially of the perpetrator where there is more chance of such a history being recorded) are also important where lower level perpetrators are less likely to face an investigation that ends in a positive outcome.

The data suggests that persistent offenders tend to remain such; the strength of relationships between past offenders and current IPV offences is strongest. If a victim removes their support, this has an impact of increasing the probability of further crimes and IPV crimes; it gives the perpetrator a *carte blanche* for more IPV later. The classification of the incident is also an important factor for the successful outcome to the investigation. P1 and P9 response classifications are less likely to lead to victims withdrawing from the case. Likewise the focus of the officers (as defined by the highest proportion of logs written by one officer) reduces the likelihood of withdrawal from the incident. This implies that the use of a small group of officers on a case would be beneficial from the perspective of keeping victims positively involved in the case.

Factors Influencing IPV Outcomes

Positive Factors	Negative Factors
- Officer focus- how high a proportion of logs does the most involved officer write	- Classifying the incident in an intermediate rank (P2-7)
- Lead Officer- how many logs does the most involved officer write	- Perpetrator involved in relatively low level criminal behaviours
- Drugs, Alcohol & Mental Health flags on the incident	- Perpetrator a victim of relatively serious crime
- Ex-partner involvement	- Not having support from the victim
- Perpetrator involved in serious crimes	- Very young or very old perpetrators
- Male victim	

The academic literature is used to guide the variables used in the analyses. The factors highlighted by this literature are often found to be important influences in a number of

the models. Unfortunately the literature tends to focus on those factors relating to the victim and perpetrator, rather than the factors that are directly in the control of the police. These are often more focused on the 'soft skills' of the investigating officers. This study looks at factors that are more measureable, those such as the officer focus and the relative proportion of the main officer's contribution to log entries.

The role of officers is complex. In particular, the lead officer's effect on the successful outcome suggests that there is an improvement in the outcomes when the lead officers are more involved in the incidents[1]. This does not continue ad infinitum, rather it declines after a point with victims either deciding not to proceed for whatever reason or the case not fulfilling the relevant threshold tests. From this we can suggest that there is an opportunity to improve outcomes using more focused officer resourcing.

Within the report, we examine both outstanding offenders & successful prosecutions. The offender and the victim's histories are used in the analysis to consider the typologies detailed in the literature and characteristics of both parties observed by subject matter experts. Changes announced on the 10th September 2020 (which relate to the processes of WMP in relation to the initial response of WMP in some IPV cases) are after the work presented here and the impact of that pilot cannot be judged.

[1] The lead officer is defined here as the most active officer on the case as measured by the proportionate number of investigation log entries.

2 Introduction

Domestic Abuse or violence or intimate partner violence (henceforth IPV) is a global problem (World Health Organization and others (2010) and Mikton (2010)). The majority of victims of IPV are women suffering at the hands of their male partners. There is a mixed research base for the area of study. The paucity of data in many cases has led to surveys of victims or victim- perpetrator couples (see Wilkinson and Hamerschlag (2005) Table 1 for a summary of a number of these). The focus of this work is to extract informative learnings from these interdisciplinary studies and associated risk assessment tools to consider what factors increase or reduce the probability of an IPV incident being successfully investigated. The scale of the issue locally can be testified to by the creation of a three day focus of WMP on IPV by former DCC Rolfe (28- 30th January 2020) and the strength of feelings as shown in the comments relating thereto ("Domestic Abuse – It's Critical You Play Your Part" 2020).

In general the literature is based on men as the perpetrator and the women as the victims. Although there is a growing literature about same sex offences, in any situation, a male or female can be the victim or the perpetrator of IPV. Recently, the same-sex violence issue has come to light more starkly in recent months and this would be a necessary consideration once sufficient data comes to light. A recent example of sexual violence against men is given here.

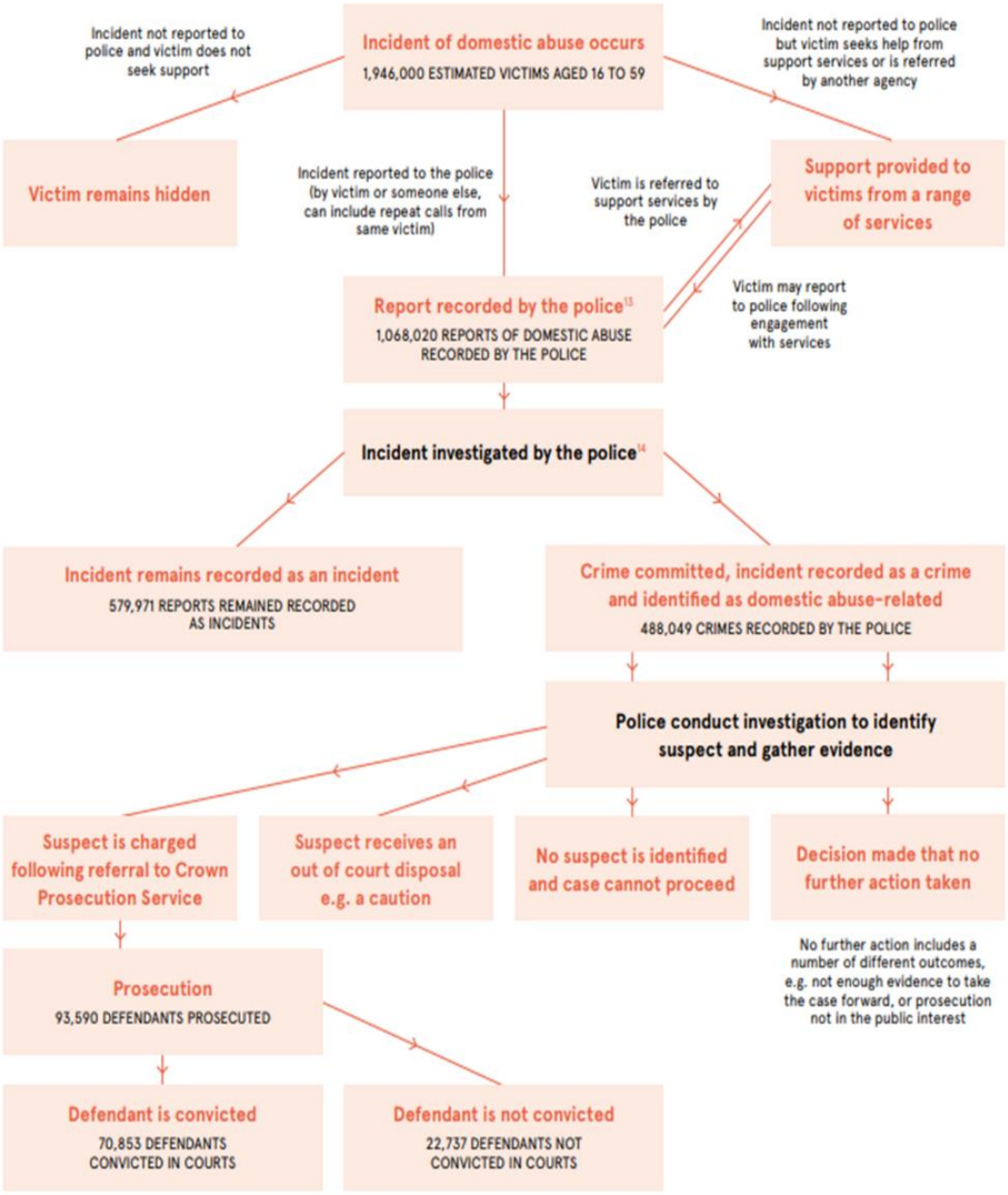
Due to the nature of IPV, a confounding factor is the lack of willingness by the victim to press charges. The incident is frequently not *crimed*. These cases might be due to the unwillingness of the victim (for a number of reasons) to take the case further despite any evidential support.

The focus on outstanding offenders is an additional issue. These are considered as those associated with an incident where a crime reference is generated but no arrest made at that time, though there may be an arrest later following any investigation. The study considers what outstanding offenders go on to perpetrate at a later date.

This work looks to build upon the literature of what drives IPV in order to help discriminate between IPV incidents and to understand the factors that can increase the probability of a positive outcome in IPV cases and to understand the issues associated with outstanding offenders. In light of this, a brief consideration of the literature and law regarding IPV is presented before considering the data and modelling associated with IPV.

The approach followed here therefore uses the typologies of the victim and offender in addition to factors that support the victim through the process and the investigation in order to improve the conversion of the reported incidents to a case that the CPS is able to take to court. Understanding these factors together give the opportunity to increase resource efficiency and effectiveness whilst trying to ensure that the victims and defendants are dealt with fairly and compassionately.

IPV cases go through the criminal justice system as other offences do, though there is some debate as to whether the system works sufficiently well, with many cases collapsing as discussed elsewhere in this report. Transform Justice (Gibbs (2018)) provide a helpful flow chart of the process presented below in Figure 1.



Source: Gibbs (2018)

Figure 1 Criminal Justice Process for IPV

This study presents the *problem* and then the *outcomes*, some of which are *actionable* by the Force and others which cannot be influenced. These final set of variables or factors are still important & informative, and as such are classed as part of the '*Knowledge Base*'. This includes the academic literature and legal situation. The final sections deal with the underlying data and details on the models and modelling technique including the model metrics.

3 Statement of the Problem

There are a number of problems that have to be considered. An outstanding offender in this situation is one where there has been a crime reference created but no arrest made. The first problem posed is the impact of these nominals on performance with regards to repeat offences etc. The second is to consider the factors that help explain a successful charge in IPV cases. The second model is based on the outcome of the investigation. The successful outcomes are those classified in the clear up codes as either cautions or charges. This is further investigated by considering what are the driving factors for evidential difficulties or victims withdrawing their support of the case.

In both of these cases, the existence of the crime reference is used as a flag for inclusion in the study. The non-inclusion of the non- crime referenced incidents does reduce the number of data points, however in an overwhelming majority of these little ancillary information was available for analysis. This would mean that the data would be ignored and so it is removed earlier in the study with this in mind.

3.1 The Framework of Modelling

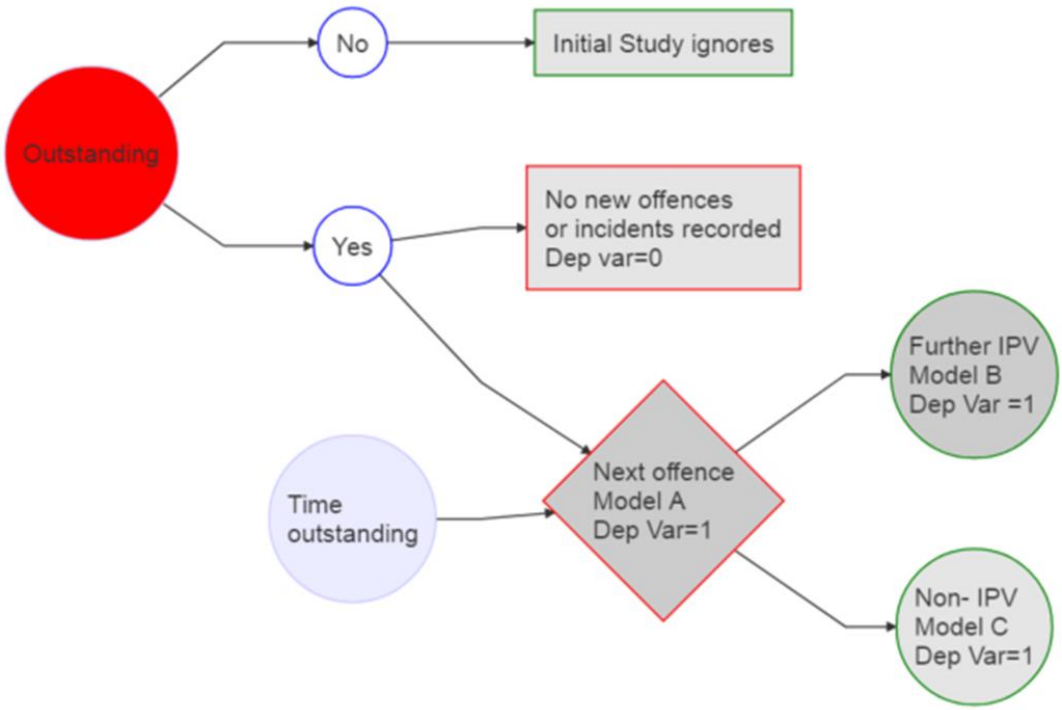


Figure 2 Outstanding Offenders to Next Steps

The models can be sub-tuned to look to explain various end-points of the offending nominal's path. Note that any history is generated at the point at which they become outstanding rather than in the gap between that offence and the next offence which would constitute foresight. The only potential *foresight* might be the length of time until arrest/ apprehension.

3.2 Focus on Outstanding Offenders

As requested in the initial brief, the initial focus will be on the outstanding offenders. These are considered as those associated with an incident where a crime reference is generated but no arrest made at that time, though there may be an arrest later following any investigation.

This gives the initial sample of approximately 140,000 nominals who by this measure *are or have been* outstanding based on the period 2016-2020 (note that 2020 is a partial year ending on 6th February, so it does include New Year but not Christmas 2020 or any other major holidays).

4 Outcomes from Study

This section splits the results into two parts; the first outlines findings that might be considered as *actionable*, i.e. factors such as the number of officers involved in the case, the second are factors that are not directly actionable but add to the understanding of the factors that are contributory factors for the offences but beyond the Forces' control such as the age of the offender. Included in the Knowledge Base section is the literature review, which is used to inform much of the empirical work. The technical details, discussion of the data & methodological approach of the study are included later in this document.

4.1 Actionable Outcomes

The actionable outcomes are those that are directly useable by the Force to optimize their resource allocations. These are generally referred to as *Policing Factors*. Though not strictly actionable, legal factors, such as the threshold test not being passed, are also included in this section. This is a natural partnering and can be controllable by other (non-policing) agencies such as the CPS.

Successful Outcomes & Victim Support Withdrawal

The main factors in this domain that have an impact on the successful outcome of an incident are shown in Figure 2. This shows factors that are likely to have a positive and a negative effect; those that can lead to a higher probability of success or reduce the likelihood of success.

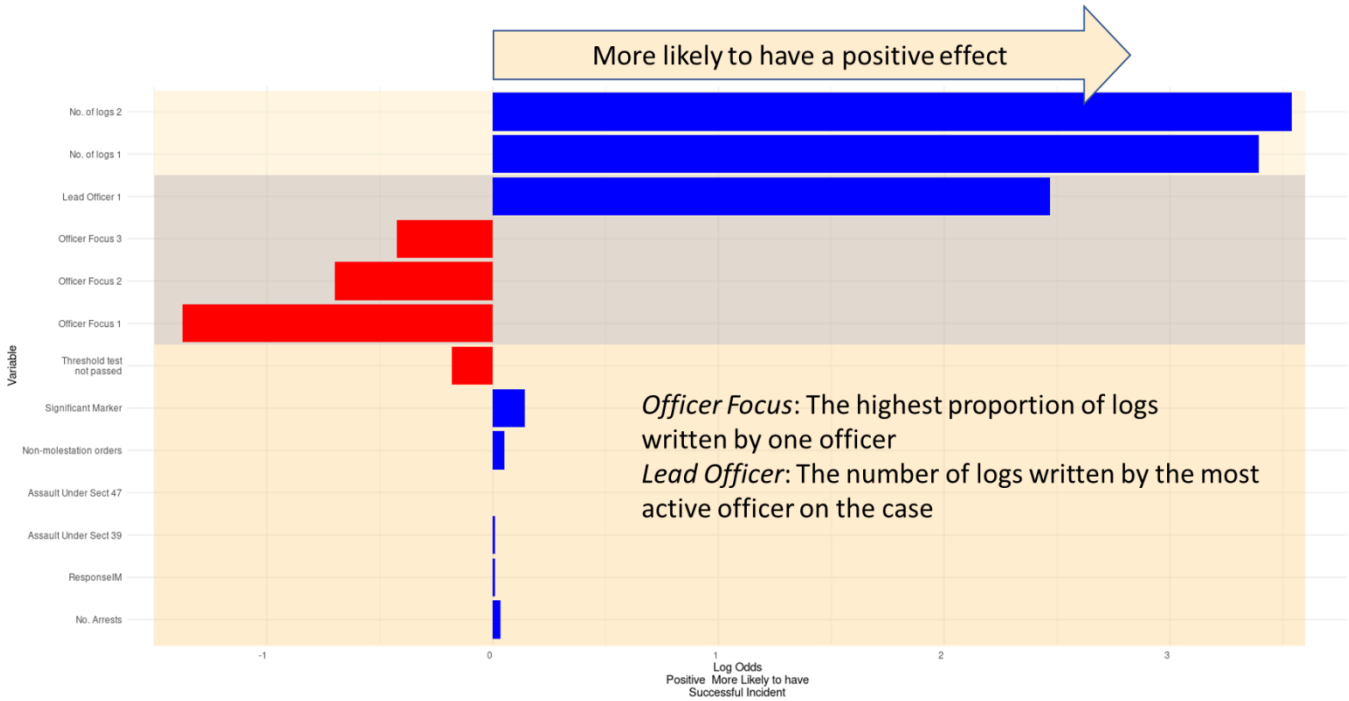


Figure 2 Policing Factors Impacting Positive Outcomes

The variables with the suffixes 1, 2 or 3 are a deconstruction of the named variable into constituent parts to allow for a degree of non-linearities in the relationships. This is

important as one can appreciate that the excessive contact by officers (for example) might be somewhat off-putting.

The impact of lead officers has a positive impact as can be seen above. Only the first part of the decomposition is included as important. The variable represents the number of logs written by the officer who wrote the most logs in the incident/ case. It gives an idea of the continuity of involvement with a victim which was highlighted as an important factor in successful outcomes by Robinson & Stroshine (2005) and IPCC (2010).

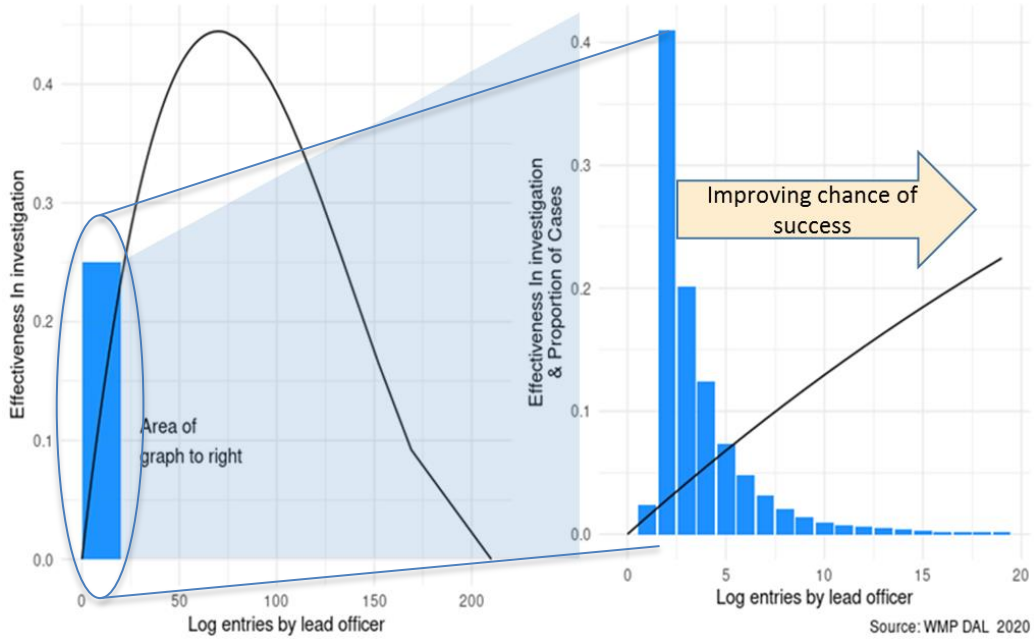


Figure 3 Impact of Lead Officer Variable

As can be seen there is a non-linear relationship between the lead officer variable and the probability of successful outcomes. There are obviously a number of extreme cases which should be discounted, but from the right hand graph we can see that the modal number of entries is 2. Over the region, we can see an increase in the probability of success as the log entries increase. This is at a diminishing rate and the number of logs above 10 are very small. **This does suggest though that an increase in a single officer dealing with the victim would be beneficial**.

Other important factors associated with positive effects on the chance of success are the number of logs and the existence of markers for the case.

Due to the importance of the evidential difficulties and victim's support of the case/ investigation, these were explicitly modelled and again the impact of a number of policing variables can be considered. In this case, a negative impact is considered beneficial as the model was looking at the probability of the case not being supported or there being difficulties.

In these situations, there are considerably more *policing and legal* variables of interest. As is mentioned in the literature, not all victims want to push towards prosecution, rather an arrest might be the desired result. This means that there are several competing factors in the outcomes. The various policing variables are presented in Figure 4.

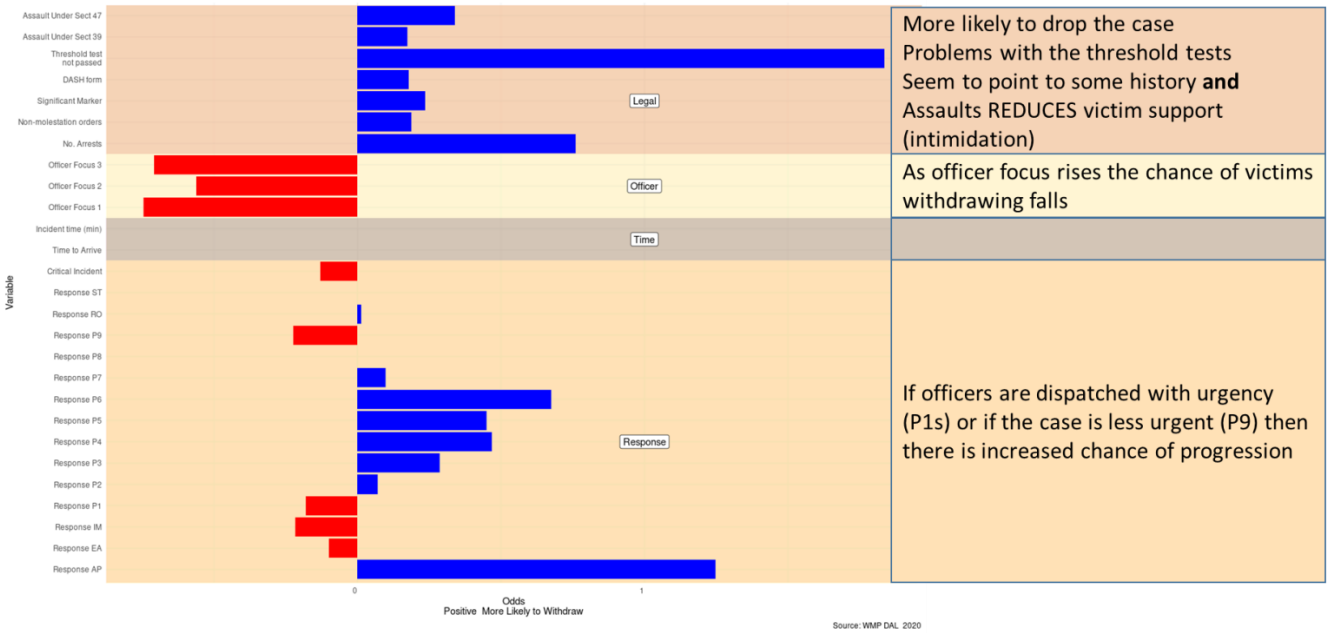


Figure 4 Policing Factors for Victims Not Supporting the Prosecution

There are a number of obvious areas where it is possible to focus efforts and improve victims continued support. As a single officer is proportionately more involved in the case (officer focus), then the chance of the victim withdrawing or there being evidential difficulties reduce. Again the non-linearities are made explicit using the three part decomposition.

The three elements make the relationship between focus and the probability of withdrawal more complex. Whereas in the case of the lead officer, only one of the elements was directly related and so the non-linearity came via the variable transformation, here there are three variables in play. Removing the cases where there is only one officer writing notes (there are 35 cases of this), we are able to get a view of the relationship between the chance of withdrawal and the amount of focus in the case.

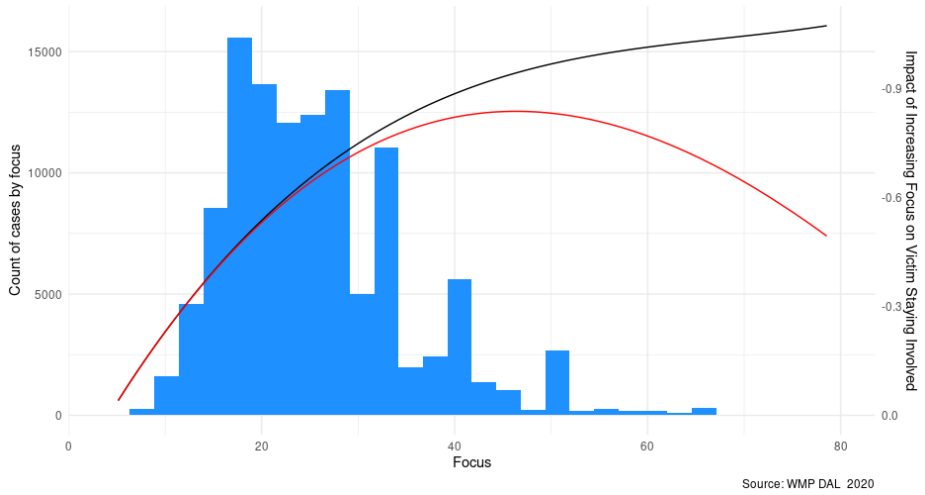


Figure 5 Impact of Officer Focus on Victims Withdrawing Support for Incidents

If the third element's effect is removed (it is primarily based on the impact of the very high focus cases which are rare), as is shown by the red line above, then we can see that there is a maximum of just below 50%. This is above many of the incidents we see in the Force where the modal outcome is about 20% and the mean and median about 25%. **This would suggest that increasing the engagement of a single main officer with the case would likely lead to reductions in the proportion of victims withdrawing their support.** This means that a victim would be in touch with fewer officers, which reinforces the findings above and the findings of the IPCC report.

We can see too that the speed of the dispatch is important. This must reflect the urgency of the incident and thus believed seriousness portrayed to the dispatching officers. P1 dispatches being the most serious and urgent would suggest a degree of severity that the victim finds harder to ignore. The P9 classification would suggest a lower severity, but this might, for example, reflect a degree of habitual behaviour on the part of the perpetrator, which may have led to the victim finally calling the authorities, both of these circumstances suggest that the extreme cases are both sufficient for the victim to call the police; either their limit is met in one fell swoop or eroded away over time. This highlights the importance of the triage process in the successful outcomes of the incidents.

<u>Outstanding Offenders</u>

A second element of the project was to look at the outstanding offenders, being those who were not arrested at the time of the incident for whatever reason. There is a split between crimes in general and IPV in particular in the future. As before the results for the legal and policing variables are considered as areas where WMP are able to directly influence outcomes.

Looking at the potential for outstanding offenders to go on to be involved in crime in general, the signal is quite weak due to the broad nature of the definitions (for details please see Technical Section).

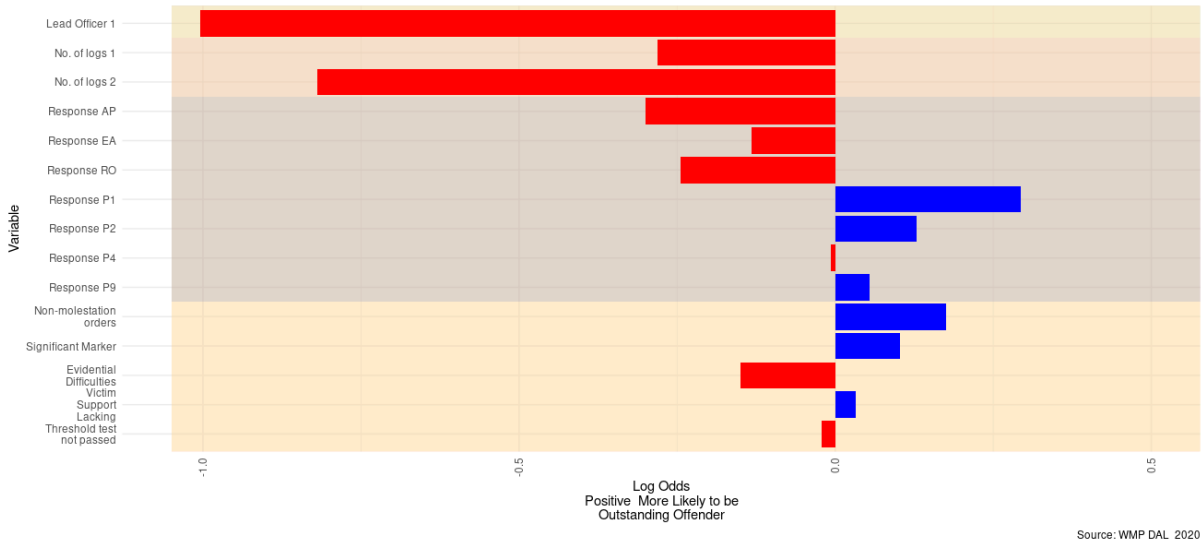


Figure 6 Factors Influencing Outstanding Offenders With Respect to Crime In General

We can see that the number of logs and the influence of the lead officer are important factors in outstanding offenders *not* having another brush with crime. Interestingly, the existence of non-molestation orders, markers and the victim not supporting the investigation does seem to lead a higher probability of (further) crime. However in this

section, this is all crime rather than IPV crime. The impact of various policing and legal factors on IPV crimes as the next crime are seen in Figure 7.

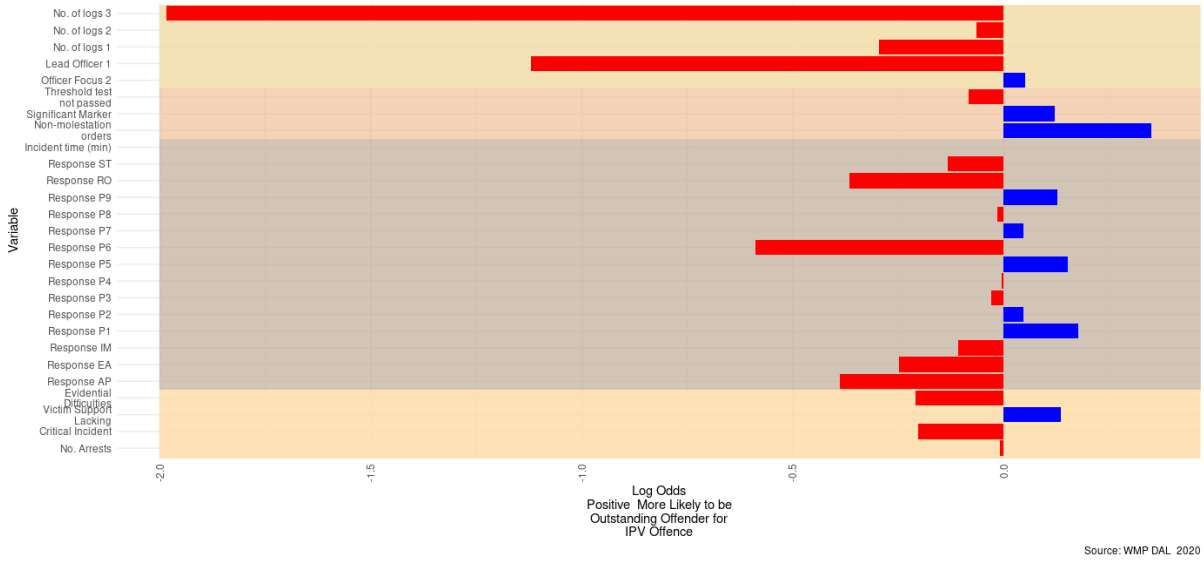


Figure 7 Domestic Violence as Next Crime

We can see that as before lead officers and log variables are still important factors that reduce the probability of further IPV crimes by the perpetrator. The response impact is somewhat variable, with the P1s and P9s both positive and of the same order of magnitude. This suggests that even though these can be related to more chance of a successful outcome, they are also associated with a higher chance of IPV being repeated at a future date. This is consistent with a story of either highly violent or chronic IPV perpetrators. The lack of evidence or evidential difficulties has a negative impact on the probability of a new IPV occurrence. This is interesting in that it would suggest that there is some difference in the behaviour of offenders in the two cases.

The positive impact of the lack of victim support suggests that the perpetrator has been able to coerce the victim to withdraw support or feels that the lack of support gives greater opportunity for such behaviours. These are perhaps the most worrying category of outstanding offenders in that there is a reinforcing circle of violence.

4.1.1 Summary of Actionable Outcomes

It can be seen in the information above, that there are certain factors that can lead to a more successful outcome for the victim. There are factors such as the role of lead officers and their interaction with the victim which influence the outcomes. Victim support and evidential difficulties are important to factor into dealing with the incidents. A majority of the cases fall with one of these as the main problem. Without them as discussed in Section 4.2.3, the issues with *hearsay* come into play. Thus anything that WMP officers can do to ensure that these issues do not become problems should be seen to be important. In particular giving more focus to the case, in the sense described here of higher proportions of logs written by a single officer will aid in the successful shepherding of the victim through the process. Currently the modal measure is about 25%, whereas this study would suggest increasing this to nearer 45%-50%. This would imply an officer being more involved with fewer cases but more specialized.

The relationship is increasing in this range, so that if 50% is not achievable any increase would lead to improvements.

4.2 Additions to Knowledge Base

This section considers the literature review *and* the various factors that are beyond the Forces' control. These are points of interest in that they can help inform decisions and can be taken into account when looking at incidents. This section also includes the literature review to allow a linkage between the findings of this study and the data available in WMP. A brief summary of the literature is found at the start of Section 4.2.2.

The rest of this section considers factors that are found to be of importance in the study with a view to explaining the outcomes of IPV incidents. These are the output from the regression analysis explained in the Technical Section 7.1 and beyond.

4.2.1 Factors Derived from Data Analysis

The statistical analysis of the data gave rise to findings that are beyond the control of officers. However these factors are important in the consideration of the incidents and to understand the incident and outcomes.

<u>Successful Outcomes and Victim Support Withdrawal</u>

The role of the perpetrator's history is particularly useful in the consideration of the outcomes of the incident. Crimes were grouped by their MOPI classification as a guide to the severity and impact. Within each of these a time dimension was introduced to allow us to understand whether there is a difference between involvement in crimes more recently will have an impact on the outcomes. In addition, the personal circumstances of the victim and perpetrators were used as conditioning variables. This gives an understanding of the gender, age etc. in the successful outcome.

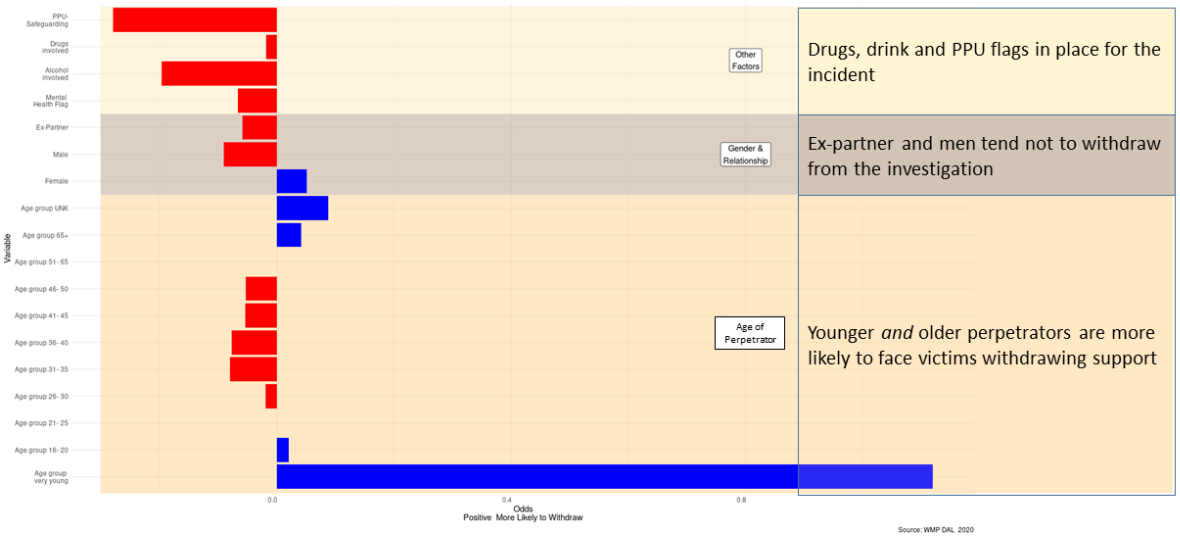


Figure 8 Personal Factors Associated With a Victim Withdrawing Support

It is clear that the younger and older complainants are more likely to withdraw from supporting the investigation and that there is a group of victims aged in their 30s- 40s that are more likely to continue to support incidents.

Men as victims are also generally more likely to see the investigation through. This may be because they have already breached the initial stigma of admitting IPV by their partner. A similar magnitude of effect is seen when an ex-partner is involved. The flags for drugs, alcohol and mental health also influence the victim to remain involved in the incident, though it should be noted that these flags are a combination of extracting information from the text of logs associated with the incidents and any flags in the database and as such are dependent upon the entry of the logs by officers.

The inclusion of the PPU safeguarding flag show a major impact in reducing the probability of the victim withdrawing from the investigation associated with the incident. Again this is drawn from the text where PPU Safeguarding logs are entered. This variable selects all the incidents where the log contains such information. There are approximately 15% of the logs that have such a flag. These logs tend to include details about historical information about the offenders and victims and information such as MARACs. These tend to be higher risk cases.

The history of the perpetrators is of interest. The modelling shows that the level of crime and the recency of the crimes also have an impact on the successful outcome and victims not withdrawing from the cases.

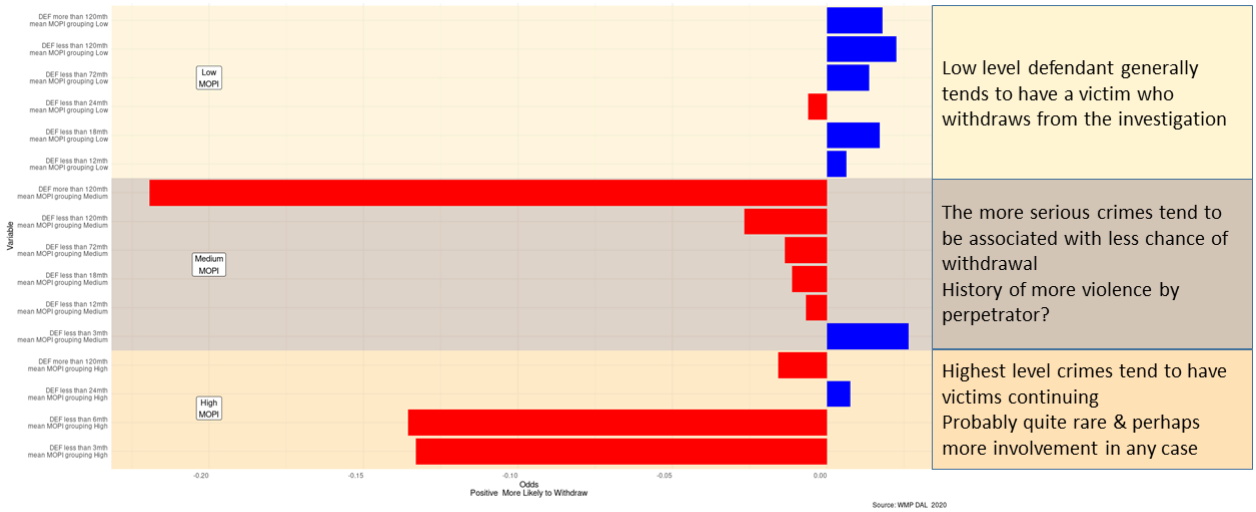


Figure 9 Perpetrators' Histories Impact on Victim Withdrawal

It appears to be the case that if the perpetrator has a long history of medium MOPI crimes (MOPI between 1.5 & 2.5), then this would be a good predictor of the behaviour of the victims. As the history recedes but the average level of crime remains high then the victim is less likely to withdraw. This is supportive of the various typologies highlighted below specified by Holtzworth-Munroe and Stuart (1994) and others.

<u>Outstanding Offenders</u>

There are a number of factors associated with outstanding offenders moving on to IPV and to crime in general that are not easily influenced by the Force. These parallel the

earlier cases. There are two outcomes for the outstanding offenders, to crime in general and to IPV in particular.

The outstanding offenders give rise to some interesting observations. Clearly a persistent offender is likely to continue in IPV incidents but also crime more generally as we can see that in both Figure 10 & Figure 11 the impact is positive, with more strength in the signal for IPV crimes. In both cases again if alcohol and drugs are involved in the IPV incident, these are factors that would tend to lead to increased probabilities of criminal and IPV activities.

There are differences in age of the offender; those who are younger are more likely to be involved in crime again and IPV, whereas those who are a little older in their forties and above are less likely to be involved in crime more generally but might be involved in IPV. Though there are missing groups in the age categories, one might suggest that as the outstanding offender ages they are less likely to be involved in crime more generally but also less involved in IPV though generally this change in behaviour is delayed until their 40s.

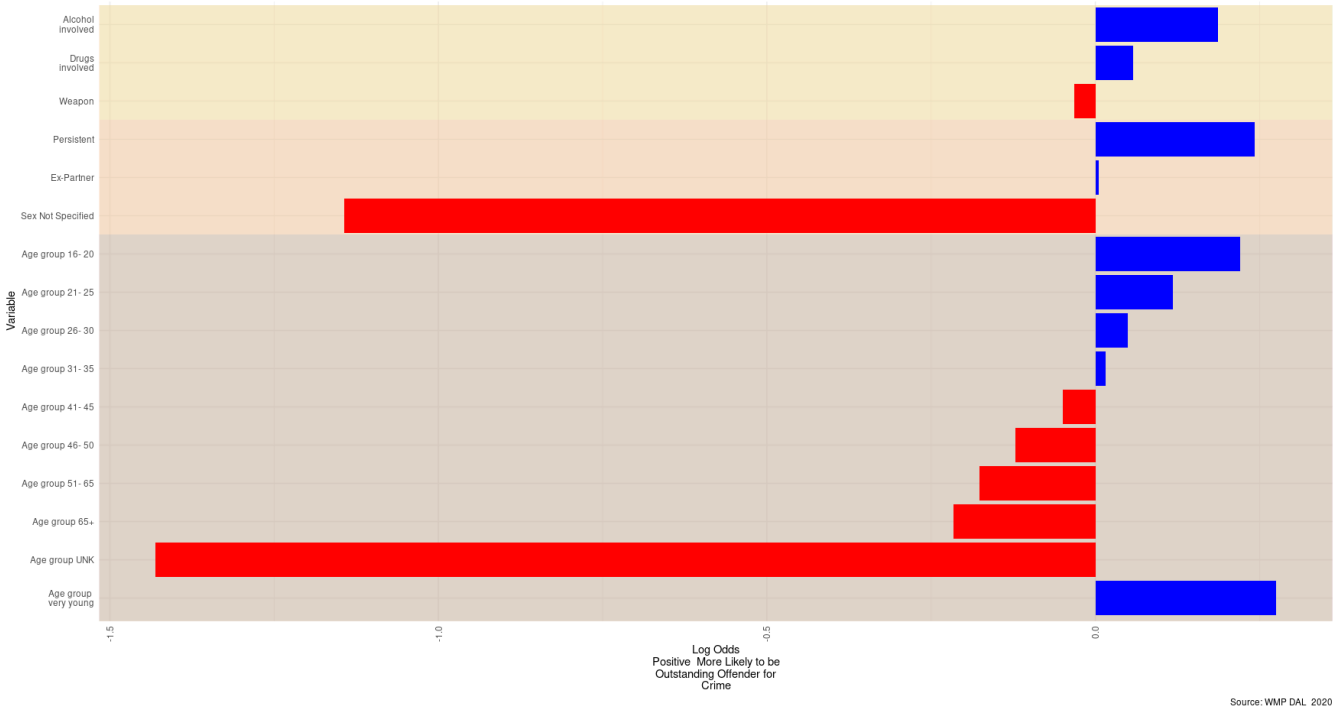


Figure 10 Variables That Impact Outstanding Offenders for Crime In General

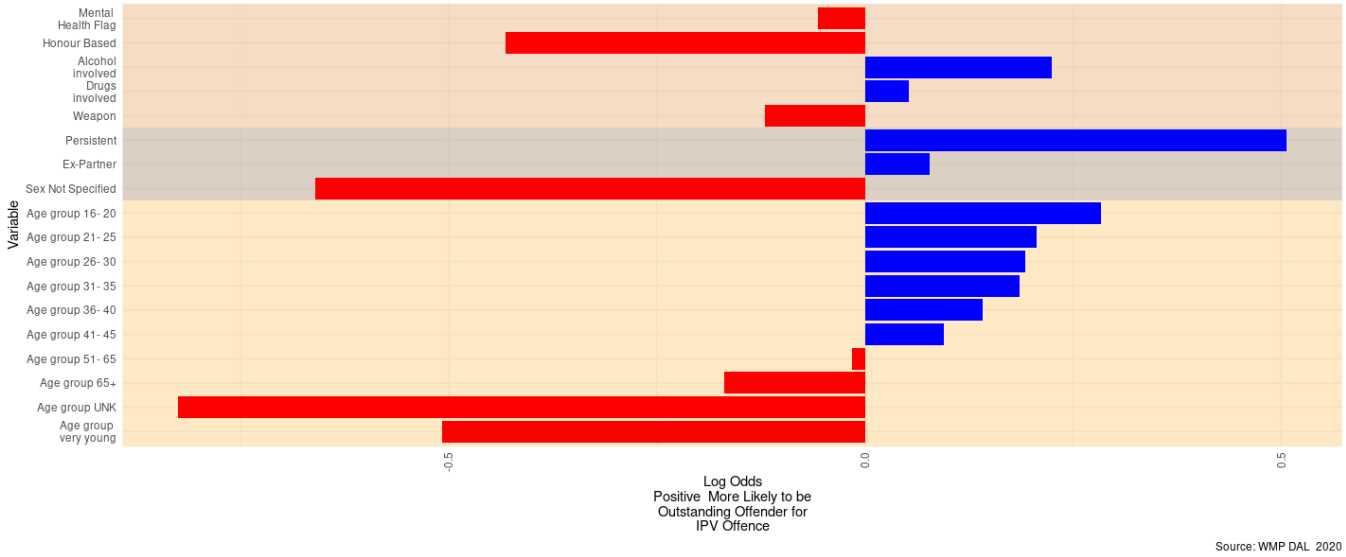


Figure 11 Factors Influencing Outstanding Offenders IPV Offences

The ex-partner factor is more noticeable for IPV offences for a further incident coming to pass. This would make intuitive sense- the ex-partner is more likely to be a factor in IPV rather than other crimes, especially in conjunction with the persistent nature of some of the offenders.

Overall for these personal situation type variables, we can see that as the age increases there is generally less probability of the outstanding offender to be involved in further incidents of any sort, though the decline is less steep in the case of IPV crimes. This can again be related to the various typologies in the likes of Holtzworth-Munroe and Stuart (1994).

As in the consideration of the successful outcome to the incident, we can also look into the history of the perpetrator as a factor that suggests further incidents are likely. As before we see that the perpetrator's history is important. The story is similar to that of the successful outcome and victim support being withdrawn. Those offenders with a history of medium MOPI classified crimes are almost always more likely to be involved in a crime or an IPV incident in the future with more recent occurrences having a greater effect. In both cases, an offender recently a defendant in a lower MOPI'd crime is more likely to be involved in either of the incidents. This is unexpected though a psychological narrative could be given to this situation.

There are a number of parallels between the successful outcomes, victim withdrawal and the outstanding offender outcomes. The personal situations of the perpetrators are supportive of the typologies in the literature. Incidents involving ex-partners tend to have more problems associated with them and should be considered as a warning sign for potential issues. The age of offenders is generally found to reduce the chance of involvement in crimes, but the impact on the support of the victim for a case is varied.

The underlying stories of the factors associated with each of the outcomes considered are supportive of the general typologies suggested in the literature that is discussed in the following Section.

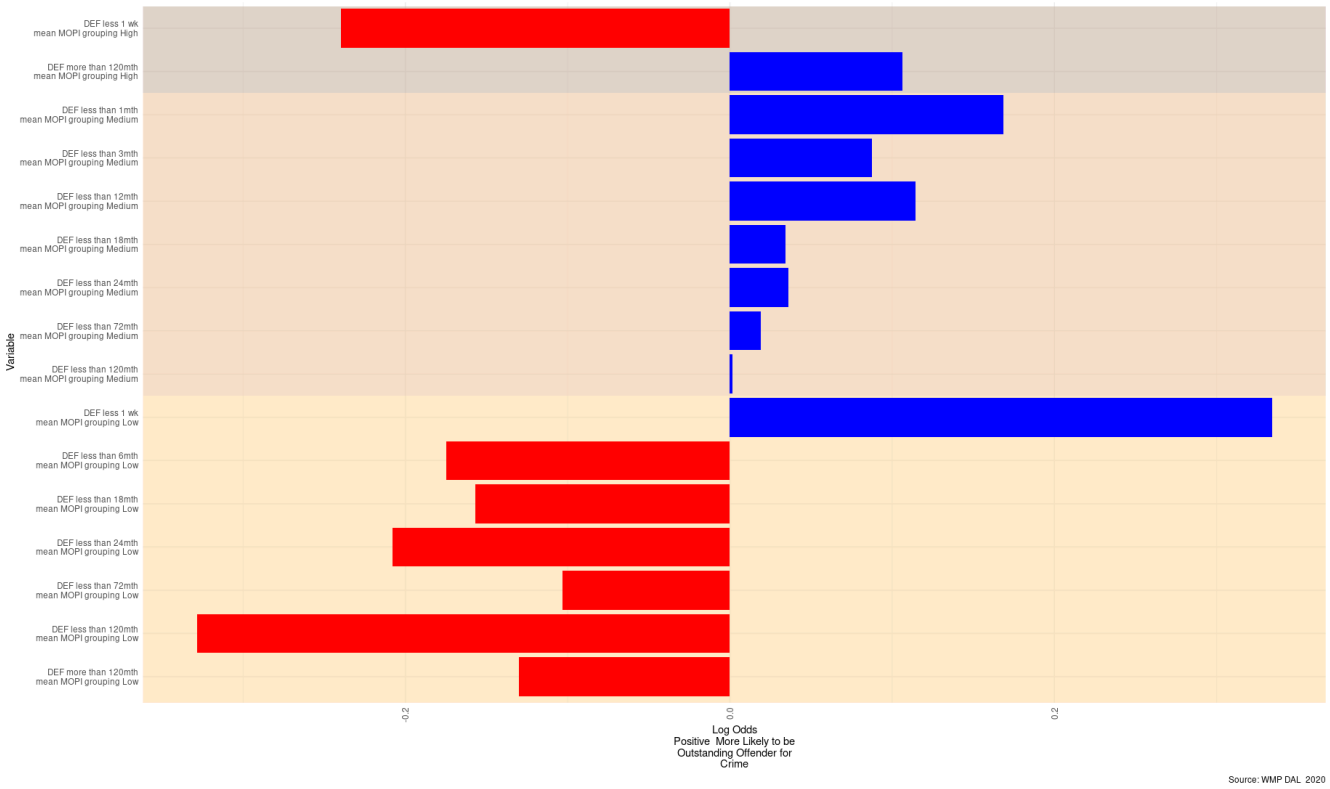


Figure 12 History of Being a Defendant: Impact on Crimes in General

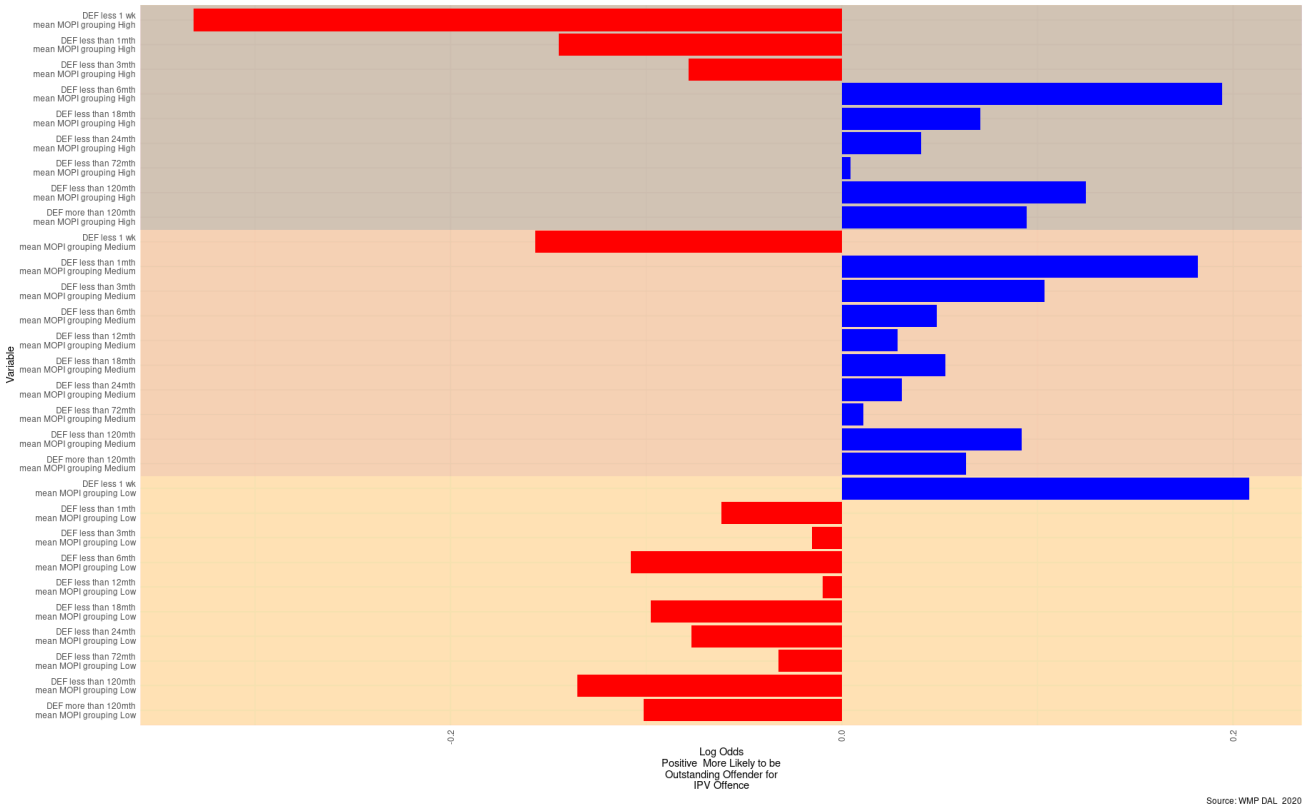


Figure 13 History of Being a Defendant: Impact on IPV

4.2.2 Literature Overview

The literature overview considers a number of elements, the typology of victims and perpetrators of IPV and the consideration of victims as complicit partners in the incident. The study used much of this work as it informs the discussion and interpretation of the findings.

Past abuse and violence by perpetrator and victim are factors in understanding IPV. Many studies suggest that some offenders are generally violent and can be considered chronic in their behaviour. However, as one would expect, the psychological factors cannot be ignored. Highly stressful environments and threats to the balance of power in the relationship can all be part of the IPV incident.

Most incidents are not converted into criminal activity. In many cases this is due to victims withdrawing their support or evidential difficulties. A strand of the literature examines this with IPCC findings (2010) suggesting how victims are treated is important in the continuation of the cases. Depending upon the case, there is also discussion of the effectiveness of the more informal discussion with the offender. This links back to the typologies considered.

The literature strongly supports the recurrent and historic contexts of IPV within an offender's past. It is important that the responding officers are fully aware of this in their response to an incident. This is made more complex by the victim's requirements which might not include the prosecution of the offender such as found in the study of Gibbs (2018) but do require specific responses to their call.

4.2.2.1 Typology of Perpetrator and Victim

A proportion of the research examines the classification of either victim or perpetrator into specific groupings. These tend to be more qualitative studies built upon various non-statistical techniques, with a primarily psychological focus based on their clinical presentation. All the approaches address at least in part the severity and generality of the offence or violence as well as the psychopathology of the offenders.

The literature concerning the victim is markedly different as it looks at the concept of *victimhood* and the fact that IPV victims are not easily pigeon-holed into the concept of the *ideal victim* (Christie (1986)). Indeed there is at least a perceived stigma and complicity for the victims who stay with the perpetrators, irrespective of the reasons.

The literature is somewhat fragmented with specific sub-groups being studied. Though the insights of such studies might be useful in some situations, it is too specific for inclusion here.

It is important to consider these typologies in order to guide the approach to the problem of successful prosecutions. If we can understand that some characteristics are associated with serial offenders then it allows for the focus of resources on these offenders to ensure that the harm they inflict is minimized. Likewise, if we can understand the victim's characteristics, we can look to move to reduce the likelihood of repeat victimization.

4.2.2.2 Holtzworth-Munroe and Stuart (1994)

Of the studies of perpetrators, Holtzworth-Munroe and Stuart (1994) is one of the earliest and most influential taxonomies. They consider the statistical approaches of cluster and factor analysis in arriving at their influential perpetrator classification. They split offenders into 3 classifications with a fourth added later to the taxonomy. These are:

1. Generally violent offender
   i. Moderate to high levels of violence and psychological or sexual abuse
   ii. High levels of criminal behaviour and extra-familial violence
   iii. Anti-social or psychopathic nature
   iv. High levels of alcohol use
2. Dysphoric/ Borderline
   i. Moderate to high severity violence and psychological or sexual abuse
   ii. Little extra-familial violence
   iii. Borderline or schizoid pathology
   iv. Moderate alcohol abuse/ effect with high levels of depression and anger
3. Family only
   i. Low severity violence
   ii. Moderate anger issues

(4. Low level anti-social perpetrators)

These authors also consider the psychological drivers of these traits/ behaviours using a developmental model of IPV. This is perhaps most useful to us when considering the distal/ historical factors. Although this information is not always available to WMP, these data might be useful in looking for signals or risk factors for couples (Table 3 op cit. gives a complete survey). In general, violent offenders are more likely to have seen parental violence, whereas borderline/ dysphoric types as well as those generally violent are most likely to have been abused as children. A number of studies linked deviant peers, such as those associated with drug abuse and anti-social behaviours, to adult criminality and the development of sexual aggression towards women.

In nearer time periods, attachment factors continue to be important as the wives of abusive husbands report that the husband's friends approved of the violence and believed that the male should control the marriage. In general, the offenders are unable to be secure within their relationships. The family only batterer tends to have a *better* marriage in terms of stability and less conflict. This can be contrasted with the generally violent offenders who objectify their partners. The inability or lack of role models of the offender in relationship management has been proposed as another factor via their impulsivity. The personality traits though not available to us can manifest in substance abuse, criminal behaviour etc. and thus the tell-tale signs of such impulsivity can be seen potentially elsewhere in the data. Interestingly, the attitudes to guilt and remorse are different across the sub-groups with the family only perpetrator feeling considerable remorse and guilt, unlike the more generally violent offender who feels little guilt and furthermore is more conservative in his views towards women.

Holtzworth-Munroe and Stuart (1994) explicitly do not suggest that there is a causal link. They rather suggest that there is a reduction in the ability or potential ability to formulate positive attitudes towards women. In their taxonomy, the family only batterer most closely matches the usual, non-violent member of society, though there is

a gradation across the types. In light of the different natures and feelings of the more extreme IPV perpetrators different management might be considered.

4.2.2.3 Theobald and Farrington (2012) and other related studies

A number of studies including Theobald and Farrington (2012) & Theobald et al. (2016) consider a more statistical view of the problem of the perpetrators and include attempts to predict **male** IPV from childhood variables based on the Cambridge Study in Delinquent Development (West (1969), West and Farrington (1973), West and Farrington (1977) and Farrington (1995) amongst others). As with the Holtzworth-Munroe and Stuart (1994) study, the factors are not available to use however as before, the variables that the study highlights give some guidance as to where to look for the underlying processes. The studies used familial and individual factors in order to attempt to *predict* the potential for IPV by the subjects. As with the previous studies, the perpetrator's behavioural and emotional development is the starting point of any IPV in later life. The lack of a fully functioning family environment can be part of the story although it is unlikely to be the whole story. It can lead to outcomes that lead to an increased likelihood for IPV.

Due to the sample in the longitudinal study, the data suggest that criminal parents, a disrupted family and being unpopular but daring at the age of 10 and abusing narcotics at 18 are good predictors of IPV at 32; for predicting IPV at 48, low verbal IQ and poor supervision at the age of 10 and having a poor relationship with your parents at 18 are important. In general, as a predictor of IPV at either age, poor parental supervision, a criminal parent and being unpopular at 10 and poor academic achievement and poor relationship with ones parents at 18 are good predictors. For each of these predictive models, an Area Under the Curve (AUC) of just over 0.7 was recorded, with over 50% of the highest risk group going on to perpetrate IPV compared with 10% of the lower risk groups. Aspects of later life are also seen to be important, with *success* factors such as satisfactory employment generally mitigating the tendency to IPV perpetration.

There are of course practical issues with this study in relation to what can be utilized for the current project, not least the history collected for their database is far more comprehensive than the information we have access to. Our subjects are those who have come to our attention for some specific reason, rather than from the population as a whole. But as before some of the earlier years' information might be useful to extract perhaps especially criminality in the family.

4.2.2.4 Offenders & Treatment

Most recently, Hester et al. (2019) has looked at the role of treating offenders specifically the highest harm perpetrators. The study used MARAC information and considered the needs of the offender in order to *treat* the IPV behaviours. At the mid-point of the 3 year study, the largest group had no needs, with latent class analysis grouping offenders into 6 groups.

1. No needs (35% users)
2. Children and parenting needs (10% users)
3. Low needs (28% users)
4. Multiple needs children and family (8% users)
5. Housing & unemployment (9% users)
6. Multiple needs alcohol and drugs (9% users)

This is particularly informative in terms of the taxonomy of offenders and their characteristics that can highlight the potential for further IPV. The direct action in the study involved counselling and psychological assistance with case managers allocated to the offenders.

Positive changes were seen in the offenders by both the case workers and the victims. There were a number of concerns especially with regards to the longer term situation. Of the 184 subjects 11% re-appeared at a MARAC more than 12 months after the interventions and 17% of the 42 serial perpetrators re-appeared in the same time span. A large reduction in the number of incidents relating to IPV with police call out was noted in contrast to the control group, with serial offenders seeing the greatest declines. Further the IDVA perceived a reduction in the risk and some increase in the sustainability of the behaviours though this was not universally the case.

This study highlights the need for awareness of the offender and the offenders' characteristics in dealing with IPV incidents. One finding that is particularly interesting and that matches the studies based on expectations of the victim is the continuity associated with those dealing with the offender and the trust that this builds.

4.2.2.5 Victims as Complicit & Other Characteristics

Meyer (2016) considers the role of the women as a victim of IPV and the stigmas that are associated with IPV. Indeed the victims of repeated IPV are often seen as complicit or at least partly responsible for the repeat offence. A number of the authorities in the study saw leaving the IPV perpetrator as a necessity for continued support, despite the lack of other supportive requirements such as a place to stay, the impact of the children etc. The removal of support and the blaming of the victim are both part of the driving forces of an unsuccessful outcome. The victim themselves become psychologically scarred and they are snared into a cycle of repeated IPV.

Tillyer and Wright (2014) consider the grey area of victim as perpetrator as well as the factors determining victim and offender. They note that there is little research on the *circle of violence* that is generated as victims become offenders and vice-versa. They find some overlap in the roles within IPV and this was independent of the gender of the individuals with the overlap being more pronounced in more minor forms of violence. They suggest that this finding supports the *family only* class of Holtzworth-Munroe and Stuart (1994) and Johnson (1995), which considers IPV as either common within the couple or male dominated (patriarchal terrorism). However the victim/ perpetrator and perpetrator alone are more similar than the victim.

Thompson and Kingree (2006) consider the role of violence for the outcome of IPV, considering the victim's and the offender's alcohol use specifically. These results show a gender difference in the outcomes for victims. Men's risk of injury was independent of their partner's drinking at the time of the IPV, whereas injury was more common for women whose partners had been drinking[2]. Lipsky et al. (2005) used the emergency room referrals of abused women to consider the impact of alcohol on IPV both as victim

[2] More recently Horvath et al. (2012) consider the relationship between substance abuse more generally and domestic and sexual violence amongst the young. The offenders were *excused* by the victims due to the substance abuse.

and perpetrator. Women who drank while being victimized *and* perpetrating IPV were more likely to drink more heavily and to use narcotics. The partners of victimized women were also likely to be heavier drinkers. The findings show that during the IPV incident most partners drank while perpetrating the offence irrespective of the behaviour of the victim. It is noticeable that the drinking partnership had some role in the IPV incident and that this is asymmetric, depending on the gender of the victim.

As was found elsewhere, the frequency of past abuse and violence was a strong factor in predicting injury for women, but for men the use of a weapon against them was a predictive factor (the study is based in the USA). Married women were found to be less likely to report their husbands; the rationales for this are varied but commonly include shame, protection of the children etc. Women who had a substantial history of being a victim of IPV were more likely to report the offender, suggesting that the victim is likely to have previously been a victim but not reported it as well.

Using the Cambridge Study in Delinquent Development, Piquero, Theobald, and Farrington (2014) look at the inter-relationships between IPV and offending and violent behaviours more generally. This is, of course, a most useful study as it gives some linkage between the overall behaviour and that inside the IPV offender's home. This study uses the convictions for offences and the age at which the offence was committed as variables along with violent crimes. There were 5 trajectories identified:

* Non-offenders
* Low- adolescence peak
* Very low rate chronics
* High- adolescence peak
* High rate chronics

As noted before, the CCSD gives the opportunity to glean information from the subjects' history in more detail than is available to WMP. These factors include educational achievement, parental history, disciplinary attitudes of parents, family history of depression, and socio-economic status of the family *inter alia*. Those offenders in the *high chronic* category show highest prevalence of IPV. There was a significant overlap between those who were convicted of violent crime and those involved in IPV. The childhood factors were seen to relate to criminal violence and IPV but this was not robust to the conditioning of other variables in the model.

This study suggests that factors that drive criminal violence are closely related to those that drive IPV. Both of these behaviours are driven by frequency of offence. This would support the IPV grouping of the *generally violent offender* above but not other members of the taxonomy. The study does highlight the sampling issue that might undercount the internal, familial IPV, the result is potentially useful in again emphasizing the role of a (particularly violent) criminal history in the incidence of IPV.

4.2.2.6 Situational Issues

The relationship between the individuals in IPV and their history is one element of the occurrence of the offence. There are also contemporaneous issues or situational issues that can act as stimuli to such an event. Wilkinson and Hamerschlag (2005) consider this approach: what factors exist that lead to a higher probability of IPV occurring. A number of catalysts have previously been identified such as stressful life events and threats to the relationship. However these authors consider the balance of power and

control within the relationship with violent offenders wanting to control the victims of the crime. This was seen to be more likely a male based approach to the problem. Some authors have also found that a pre-emptive self-defense rationale has been found especially by women and those who commit homicide.

The psychological role of the individuals in the relationship also has an impact. If there are threats to self-esteem and the perceived role of the person in the relationship then again this might lead to IPV. In most cases, an argument precedes the IPV incident, with this being *blamed* for the incident as the normal vocal discussions and negotiations have failed. The dynamics of an argument, escalating towards violence is potentially one of the factors overwhelming the coping mechanisms of both victim and perpetrator.

Interestingly, Wilkinson and Hamerschlag (2005) explicitly discuss the role of law enforcement in the construction of the events. There is some evidence that if the police have an informal word with a male offender then there are fewer subsequent events. Given that marital breakdown is also potentially a factor in IPV, ex-spouses are also more likely to be informed upon. As with much of this literature, the study is light on quantitative answers, even in terms of direction with mostly proportions being reported. A study in Eisikovits and Buchbinder (2000) shows the asymmetry of the relationship between the victim and the police. The first experience was dissimilar to the later experiences, with the victims' experiences being more positive in the second case and beyond.

In a study based on 222 victims in Wales, Robinson and Stroshine (2005) looks to investigate the expectations of the role of the police. What is expected by the victims of IPV is not a simple check-list. The interviews highlighted a number of factors.

* Police Behaviour:

Greater degrees of investigative efforts tend to reflect well on the satisfaction of the victim. It is no longer the expectation that the offender needs to be arrested much as discussed in Eisikovits & Buchbinder (2000)

* Demeanour:

The police's interests in the victim's feelings was seen to differ across victims of IPV and non-IPV. The time taken to listen, appear to be concerned and be interested in the welfare of the victim is important in increasing the victim's satisfaction.

When victims were more in control of the call for help, they were more likely to be satisfied with the police actions. It is the fulfilment of the expectations more than the characteristics of the victims that are important in driving satisfaction levels. These findings support the importance of particular training and attitudinal approaches for the police attending IPV incidents and thus following through to a prosecution.

The Independent Police Complaints Commissioners (2010) also highlight these important behaviours by the police. Indeed, their recommendations include

* Empathy with the victim
* Details of call need recording
* Reaction to escalation in the incidence
* Use of history within the intelligence logs and reports
* Risk assessments need to be made and updated as the situation changes

We can see that there is an impact of how victims are dealt with as to the final outcomes of the incidents, whether it is an arrest or not.

4.2.2.7 Case Specific Factors

The sociological and psychological factors are clearly beyond the control of the law enforcement agencies, though they do give the conditions of the case. These determine the background to the investigation and moving the case forward to the CPS and prosecution or other action. The effectiveness of these is determined at least in part by the nature of this background and history. Thus the number of logs associated with the case might have a different impact on the advance of the case where the perpetrator is known to be a generally violent offender, relative to that of a family batterer or alternatively when children are involved a different number of officers might be best deployed. Further factors such as time to arrival at the scene may have an impact in terms of ensuring victim support and the presence of evidential problems.

There are obvious difficulties in measuring this type of impact in the West Midlands where the roles associated with a case are evolutionary- response has first contact, passing to the NPU level and then potentially PPU. This makes the process explicitly piecemeal and will therefore have an impact on the victim's experience of the case. A response unit might appear at the scene quickly, but also might be dispatched equally as quickly with associated constraints on their actions at the incident, e.g. if the offender is not there, an arrest is unlikely. Where a victim is unable to make a statement immediately, as has been found in the literature, the victim is unlikely to file a statement later.

4.2.2.8 Victim Support of Prosecutions

A number of cases (often more than half across various studies) fail due to the reticence of victims to give evidence against the offender. There are many discussions of the reasons for this. Ellison (2002) discusses an approach used in some states in the USA, where victim support is not required for the prosecution of IPV type cases. These approaches are considered for transplanting to the UK. Hoyle (1998) suggests that the withdrawal of the victim in essence stops the case. The cases became "unwinnable" and "unprosecutable".

The CPS use a number of tests to decide on the prosecution. The lack of evidence either because it was not collected at the time or because the victim did not choose to continue, for example, by going to the police the day after is a contributory factor in the collapse of the case. Any unwillingness by the victim to support the case often leads to the pulling of the case and associated resources. Only occasionally did the police continue investigating a case after victim support was withdrawn. The understanding is that there must be evidence to prosecute the case rather than necessarily a witness.

Once the victim has withdrawn, the hearsay evidence rulings become applicable except in the case where the victim is afraid. This is according to Ellison (2002) generally narrowly interpreted to denote intimidation. The rationale for a withdrawal of support is clearly a complex issue. Hoyle and Sanders (2000) look at some of these issues. It is seen by them to be a rational choice[3]; either the arrest was sufficient to change the offender's behaviour (often a small minority) or the costs of prosecution outweigh the

[3] The author is somewhat cognizant that there may well be a lack of rationality in situations that involve IPV. However the victim's choice later might be somewhat more rational.

benefits, perceived or otherwise. The fear of retaliation was a real fear for many victims in the study. This might not necessarily be through physical violence but might include actions such as getting custody of the children. Other reasons given included wanting the marriage/ relationship to work, the economic cost and the belief that the violence was due to some other problem such as drugs or alcohol and that the offender just *needs help*.

The Gibbs (2018) study more recently continues to support the view that *at most* victims wanted arrest but not prosecution of the offender. The Project CARA (Strang et al. (2017)) findings further support Wilkinson and Hamerschlag (2005) showing that the most important single predictor is the victim's satisfaction with the police's response; that is how the victim is treated by the police and that they do what is believed to be expected, even though 'getting help for the offender' was the most popular response with only about 1/4 wanting an arrest.

The role of children in the decision to withdraw support is considered in Rhodes et al. (2010). Children are seen to have a positive and a negative impact on the decision to leave the offender. This research was based on 7 focus groups with a total of 39 victims. There were concerns that victims did not want to "tear the family apart" (especially in the case of the abuser being the biological father) but also wanted to show the children that violence was not acceptable. Another factor for non-English speaking victims was that the children would be required to assist in court and that this was something that the victims wanted to avoid. Once law enforcement was involved some victims were afraid that Child Protective Services would become involved too. In a second, follow-up study, Rhodes et al. (2011) consider the impact of children using US data. They find that victims with children less than 18 are more likely to participate in a prosecution than those without and are more likely to apply for a Personal Protection Order. The fact that the children pull the victim in two directions- to support the prosecution and to protect them in the fallout of the prosecution, is considered the main reason why the identification of the impact of children is difficult and small; indeed the effect is on a par with the history of prior IPV and severe violence.

The fear of losing the children was a factor directly for some victims but offenders were also found to be using this as a form of control. There is therefore a balance between the need to protect the children and the possibility of losing the children that is real for victims. This balance can even leave the victim unwilling to contact the police.

The victimless prosecution aided by this change in the hearsay requirements depends therefore on the initial police investigation. More comprehensive statements, photographic evidence and other enhanced data gathering at the initial report have all been found to reduce the dependence on the victim's testimony, though of course the issues of CPS resources available to prosecute cases is still a limiting factor.

A direct consideration of the variables that are a good predictor of victim support in (US) IPV prosecutions is found in Kingsnorth and Macintosh (2004). Again this is an American study, however there might be helpful insights in the study. This study is framed in Rational Choice Theory (RCT), as used later in Hoyle and Sanders (2000). There are three dependent variables used- whether the victim (or other party) called for assistance, an assessment of the attitude towards the arrest at the time of the offence

and the continuous support of the victim to the prosecution. These were converted to multinomial outcome variables (Yes, No & Unknown)[4].

The results from this study show an ethnicity factor with African Americans less likely to want prosecution than whites though the attitudes to arrest and the support of the arrests were the same as other groups. Men are less likely to call for assistance than women or to desire or support prosecution, perhaps reflecting the unwillingness of exhibiting weakness in a culture of male dominance. The severity of the attack does impact the support for arrest and prosecution though not the initial call for help. Medical attention is another factor that affects the call for assistance (negatively) and the support for prosecution (positively). In California where the study was conducted, the law requires medical practitioners to report IPV so medical treatment will clearly see more reports. As might be expected, victim substance abuse tended to reduce the likelihood of any of the outcomes occurring. An injury to the suspect reduces the likelihood of the authorities being informed of the incident.

The male- female suspects split is interesting as men are more likely to be on probation for IPV and be served with a PPO. Women suspects are far more likely to be injured than men and three times more likely to be involved in both parties being arrested. The way in which IPV affects men and women differs considerably and there are more benefits potentially in focusing support on women than on men in this study.

As discussed earlier, the victims often do not support an arrest or charge of the offender. The disposal of the case *out of court* is sometimes seen as an alternative, though in many cases the charge is promoted where there is sufficient evidence, not least because the report is not the first actual incident even if it is the first reported incident. The use of cautions and community resolutions were found to be effective and the victims were satisfied with the outcomes in many of these cases. Project CARA (Strang et al. (2017)) implemented conditional cautions by the local police service and this lead to a reduction in the re-arrest and re-offences of the perpetrators in the study. Further studies reported in Gibbs (2018) support this type of pattern in behaviour changes when an offender is engaged in a perpetrator programme, even when the offender had a history of IPV[5]. These focus on the coping mechanisms and the attitudes of the offender towards their behaviours. It is not always easy to determine their effectiveness due to the incomplete nature of the evidence and lack of data provided.

4.2.2.9 Summary of Literature

Intimate Partner Violence is a complex issue with complex causes and outcomes. There are thus many views of the most effective method of dealing with these depending upon the underlying characteristics and the nature of the incident. This all gives us a possible insight into the factors that would be desirable of inclusion in this project if at all possible. It further highlights the manner in which factors pull those involved in opposite directions and the difficult situation in which officers will inevitably find themselves.

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[4] A Multinomial Heckman was used to account for the selection biases in the data.

[5] Some agencies do not believe that these programmes are effective

The lack of victim support for a prosecution is often the telling factor in driving the case forward towards a *positive* outcome. However, the literature suggests that this is not necessarily a desired outcome for the victim who might only want the offender to get help and calling the police is seen as a method of achieving this. This mis-match of the measurement of success is an example of the principal-agent problem where incentives exist that are sub-optimal for the victim (the principal), though optimal for the police as agent (in terms of their metrics or guidance). This creates an over-supply of arrests relative to the private utility of the victim.

4.2.3 The Law

4.2.3.1 Domestic Abuse Bill

The latest legislation is enshrined in the Domestic Abuse Bill ("Domestic Abuse Bill" 2019). Within this there are outlined definitions for IPV and the details of the approaches available to Law and law enforcement. Domestic Abuse is defined in the following manner:

1. Both parties must be older than 16 and personally connected
2. The behaviours must be abusive
   i. Physical or sexual abuse
   ii. Violent or threatening behaviour
   iii. Controlling or coercive behaviour
   iv. Economic abuse
   v. Psychological, emotional or other abuse

The connections are defined within Chapter I lines 14-26 of the Bill. It further explains the powers available to the legal authorities to deal with IPV. These include Domestic Abuse Protection Notices (DAPN) and Domestic Abuse Protect Orders (DAPO) with the resources outlined for their breach, including arrest. The breach of a DAPO involves potentially 5 years imprisonment and/or a fine.

One of the issues raised by Ellison (2002) is that, when a victim withdraws their support for a prosecution, the evidence becomes *hearsay*. This is according to the ("Criminal Justice Act" 2003) only admissible where the victim/ witness is unavailable. In IPV cases, this would be because *the person does not give (or does not continue to give) oral evidence through fear: Section 116(2) (e)*. If this is not the case, for reasons discussed in the previous section (victim support of prosecution), then the evidence might be ruled inadmissible.

Further to the issue of hearsay, investigating officers can also use *res gestae*. These are second-hand statements admissible to the courts without use of the hearsay application. These are statements made at a time where it is considered difficult to believe that the speaker can be fabricating the statement. It is important to note that for admissibility the statement must be spontaneous or the event so overwhelming that the victim continues to be dominated by this event.

In two cases, Barnaby vs DPP (*Barnaby v the Director of Public Prosecutions EWHC 232 (Admin)* 2015) and Ibrahim vs DPP (*Ibrahim V Crown Prosecution Service: EWHC 1750 (Admin)* 2016) demonstrate that the 999 calls and following arrival at the case with subsequent statements can be used in res gestae evidence even though the arrival in the

first case was 16 minutes after the last call and the signs of the abuses were seen by officers and the victim subsequently refused to make a statement. The phone was admitted as there was no belief that the caller could have fabricated the call and its contents. The victim refused to sign the investigating officer's notes saying that she had been beaten up last time she complained. The continuity and contemporaneous nature of the statements lead to the admission of these pieces of evidence under res gestae hearsay rules[6].

The second case involved a delay of about 85 minutes before calling 999. This was allowed in the case due to the circumstances. The initial 999 call was reporting an assault and the tape demonstrated the agitated nature of the caller. The victim withdrew her support in this case, after the police took photographs of injuries and saw the evidence of the altercation in the flat. The presiding judge and the High Court both admitted the phone call as they surmised that the victim was in fear of her partner and so the evidence was admissible. The evidences' admissibility can however be challenged by the defense and so as with hearsay, building a case on purely res gestae adduced evidence is difficult without other context and support.

4.2.3.2 Serious Crime Act and Earlier Legislation

Due to the current political climate, the Domestic Abuse Bill is (at the time of writing) did not complete its passage through Parliament. A carry-over motion was passed allowing the legislation to progress through the next session of the House. Thus in the current situation at time of writing, the Controlling or Coercive Behaviour Sections (76 & 77) of the Serious Crime Act (("Serious Crime Act" 2015)) is still on the statute books. The personal connection is again a requirement and the effect of the behaviour must be *serious*. The guidance lists a number of behaviours that would constitute these types of behaviour (but not an exhaustive list).

1. Isolating a person
2. Monitoring a person
3. Depriving them of support services
4. Financial abuse
5. Threats to hurt or kill either them or a child

This law requires a continuous or repeated behaviour; one-offs do not meet this threshold. There is no specified timespan but too long a time would not be considered as meeting the requirement. The behaviours are to be serious and known (or the perpetrator ought to know that) the behaviour is serious. The parties to the case must also be in or have been in an intimate personal relationship. In many ways, there are parallels between the two pieces of legislation.

Previous legislation (("Crime and Security Act" 2010) and ("Protection from Harassment Act" 1997)) has also been used to provided *Domestic Violence Protection Orders* (DVPOs) with a temporary *Domestic Violence Protection Notice* (DVPN) provide a subset of the new DAPOs with fewer agencies able to apply for the orders. Not complying with a DAPO is a criminal offence whereas the DVPO is a case of civil

[6] It should be noted that Lord Justice Fulford and Mr Justice Jay commented that the Crown had not provided the information beforehand and the res gestae rules should not be used to sidestep evidential requirements in the courts

contempt[7]. Unfortunately Gibbs (2018) suggest that the cost-effectiveness of the DVPO is limited and possibly negative (Kelly et al. (2013)). The outcome of the order was generally mixed- some victims found it gave them a breathing space, others felt that it took control away from them. One of the issues with DVPOs is their civil nature- a characteristic dealt with by DAPOs.

4.2.3.3 MARACs

A Multi-Agency Risk Assessment Conference is generally called when a victim is seen to be high risk. The referral brings together a number of agencies, though not the victims who are represented by an Independent Domestic Violence Advisor. The approach looks more holistically at the victim's situation and attempts to increase the safety of the victims. These are generally held monthly and cover a number of cases. In a small number of cases, a case may be referred without consent, but this is rare. In these situations, the information sharing is based upon a decision concerning the level of risk involved.

Agencies involved in the MARAC include local health care, child protection and housing agencies in addition to the local police service. The primary concern is the *adult* victim of the abuse in the high risk categories. The wider participation in the MARAC allows the committee to deal with the issues often faced in the first instance by the police, allowing them to focus on their role specifically.

[7] The number of breaches of DVPN and DVPOs was 1-2% in Kelly et al. (2013).

5 Data in WMP

Building from the insights of the literature and the logic tree discussed, we can look to develop the links and relationships between outcomes and information retained by WMP. The underlying logic is that the incident is reported to create an incident reference number; a number of these were turned into crimes. Of these, a number of these were dropped for various reasons. A small number are converted into court appearances.

Outstanding offenders are considered those for whom the incident is crimed, but the arrest has yet to be made. This is as opposed to the outstanding offenders whose warrants are live.

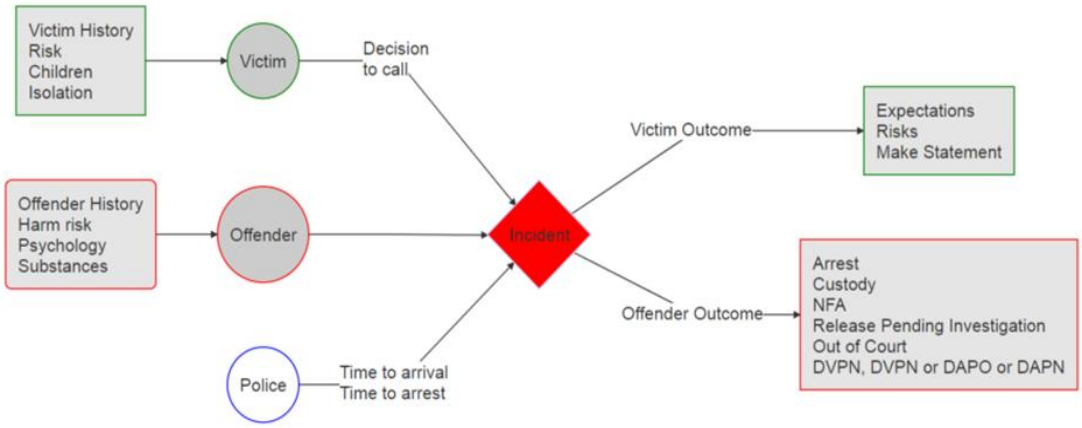


Figure 14 IPV Incident Process Chart

The factors to be considered in the initial outcome of the incident are presented in the flow chart. It shows the types of variables to be included in the dataset for the modelling. Obviously it is difficult to measure some of these such as the expectations of the victims.

Talking to SMEs, the time to arrive at an incident will have a number of effects. Firstly, the offender is more likely to be there and thus an arrest is more likely to be made quickly; secondly, the emotion of the incident is still palpable. This means that the victim is more likely to make a statement. Indeed, if a statement is not taken at the initial incident, it is generally the case that the statement will be unlikely to be made. Associated with this, is the arrest of the offender. It appears that if there is no history of IPV and the incident is *not serious* then an out of court outcome or voluntary interview will be pursued. If this is not the case, then an arrest will be made. If an arrest is made which is not at the time of the incident, this would suggest a serious incident. The time decay is steep in IPV incidents; as time passes, the seriousness of the incident is discounted more by the victim leading to a lower probability of following up with officers at times after the incident.

The SME also confirmed the approach that victimless prosecutions might happen in the most serious incidents, but these would only be the *most* serious incidents. In other cases, it would be possible for the offender to claim self-defense for example which would be difficult to contest using purely hearsay/ res gestae evidence.

It further appears to be the case that a repeat victim tends to respond in a similar manner after each incident. If a good experience occurs in the first incident, this is believed to increase the probability of continuing with the case through to a later stage. It was also believed to be the case that continuity of contact with a single officer through the incident and repeat incidents also assists in increasing the success of victim statements supporting the case. Currently, though an incident might have occurred to a victim a number of times, the details of previous incidents might not be as clear to the attending officer in the current response organization, which might limit the trust and human/ social capital built up by the officers with the victim.

5.1 Number of Incidents

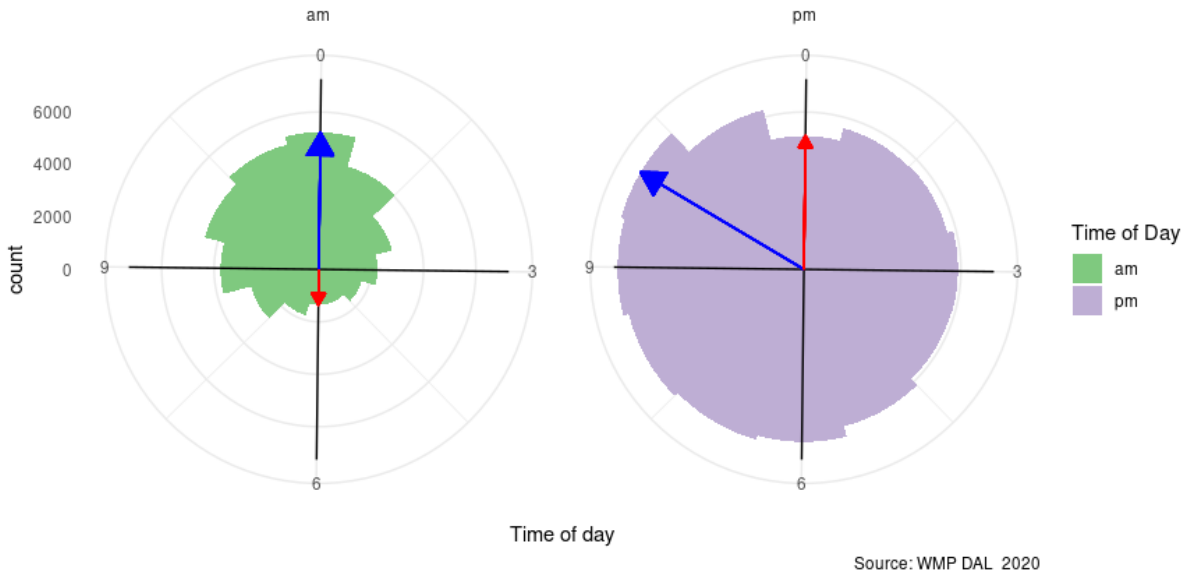
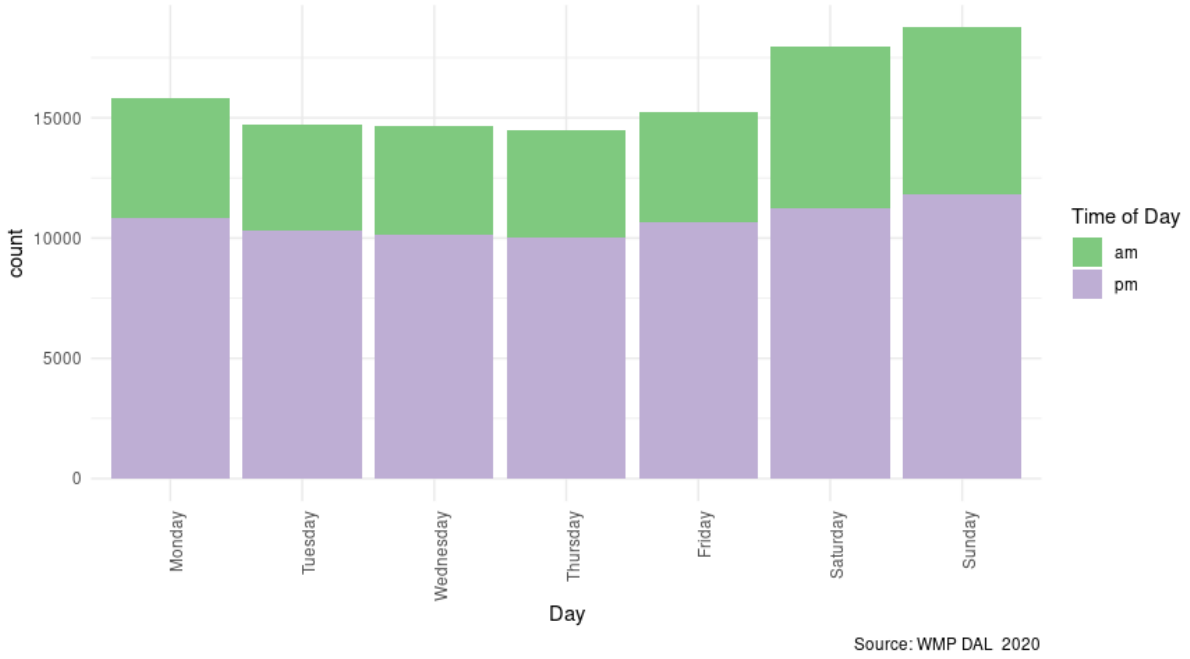


Figure 15 Time of Day Associated With IPV Incidents

The circular plot is interesting as it shows low points in the call time over the day. The clock hands show the maxima and minima for the time of day. It can be seen that the afternoon is generally the worst time of the day, with the post 6pm time up to around 1am being *the busiest*. The earlier part of the day before 9am (i.e. while generally asleep) is the quietest time. Generally the day of the week does not see any major differences across the week during the afternoon, though the weekend mornings have higher levels of IPV incidents.



5.2 Time to arrive at the incident

The arrival time is seen as critical to the success arrest of an offender and the recording of a statement by an attending officer. Data for this was retrieved for a number of years. Note that time at the incident is the difference between either cancellation or departure and arrival at the scene. There are a number of very long responses. It is not clear whether these are typographic errors. The longest response time is 6 months for an incident that was called in in June 2018 and responded to in December 2018.

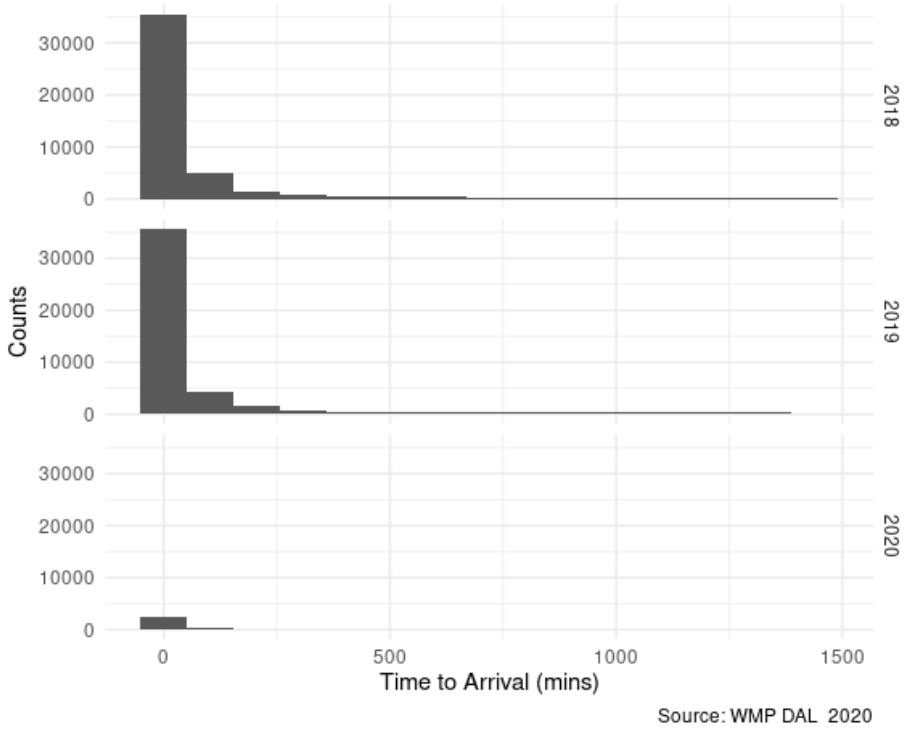


Figure 16 Time to Arrive By Year

5.3 Age of Offender

As would be expected the range of ages associated with offenders is broad. The average age is in their mid to late 20s though there are substantial numbers before that and out into their fifties.

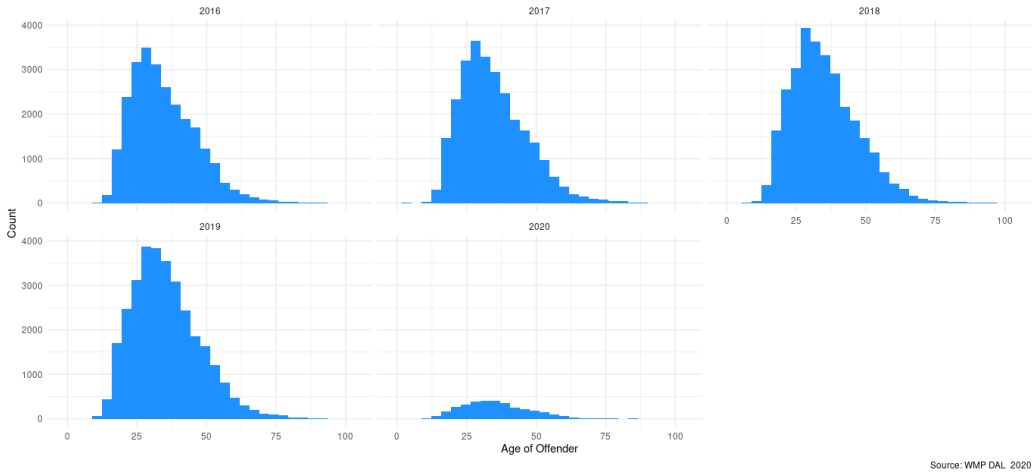


Figure 17 Age Distribution of Offenders

This can be seen as stable through time (note that the 2020 numbers are for only part of the year).

5.4 Ethnicity

A particularly sensitive area is the ethnic split of the IPV offenders. This data allows us to consider the racial and ethnic split of the IPV incidents. The Chinese, Japanese and other SE Asian records have been combined into a single SE Asian category, however we can see that there are very few incidents involving this ethnicity. 2020 was removed as this contained no additional information.

The main perpetrators are White, northern Europeans with Asians (from the sub-continent) and Black perpetrators with a considerably lower proportion per annum as can be seen below.

% of Each Year's Offenders by Ethnicity

YEAR	ASIAN	BLACK	MIDDLE EASTERN	NOT KNOWN	OTHER	SE ASIAN	WHITE NORTH EUROPEAN	WHITE SOUTH EUROPEAN
2016	15.68	11.10	0.39	15.75	2.47	0.16	53.85	0.61
2017	15.44	10.72	0.48	17.88	2.70	0.17	51.78	0.84
2018	15.80	10.28	0.50	20.24	2.61	0.22	49.54	0.82
2019	15.54	9.92	0.48	24.12	2.49	0.16	46.48	0.82

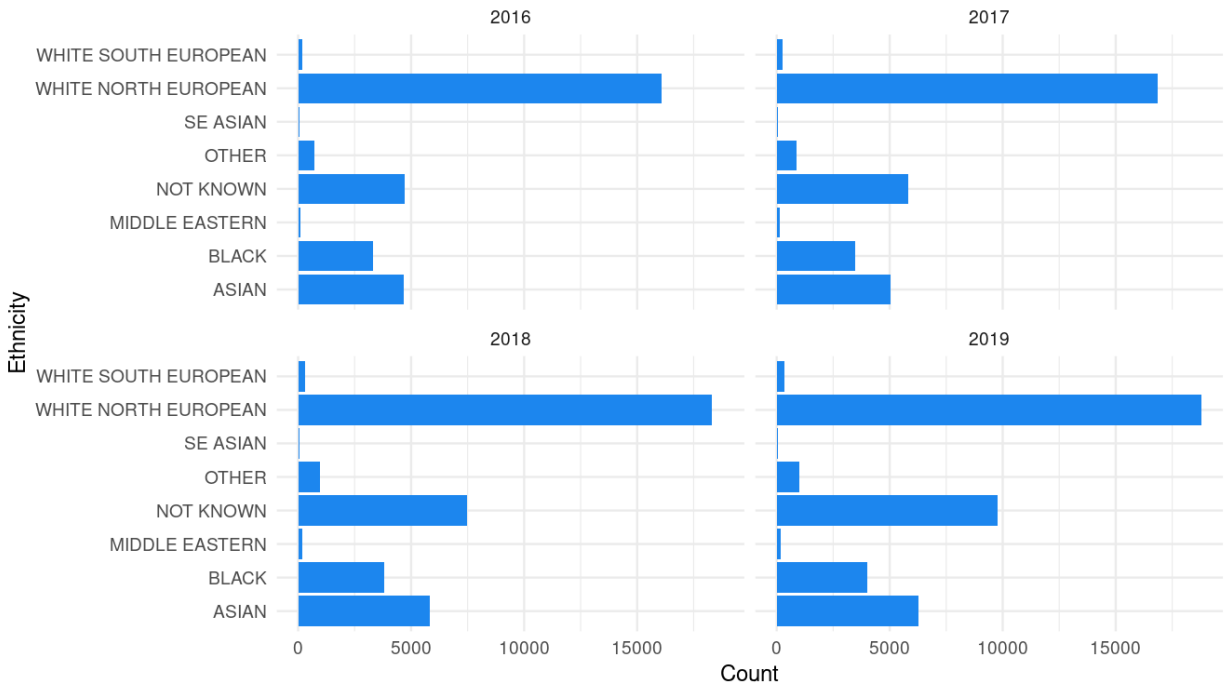


Figure 18 Ethnicity Split in IPV Cases

5.5 Arrests

The fundamental issue of outstanding offenders leads us to consider the incidents where an arrest is made. From the raw data which includes a number of arrests field, there are a number of outliers (number of arrests >10). In light of this, defendant and suspect counts were also calculated where available.

These are somewhat more limited, but as expected there is no direct mapping in all cases between the two. There is a strong relationship between the existence of a crime reference and the existence of a suspect or defendant. The nominals of interest are those who are not arrested but who are potentially defendants or suspects.

The crime reference is seen as the gold standard of the existence of a crime. If this exists, then a crime has taken place. Those incidents where there is a crime reference *and* no arrests are those incidents where there is an outstanding offender. Where there is no crime reference, it is taken to be the case that the incident is closed without it being 'crimed' and so there will not be an arrest associated with that incident. That said, there are about 2,100 observations where an arrest is made, though no crime reference is filed (this represents 0.73% of the sample since 2016). These data are therefore left in the dataset but acknowledged as somewhat odd. Those incidents that are crimed and where there are no arrests made represent 48.49% of the incidents. These numbers will under-estimate the number of arrests associated with the particular incident as they refer to those incidents where the offender is arrested immediately or before the log itself is closed (i.e. almost immediately after the officers leave the scene). The OASIS log number of arrests do not include those made following an investigation.

	Arrest Made (%)	
Crime exists	FALSE	TRUE
FALSE	98.480	1.520
TRUE	92.940	7.060

We can see from this that the when a crime exists, the vast majority of cases have no arrest associated with them. It is these cases that are of primary interest in this work. This can be compared to the situation where there is a defendant or a suspect associated with the incident. In almost 95% of crimed incidents a suspect or defendant exists, i.e. the partner is believed to be responsible.

	Defendant or Suspect (%)	
Crime exists	FALSE	TRUE
FALSE	100.000	0.000
TRUE	5.150	94.850

5.6 Other Characteristics

We can link the various data sources together to get an underlying picture of the incidents and crimes in the period since 2016.

In order to consider the problem of outstanding offenders, we will use a constructed variable ('outstanding') that takes the value 1 when a crime reference is logged and when no arrests are made at the scene. A second aspect of the later arrest is initially not included.

In addition to the initial IPV incident, the history of the offender is an important aspect of the offence. Discussions with SMEs suggest that *history* is an important aspect for the follow-up of the incident. Only the crimes are included for the history as the identifier for the incident is not recorded directly (or consistently in the logs). The history is limited in two ways, firstly and most obviously only crimes before the incident date are included and secondly only incidents within the MOPI[8] data window are admissible. Thus if an incident occurred after the MOPI date for a crime that crime is not part of the history available.

The typology of the offender literature would lead us to believe that offenders who are violent outside the domestic environment are likely in some cases to be violent inside it. Therefore we must consider the various crime types associated with the nominals. The count of each of the specific crime groups that occurred before the incident date are included at each point as the incident is the ongoing unit of interest in addition to the nominal. A metric based upon the MOPI values is also calculated. This takes the MOPI

[8] Management of Police Information – essentially this provides guidelines as to periods of time for which information about offences can be kept (the more serious the offence, the longer it can be kept).

value of the crimes associated with the nominal as either victim or defendant/ suspect. These are grouped using bins based on time before the incident at hand.

1. Less than 1 week (i.e. near contemporaneous)
2. Less than 1 month
3. Less than 3 months
4. Less than 6 months
5. Less than 1 year
6. Less than 18 months
7. Less than 2 years
8. Less than 6 years (MOPI criterion)
9. Less than 10 years (MOPI criterion)

These are independent of each other, so can be combined if the bins are found to be too narrow. The MOPI score for the crimes is used as a proxy for the severity and are taken in two different ways. The first is the average MOPI level of the crimes up to the date of the IPV incident as victim and defendant/ suspect taking into account all the incidents before a specific incident, the second uses only that history associated with the specific incident again as victim or defendant/ suspect.

The nominal has a mean MOPI score based on their role in a set of specific crimes, and also a mean MOPI score for events before the incident reported in the data.

We can see that there is little difference in the proportions of outstanding offenders between 2016-2019 (2020 was omitted from the averaging as there are so few observations). Likewise the no-criming with no arrest is equally constant around the same level. The monthly data gives the same story, though one can see an inverse relationship between the two main outcomes.

Year	No Arrests	No of Outstanding	Prop Arrests	Prop Outstanding	Mean Prop Arrest	Mean Prop Outstanding
2016	2997	28400	9.550	90.450		
2017	2679	31683	7.800	92.200		
2018	2521	36638	6.440	93.560	7.400	92.960
2019	2379	40725	5.520	94.480		
2020	215	4606	4.460	95.540		

In order to consider the outcomes, the crime references etc. need to be linked to the various custody tables. The link to this for each reference is based on the closest date to incident date (after the incident) for the nominal involved in the incident. Though this is in no way perfect, it does give a link between the incidents and crimes to the records.

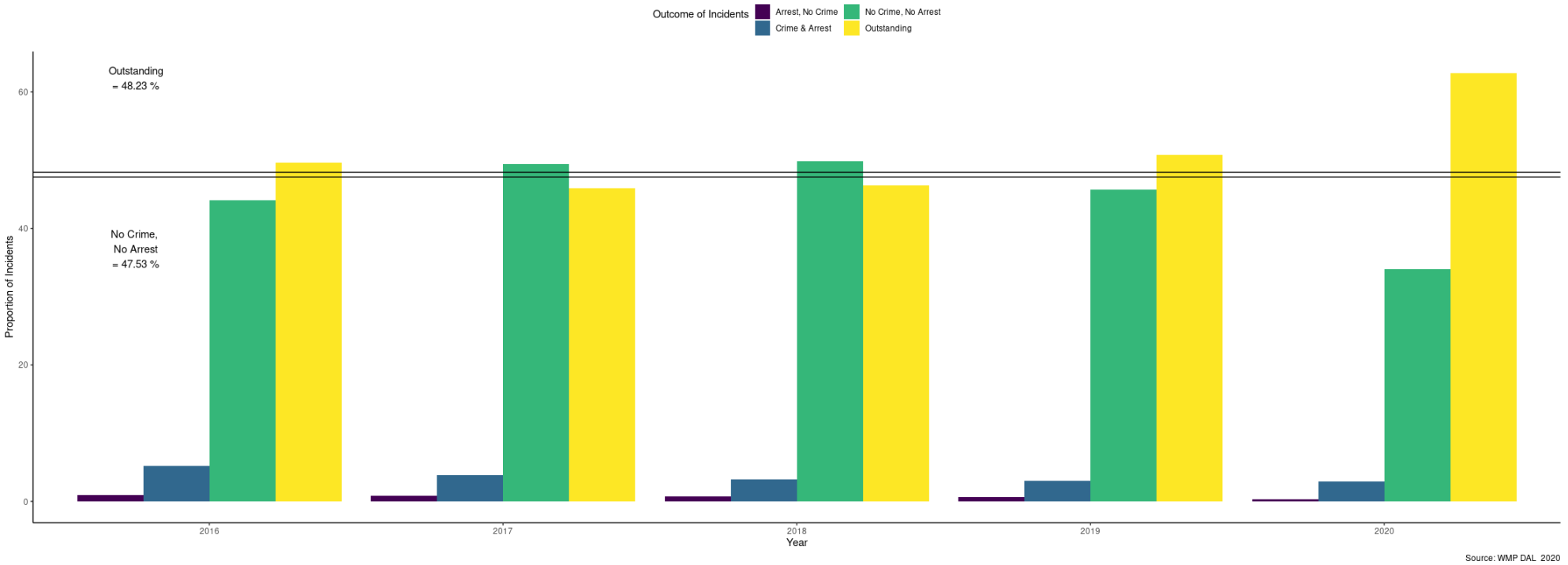


Figure 19 Outcomes of Incidents by Year

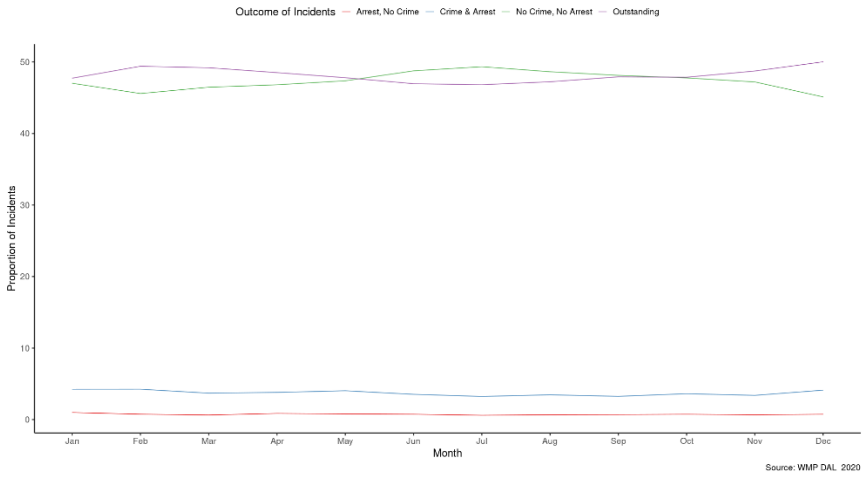


Figure 20 Outcomes by Month

From these data we can see how many types of outcomes occurred. Blue numbers are more than 10% of the total, red more than 20% and bold numbers more than 30%. The disposals were taken from ICIS records with a slight modification. If there were evidential issues and the custody reason was not one involving assault, non-molestation orders, criminal damage, harassment and the like the custody was assumed to be unconnected to the IPV and thus the disposal code was changed to *no further action*. Though this might discount some outcomes, it is believed to be more accurate than not making the modification.

Description	Outcome Of Incident	2016	2017	2018	2019	2020	Total	Total (%)
CASE CLOSED PENDING	NO FURTHER ACTION	28	28	31	40	1	128	0.09
CAUTION	NO FURTHER ACTION	472	392	295	275	10	1444	1.00
CHARGE OR SUMMONS	COURT DISPOSAL	952	1115	936	699	90	3792	2.63
CLOSED PUBLIC INTEREST	NO FURTHER ACTION	67	134	119	72	2	394	0.27
COMMUNITY OR OTHERS	NO FURTHER ACTION	580	469	472	447	23	1991	1.38
NON CRIME	NO FURTHER ACTION	**12454**	**12537**	**12517**	12117	1368	50993	35.31
POSTAL CHARGE	POSTAL CHARGE	46	103	74	59	3	285	0.20
PROSCUTION NOT POSSIBLE	NO FURTHER ACTION	29	21	18	14	0	82	0.06
SUSPECT BUT EV ISSUES	NO FURTHER ACTION	8354	**10622**	**14841**	**18556**	**1858**	54231	37.55
Total	Total	**29850**	**32548**	**36976**	**40453**	**4585**	144412	100.00

The table above shows *only* the leading outcome by each description held in the data. Figures in red represent more than 20% of the annual total and bold more than 30%. It shows that there are a number of main outcomes, *Suspect but evidential issues*, *Non-crime* and *Court Disposal*. This would coincide with the SME discussions regarding the IPV offences. The first group is a catch-all for victims not supporting the case or other evidential issues. The second group are of the no further action type with the third moving into the criminal justice system.

We can look to the relationship between the time to close the investigation and the outcome as shown above. The time to close is grouped to allow for easier consideration.

In the first model, one considers whether there is a *next* IPV incident and if there are crimes in between the two (excluding the first but including the latter). If there is a next incident, a dependent variable is set at the value 1, else it takes the value 0. Given the characteristics of the nominal, including any history etc., the model is estimating the probability of a new incident. The time to close the incident is available. This is taken from the log records and is measured in days.

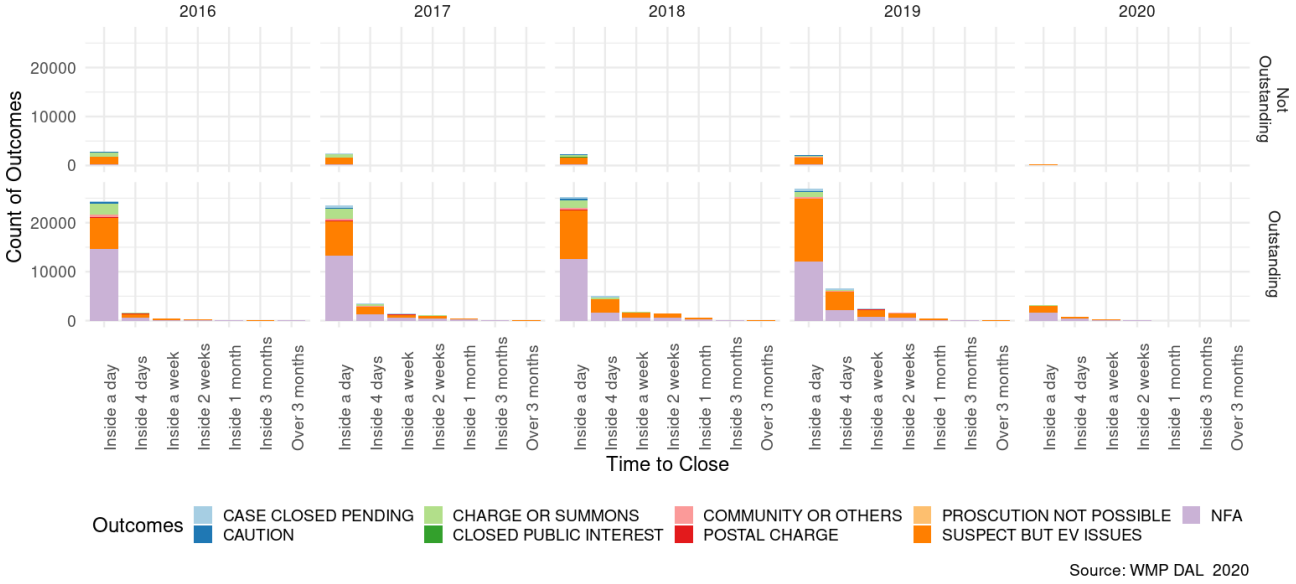


Figure 21 Outcomes for Outstanding Offenders

Obviously the time to close is generally zero when there is no outstanding offender as an arrest is made at once. In the outstanding cases there is quite a drop off after the first day. There might be a crime recorded however there is no arrest forthcoming immediately (though later that day is possible). We can see that the direct no further action (taking into account non-crimes and impossible prosecutions) and the evidential issues (primarily witness support) make up the main part of the cases with evidential issues appearing to be the main outcome for the longer cases.

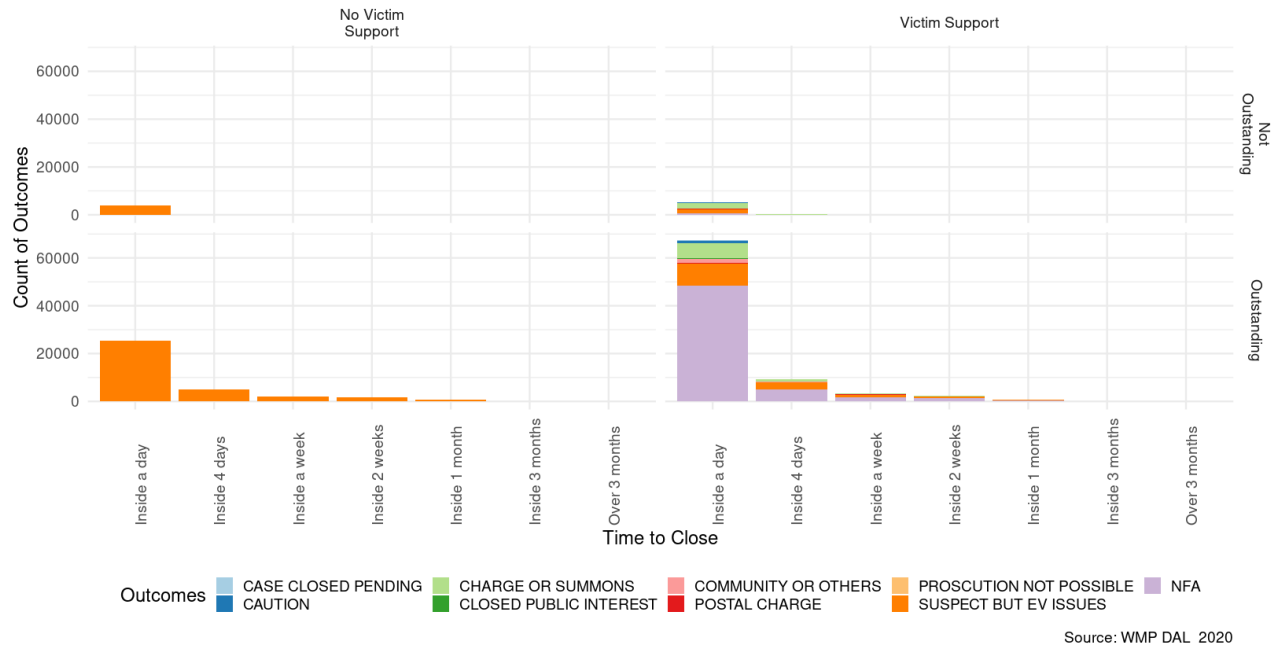


Figure 22 Outcomes with No Victim Support & Victim Support

By looking at support of the victim, as soon as this is withdrawn the investigation is logged as either OC14 or OC16. OC15 gives rise to evidential difficulties but victim support.

5.7 Data on Successful Resolutions

In order to appreciate a successful outcome, the relative scales of the outcomes needs to be seen. This is demonstrated in the following chart.

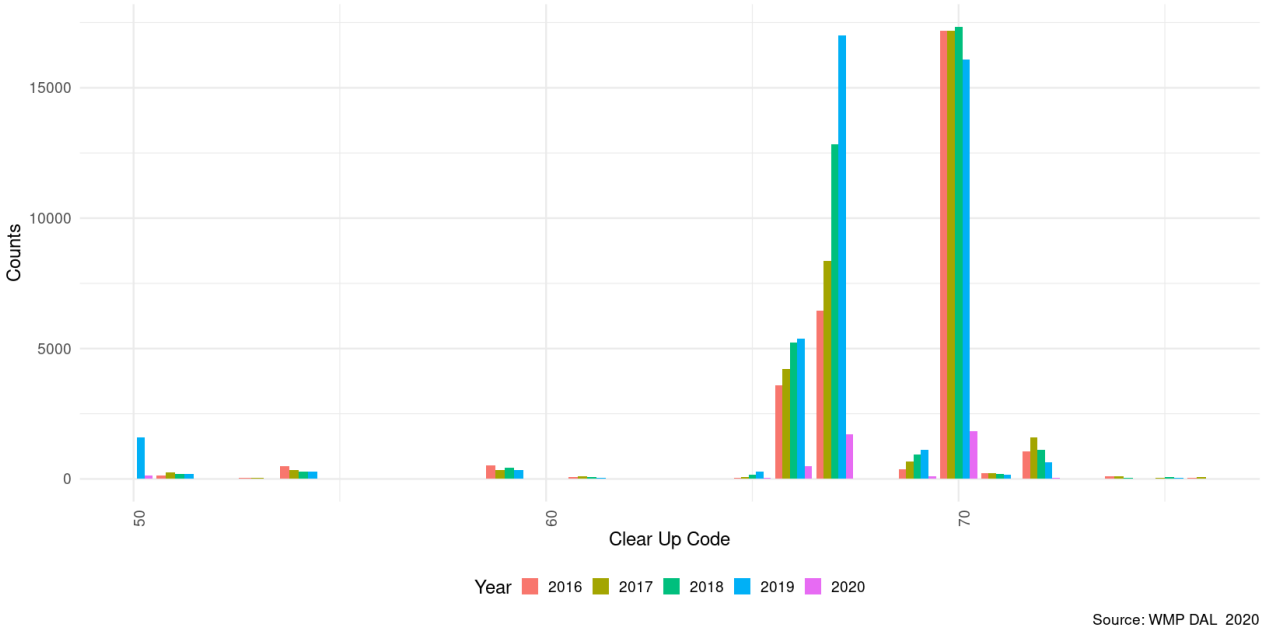


Figure 23 Clear Up Codes by Year

This graph does not give a clear picture of the outcomes. It is clearer to look at the outcomes associated with the incident. These were classified as a success if the clear up code is associated with a caution or charge; notably the community resolution and other outcomes such as evidential difficulties or lack of victim support are seen as unsuccessful outcomes. The variables *victim support* and *evidential difficulties* are directly generated off the clear up code and so would lead to an (im)perfect separation- as soon as one of these variables is in play, the outcome is successful except in a very small number of cases where there was an exceptional clear up code.

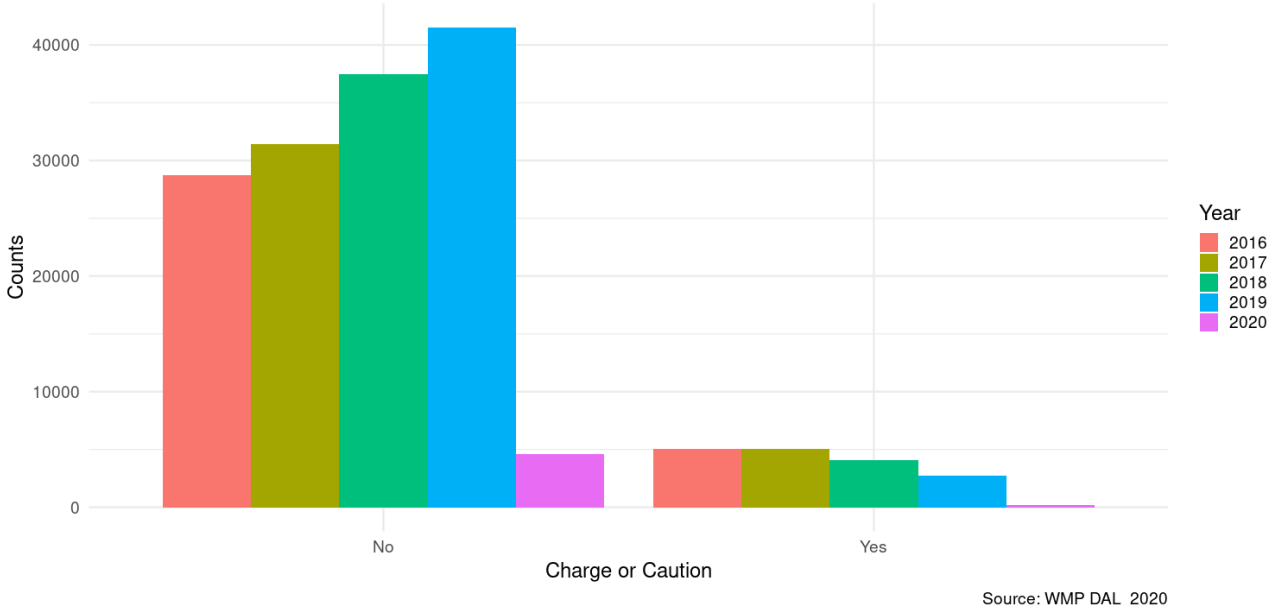


Figure 24 Outcomes by Year

Year	Unsuccessful	Successful	Proportion of Total Successful
2016	28701	5024	14.897
2017	31437	5018	13.765
2018	37463	4094	9.852
2019	41518	2765	6.244
2020	4635	207	4.275
Total	143754	17108	10.635

Charge or Caution Outcome	Victim Support	Evidential Problems	2016	2017	2018	2019	2020	Total
No	No Support	No Problem	1098	1769	3083	5848	1369	13167
No	No Support	Problem	6420	8266	12463	15855	1426	44430
No	Victim Support	No Problem	17610	17230	16825	14789	1452	67906
No	Victim Support	Problem	3573	4172	5092	5026	388	18251
Yes	No Support	No Problem	18	9	30	94	43	194
Yes	No Support	Problem	0	0	0	0	0	0
Yes	Victim Support	No Problem	5006	5009	4064	2671	164	16914
Yes	Victim Support	Problem	0	0	0	0	0	0

5.8 Summary

We can see that the proportion of successful outcomes averages at about 10%. This separation is important and leads to the consideration of two models- one dealing with success in terms of caution/ charge and a secondary one which is conditional on the unsuccessful outcome of the incident. This looks at the differences between those unsuccessful because of victim support being dropped or evidential difficulties and those dropped for other reasons.

6 Conclusions

This study considers the factors that explain the success or failure of IPV cases and what factors are involved in victims withdrawing their support or evidential problems being important. It uses Directed Acyclical Graphs and regularized regressions to highlight these factors and it is found that there are a number of commonalities across the models and outcomes. Some of these variables are under the direct control of the Force, others are *states of the world*, things that cannot be changed. This allows the officers to be allocated in a manner that can improve (but of course never guarantee) the chances of successful outcomes and the protection of victims.

Increased involvement with the victim, especially when these logs are written by a single officer (i.e. creating a single point of contact) is beneficial for the success of the cases. The single (or small number of) point(s) of contact as shown by the officer focus can reduce the probability of a victim withdrawing support and help in the success of the investigation. Part of the effect can be explained in terms of investigate efforts and also as empathic response to the victim as discussed in Robinson & Stroshine (2005) and IPCC (2010) respectively. The lack of an arrest was not seen in these studies to be problematic in certain circumstances and this is reflected in the models of the withdrawal of victim support.

The data suggests that the typologies of offenders as developed in the literature. It appears that in many cases, a history of medium MOPI'd crimes tends to be a signal for increased awareness either as the victim withdraws support or being involved in a later offence. This might be for a number of reasons including a generally high level of violence associated with the perpetrator and possibly a degree of intimidation, which itself is credible due to the history of the perpetrator.

Age is another variable that is important. The victim is less likely to withdraw their support if the perpetrator (& by expectation the victim) is middle-aged. This again points to a Rubicon being crossed, but victims with younger assailants suggest that the police are called with a view to stopping a crisis situation, possibly without wanting arrest and the older victims might feel that they are unable to deal with the fall-out of the (most likely) long term relationship if an arrest occurs. Younger perpetrators also are at more risk of being offenders in crime as a whole, and especially IPV where the decline of the positive impact is less than for crime in general.

As a final consideration, the nature of IPV and spousal violence is complex and many of the models here demonstrate the inter-relationships and interactions of the factors involved in the decisions and outcomes made by *all* parties involved in the incident. The response of one person can differ wildly from that of another to a similar situation. Though these models cannot describe the relationship between the victim and perpetrator, they do highlight important relationships.

- Victims benefit from a small number of officers being involved in their case & active involvement in the case either in that it helps the successful outcome in the immediate case or it reduces the probability of a perpetrator going on to some other (IPV) offence
- The offender's history can be a pointer to further problems down the line

- Police and Social Service flags such as Safeguarding and Alcohol flags are useful signals that the victim is less likely to withdraw support. Incidents where these would be reported should be of especial notice.
- Persistent offenders & ex-partners' involvement can be a signal that there will be continued IPV
- An incident where victim support is dropped is likely to lead to an increased probability of another IPV by that perpetrator
- If a man reports the incident as a victim, it is more likely that this will be seen through to a successful conclusion.

There are some situations where there is only a limited scope for helping the victims of IPV, but this study has shown that by looking to best use resources we can maximize the chances that a perpetrator will be apprehended or will not go on to be involved in an incident again.

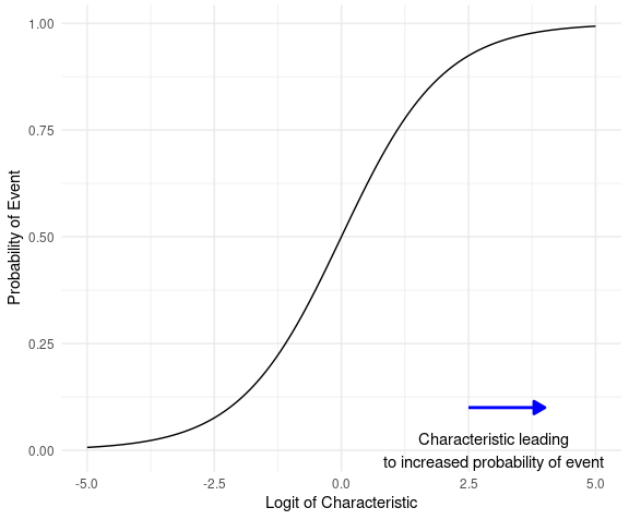
7 Consideration of Modelling Techniques

The modelling techniques used are a combination of logistic regressions with a regularization penalty and Directed Acyclical Graphs (DAGs). These are two common techniques used to deal with data sets where variable selection is required and an understanding of the causal links.

The DAG approach isolates important relationships between the variables and the direction of causality. The variables are represented as nodes with arrows between those that are related. The approach used in this study is one of a regularized path for the DAGs. This creates a set of DAGs that become more parsimonious as the constraint on the variables increases.

With the various dependent variables being split up to take into account different outcomes, we can see if there are some situations where the outcome is dependent upon some factors but not others. A Directed Acyclical Graph can be used to show the relationships between variables (as represented by nodes). The data is used to derive a direction of the relationship between these variables. This allows us to see interactions and latent relationships that might confound the modelling relationships. Rather than a single DAG as is common, in order to find the consistently important drivers of the dependent variable, a path of DAGs was calculated. This involved a regularization path much as is used in the LASSO and other such methods. More details of the method are given in the Appendix 1.

The second element of the study uses logistic regressions. The impact of the various variables is based on a logistic regression, which models the probability of the dependent variables occurring. The variables directly estimate the log-odds of an event. A positive coefficient on the variable increases the log-odds and so the probability of an event occurring. It should be noted that the impact of a variable is not constant- the impact changes through its range reflecting the requirement that probabilities are bounded between 0 and 1.



An issue that is important is the extraction of the important variables, rather than including all (as in in the data set) in the regression. There are a number of methods to do this, however the regularized regression is a standard approach in many cases.

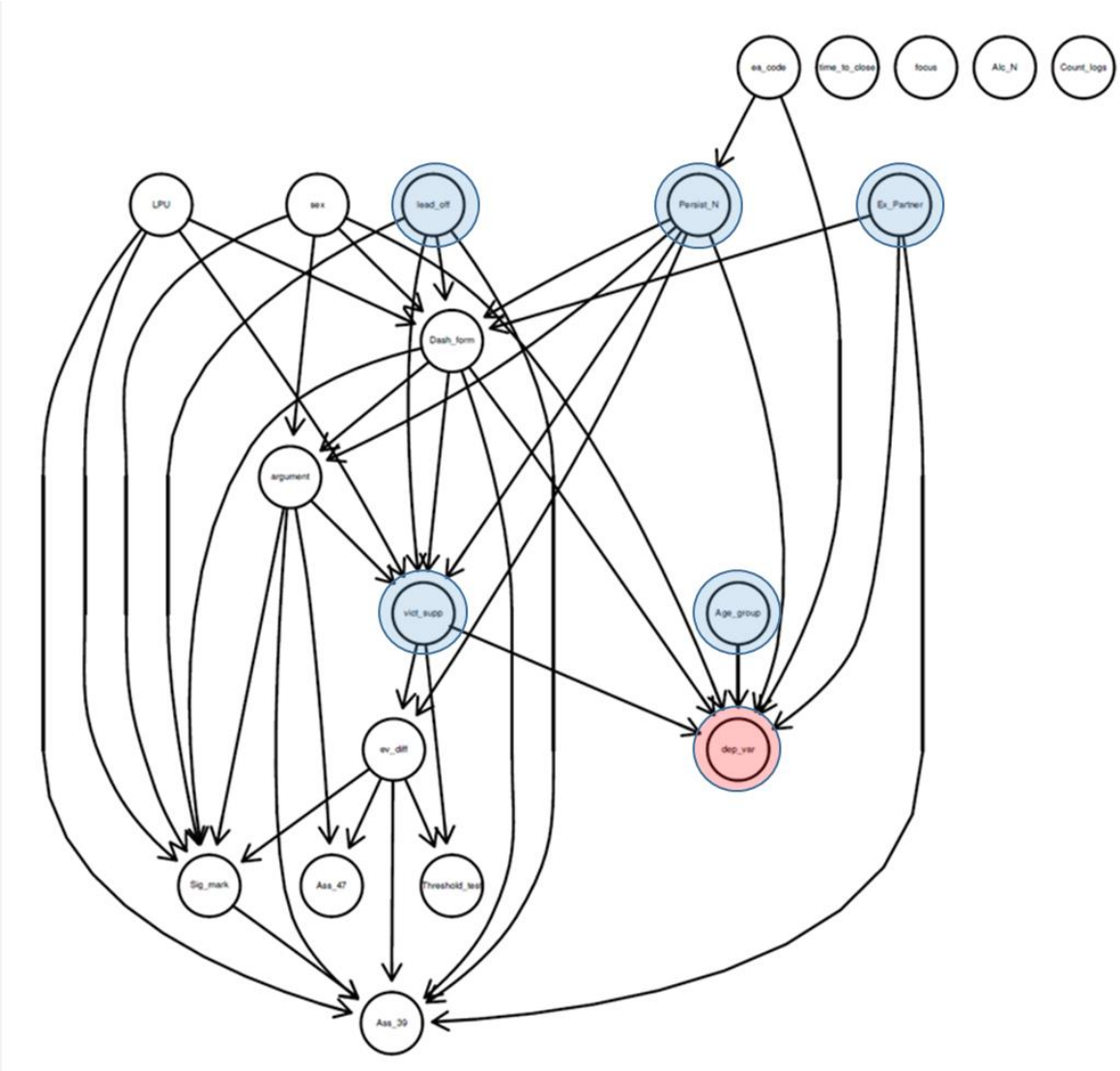
Combining the insights from the DAG and the regression allows us to consider the effect of the underlying features on the variable in question.

These final set of results are discussed in Section 4, with model metrics given in the Appendix. This section considers the output from the DAGs.

7.1 Findings from DAG

The DAGs are used to inform the important factors in the determination of the dependent variable, for example will the incident end in a successful outcome. The node labelled `dep_var` is the terminal node (or target) though in some cases there are other nodes that are also terminal. The DAG takes information that is in the data and a number of rules that the relationships must obey in order to create the graphs. In each of the following graphs the model is allowed to become more complex. The red node is the terminal node, with blue ones showing that nodes that were seen to be important in the second, logistic regression steps.

The variables found to be important in the DAG path are consistently found to have an impact. Indeed these were found to be the most important in the regressions as well.



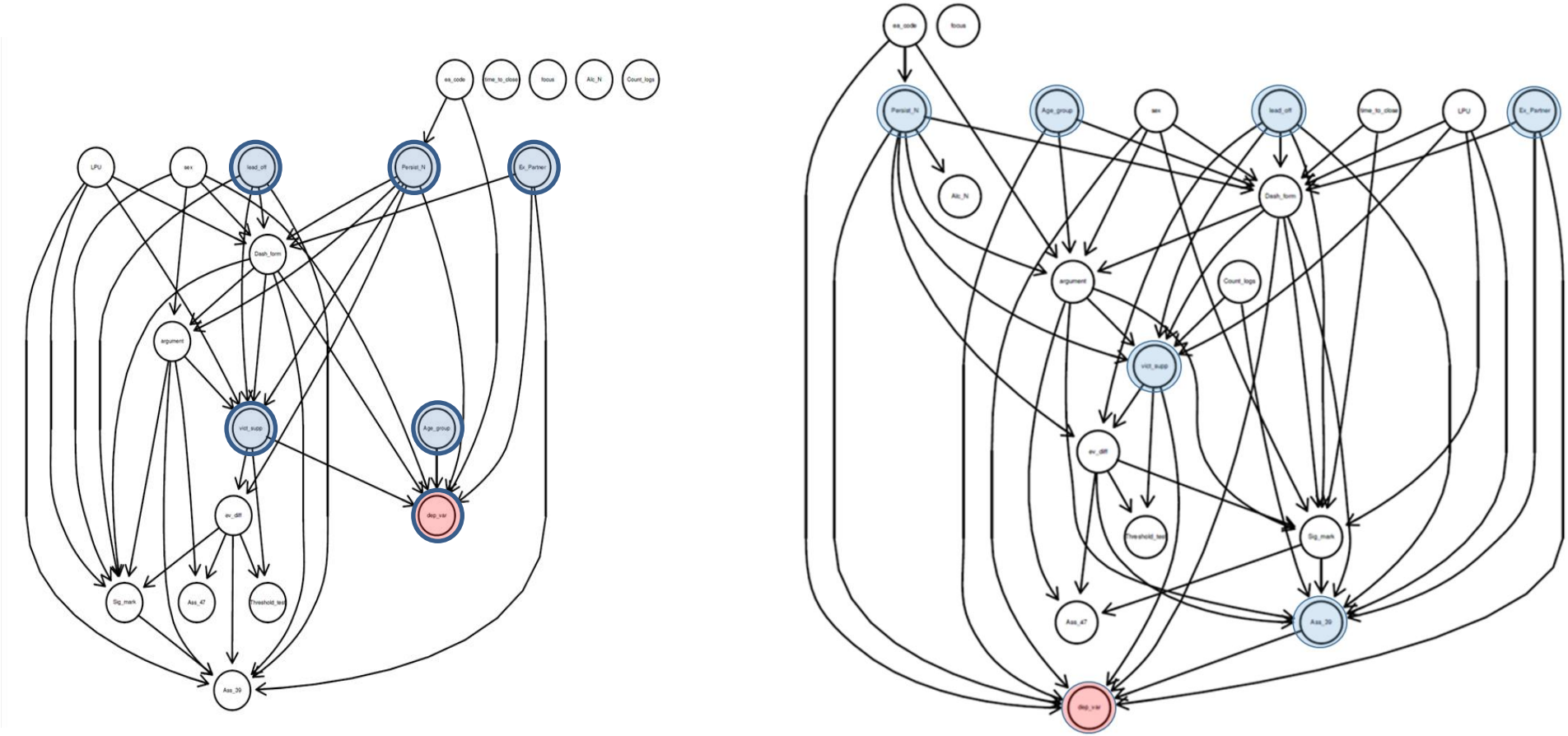


Figure 25 DAGS for IPV of Increasing Complexity for Crime In General

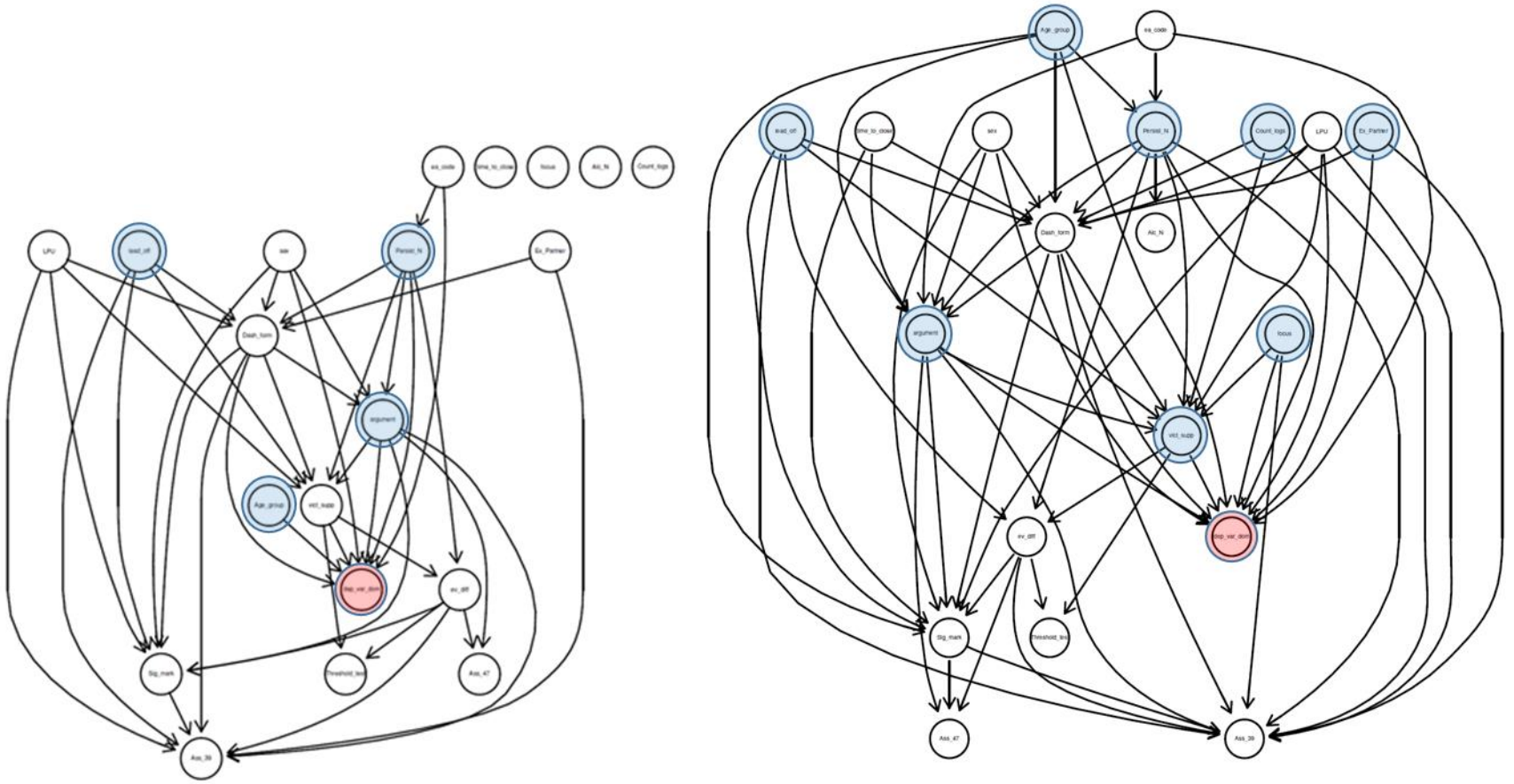


Figure 26 DAGs for Domestic Violence Outstanding Offenders

The more complex DAGs show that there is a great deal of interaction and a number of paths to the dependent variable. For example the ex-partner being involved has a direct link to the perpetrator (i.e. the ex-partner) being involved in a domestic as the next crime. It is also the case that the ex-partner's involvement also leads to evidential difficulties and possibly an Assault under Section 39 being used to charge the incident in question. It was also interestingly not related to an argument, which is not what one might expect. Victim support can be an indicator of the nominal perpetrating a later domestic crime. This is itself dependent upon LPU, the officer focus and the involvement of the lead officer (as defined before), the number of logs filed for the investigation as well as the age group of the perpetrator.

Taking the lead officer as an example, we can look at the overall picture of the coefficients (i.e. positive have a positive impact and negative a negative impact), we can see some interesting patterns. This has informed the use of splines in the regressions as discussed in Section 4.1.s

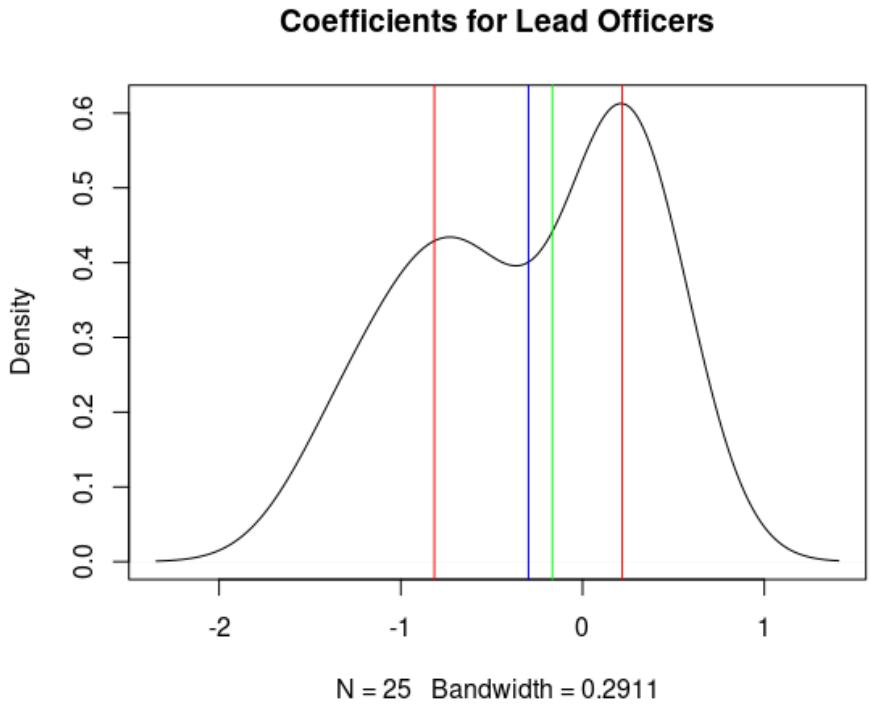


Figure 27 Impact of Lead Officers on Outcomes

The potential non-linearities are seen from this density where there are two modes and very distinct coefficients at the 25th and 75th percentiles. The mean in blue and the median in green also suggest that a more nuanced estimation is required. Similar relationships are seen through a number of other variables such as whether an argument was taking place. This takes a single DAG and looks at the impact across the range of outcomes; an alternative approach is to consider how the DAG changes along the statistical path taken as more variables are introduced. This is presented for the

cases of Victim Support, Evidential Difficulties, Ex-partner involvement and whether Section 39 assault was charged on the dependent variable (in this case a crime being committed in the gap between the two incidents). The impact of the evidential difficulties is negative meaning that the probability of the nominal being crimed between the two consecutive offences is reduced. On the other hand, if Section 39 Assault has occurred a positive impact is seen.

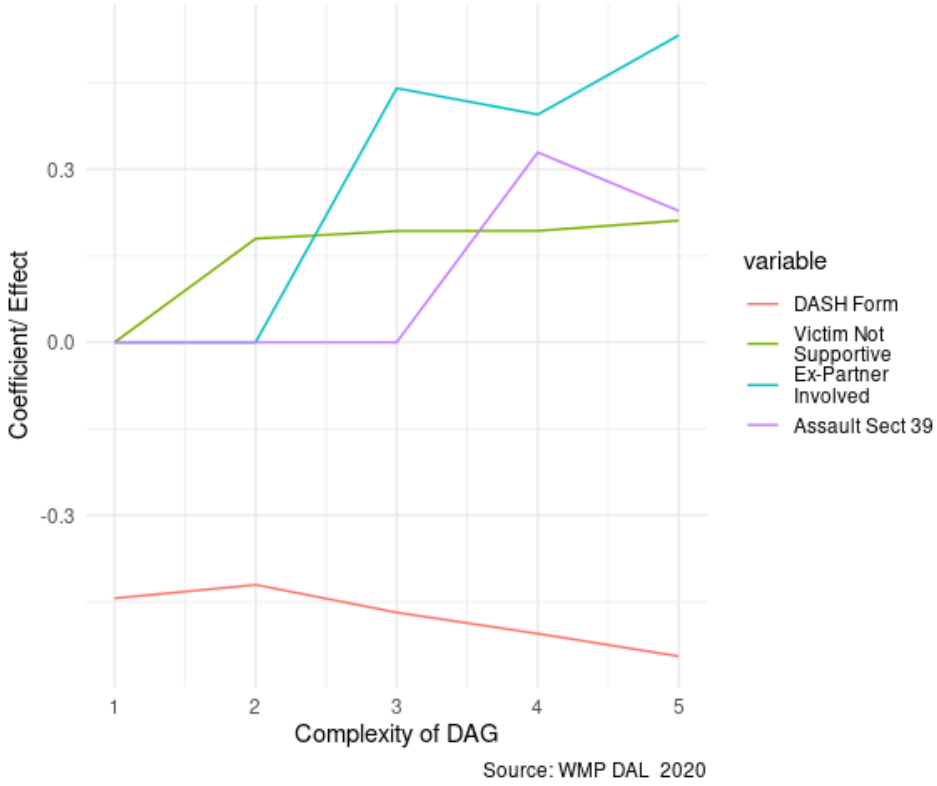


Figure 28 Variable Importance from DAG Analysis

The models' complexity was also considered, with a view to parsimony in addition to model fit. A number of different approaches were taken to the modelling. The results of each approach were cross-referenced against each other to ensure that the results were sensible and consistent. The optimization was set to maximize the area under the curve (AUC) using Bayesian Optimization (Mockus, 1994) and the Nelder- Mead algorithms. This was in addition to the cross-validation across the hyper-parameters. The optimizing surface was found to be flat around the optimal hyper-parameters and a number of costs for the upper confidence bound but with a preference to $\kappa = 2.58$ and $\kappa = 1.96$ reflecting the 99% and 95% confidence percentiles. Though the optima were not identical, they were similar enough to be confident that they reflected the best underlying models. In all cases the area under the curve was around 0.76 (for reference an AUC of 0.5 is equivalent to the model not being able to discriminate between those of interest and those not of interest). The AUC was found to be similar across a range of values, suggesting that the estimation surface is relatively flat. In this case, the parsimony was preferred when the estimates show agreement with the Directed Acyclical Graphs above.

7.2 Metrics for Models

The models' results have been discussed in earlier sections. The model metrics are presented here rather than further analysis of the outcomes. The AUCROC, ROC and Precision- Recall Curves are considered and the Youden (1950) index for both the test and training sets presented. The Youden statistic defines the optimal cut-off point for the 'success' or 'failure' of the dichotomous choice, rather than asserting a probability of 0.5 as is often the default case. In terms of interpretation, the ROC curve is demonstrating the improvement over luck as represented by the 45° line. The AUCROC measures the area between the empirical ROC curve and the 45° line. The precision-recall curve shows the relationship between the precision (positive predicted value) and recall (or sensitivity) for each cut-off value. It is not unusual for P-R curves to be somewhat wiggly. These P-R curves are often more use in the case of imbalanced data such as in this case, where ROC curves can exaggerate the performance (good or bad) for imbalanced data whereas PR curves are similar for imbalanced and balanced data.

7.2.1 Outstanding Offenders

The Logistic Model for the outstanding offenders considers the next offence for the offender in the IPV incident. The usual metrics were calculated for the training and test sets. For the crime offences in general, the following AUCROCs and Precision –Recall graphs are constructed.

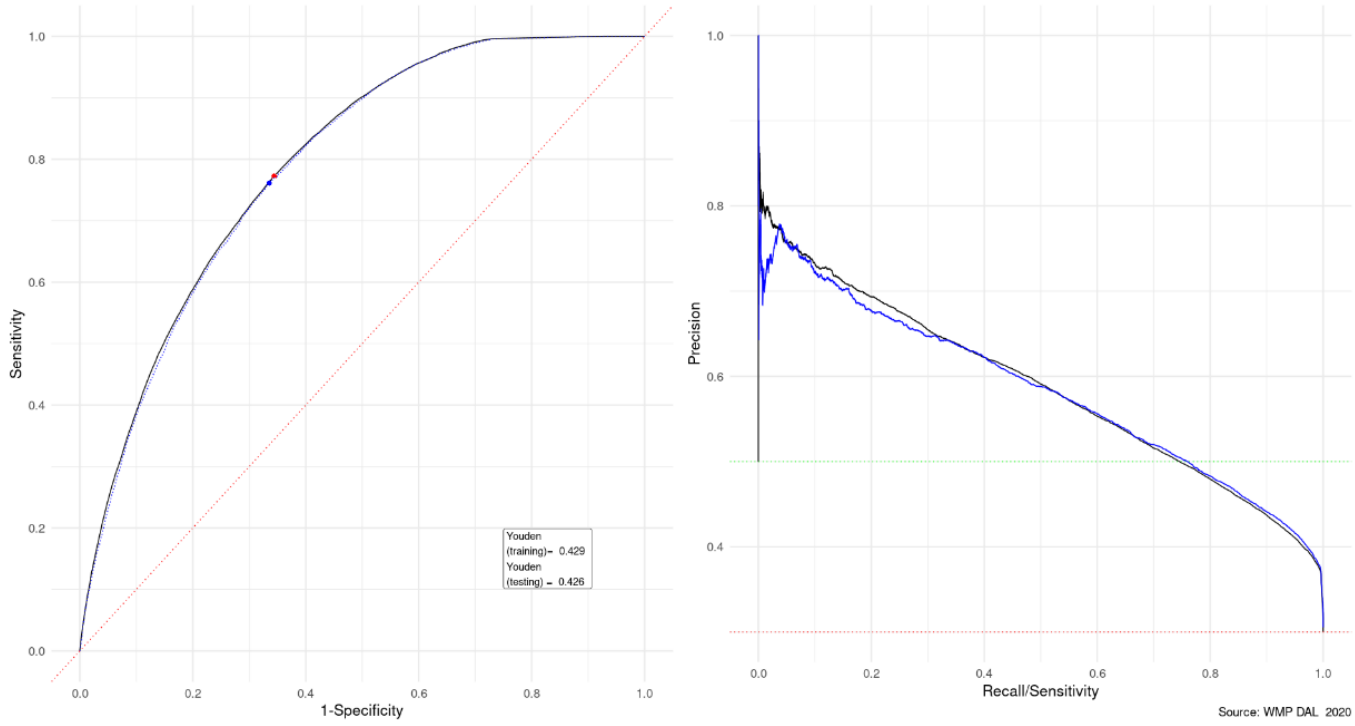


Figure 29 ROC & Precision-Recall Charts for Outstanding Offenders (Crime in General)

These graphs demonstrate the similarities & stability of the two models. Both are effective at differentiating between the outcomes. The AUCs are both 0.79. The K-S plot is also presented for the training (left) and test (right). This represents the ability of the model to differentiate positive and negative outcomes. In the general case, the value is approximately 0.43.

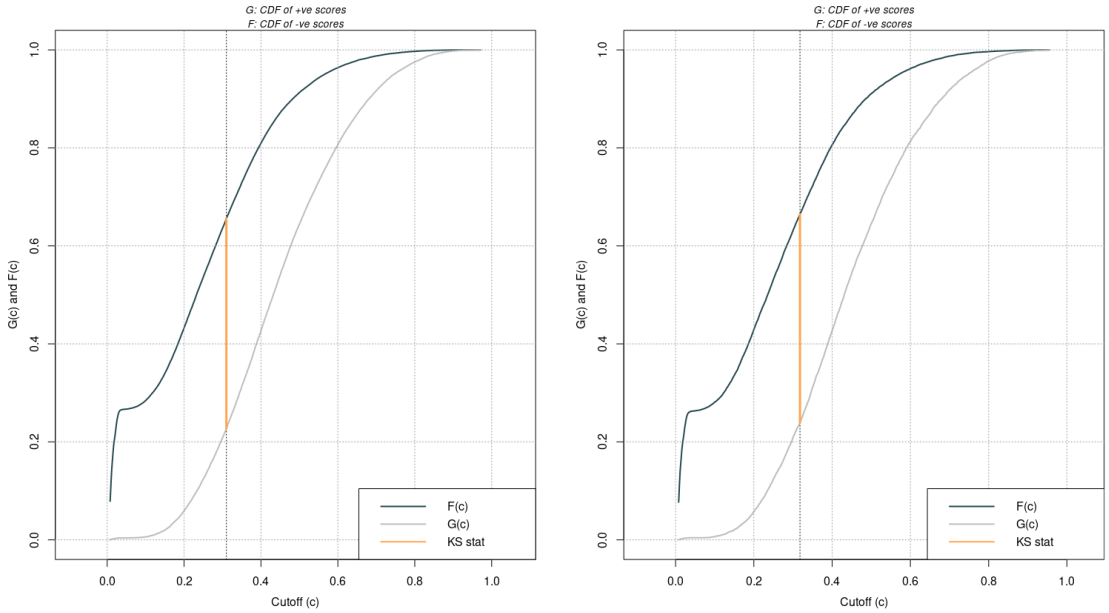


Figure 30 K-S plot for Outstanding Offenders

The outstanding offenders' models for crime in general is a well-behaved and well performing model. The model is found to be stable across the training and test set and thus the expectation is applicability to the problem at hand.

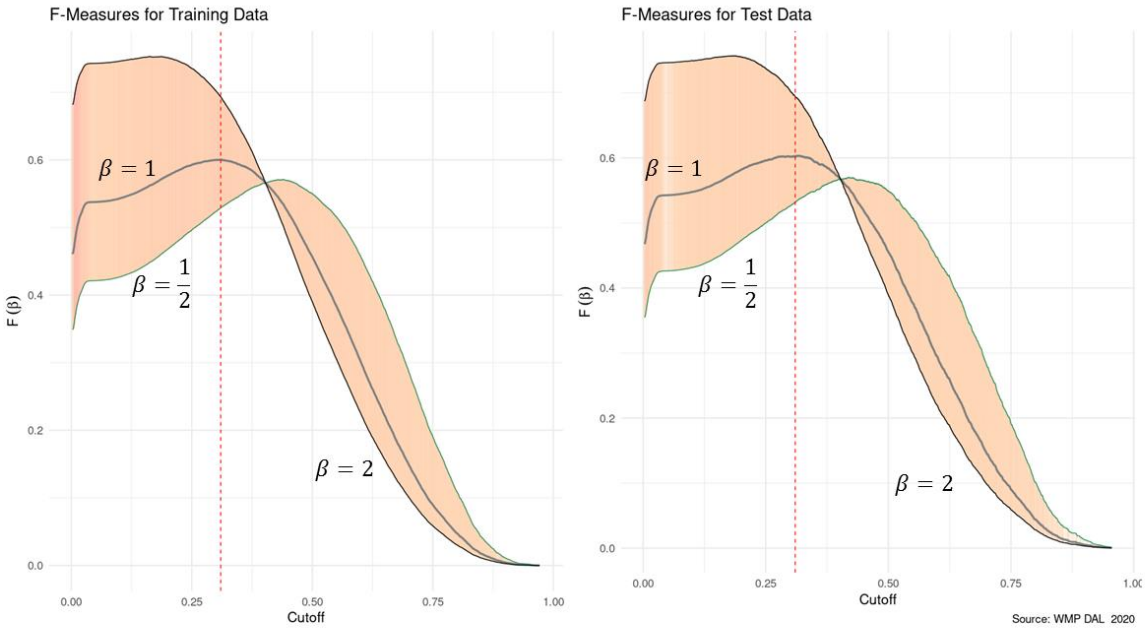


Figure 31 F Measures for Outstanding Offenders

Considering the tradeoff between precision and recall, it is possible to use the F(β) measures. As β increases from 0 less weight is lent to the precision and more to the recall, with an equal balance at β=1. Precision being the correct positive predictions and

recall being the proportion of correct positive predictions out of all positive predictions that could be made. This can be seen in the Figure 31 where the default measure shows that the selected cutoff point at 0.3 are a balance of the precision and recall requirements.

For IPV crimes, the models perform in a similar fashion. The ROC and P-R curves show good explanatory power. The AUC for the test set is a little higher than that of the training set (0.78 compared to 0.77) and of no practical difference. The KS-statistic is similar in magnitude as the crime in general, around 0.4(2).

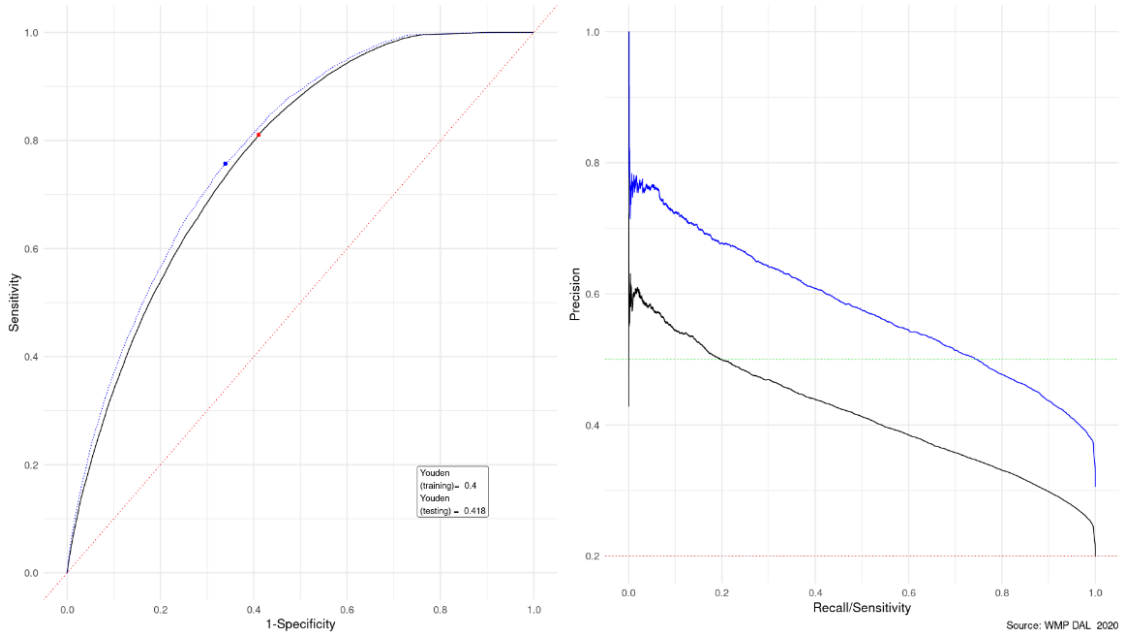


Figure 32 ROC and Precision-Recall Charts for Outstanding Offenders (IPV)

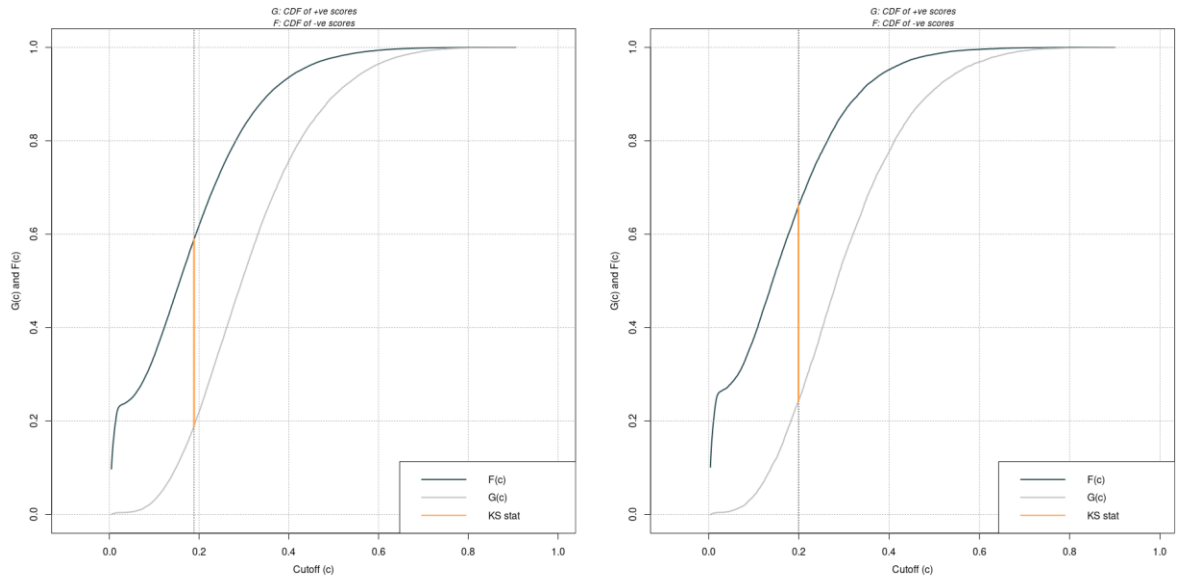


Figure 33 KS- Plot for Outstanding Offenders (IPV)

The F- measures for the IPV outstanding offenders are similar in form as those for crime in general, though there is less potential for a different balance between precision and recall.

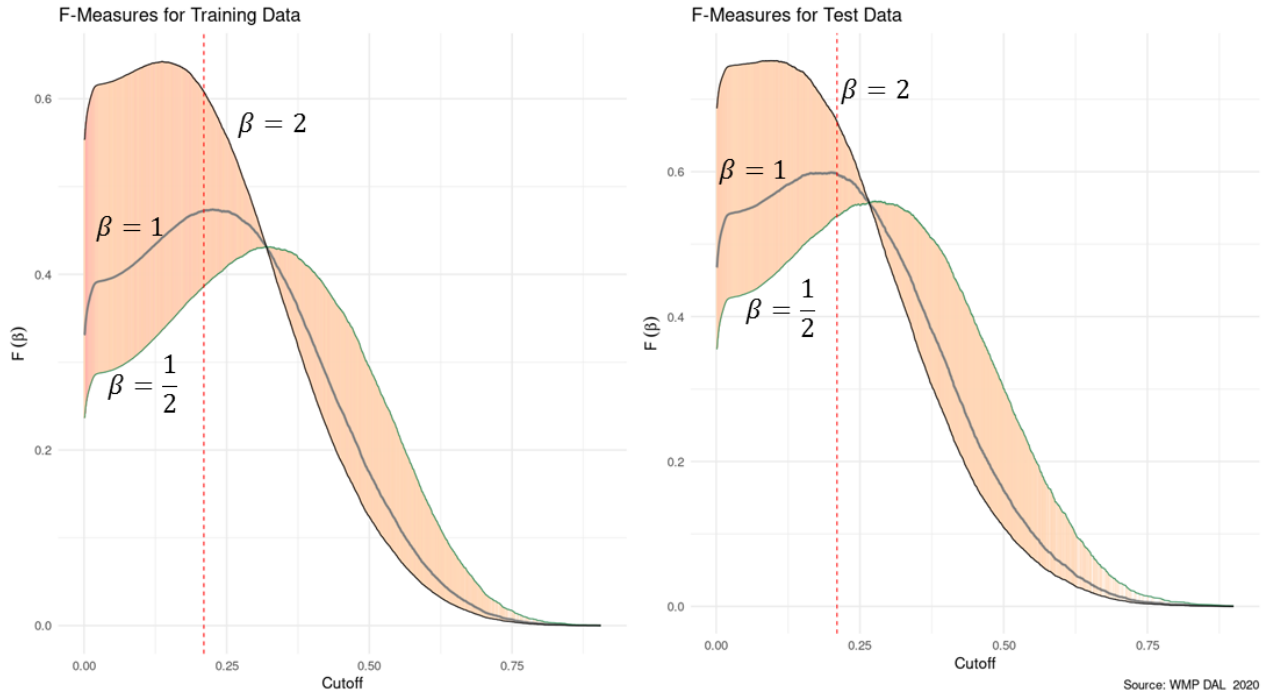


Figure 34 F Measures Outstanding Offenders (IPV)

The models for the Outstanding Offenders show good characteristics in terms of their explanatory power and stability of outcomes. The AUCs are all about 0.75-0.8. This, in conjunction with the other metrics suggest a robust set of models with good explanatory power.

7.3 Successful vs Unsuccessful Investigation

The second analysis looked at the successful outcome of an investigation. In many cases, as in the situation of evidential difficulties the case is unsuccessful for reasons beyond the officers' control. The modelling took a similar route to that discussed above. The model's first step is an assessment of what drives success. It should be noted that a simple assumption of the failure of the investigation gives a very high accuracy as a forecast. The initial model gives a number of important factors. Those incidents that are considered unsuccessful are then modelled using the victim support or evidential difficulties as the dependent variable. The basic data is a subset of the first step, conditioned on the lack of caution or charge in the first round. This gives an insight into what potentially characterizes cases dropped due to evidential issues or victims withdrawing support.

The successful - unsuccessful model was modelled initially using the cross-validation techniques with the nuisance parameters being optimized using Bayesian optimization techniques (see Technical Details). These parameters were used to estimate a model for the first step. This model was used to set the optimal cut-off based on the maximum Youden score calculated from the fit on training data set. The predicted failures in the data set were then used to measure the effect of the factors on victims no longer supporting or evidential difficulties.

The metrics are presented below as the important factors and variables are discussed in Section 4.

7.3.1 First Stage: Success or Unsuccessful Investigation

The first step of the model is to consider the factors that influence the successful outcome of an incident. The coefficients are presented as odds or log-odds, representing the increase in odds of something happening in the case of positive coefficients.

The first model is that of whether the incident will lead to a success (a caution or charge). This is an unbalanced sample in that as has been pointed out previously the percentage of successful cases is about 1 in 10. In essence, this means that as a base scenario rolling a ten-sided dice for all outcomes apart from 1, the outcome will be unsuccessful. This is the metric that should be considered when looking at the metrics of the initial model. Using a 10-fold cross-validation and Bayesian optimization for the hyper parameters, the model was estimated on the training data with metrics calculated on the test data as a measure of the model's fit. The ROC and Precision- recall curves are presented below. These show that the model is predictively successful which is taken as a measure of how successful the model is. The AUCROC for the training and test sets are 0.954 and 0.953 respectively. This is an improvement over the 90-10 pure luck. The Youden index, which gives the optimal cut off for the training and testing sets are also plotted on the ROC curves. The precision-recall graphs also add the hypothetical outcome by luck for the unbalanced sample as well as for the balanced sample (for reference). The red dashed horizontal line represents the degree of imbalance in the data.

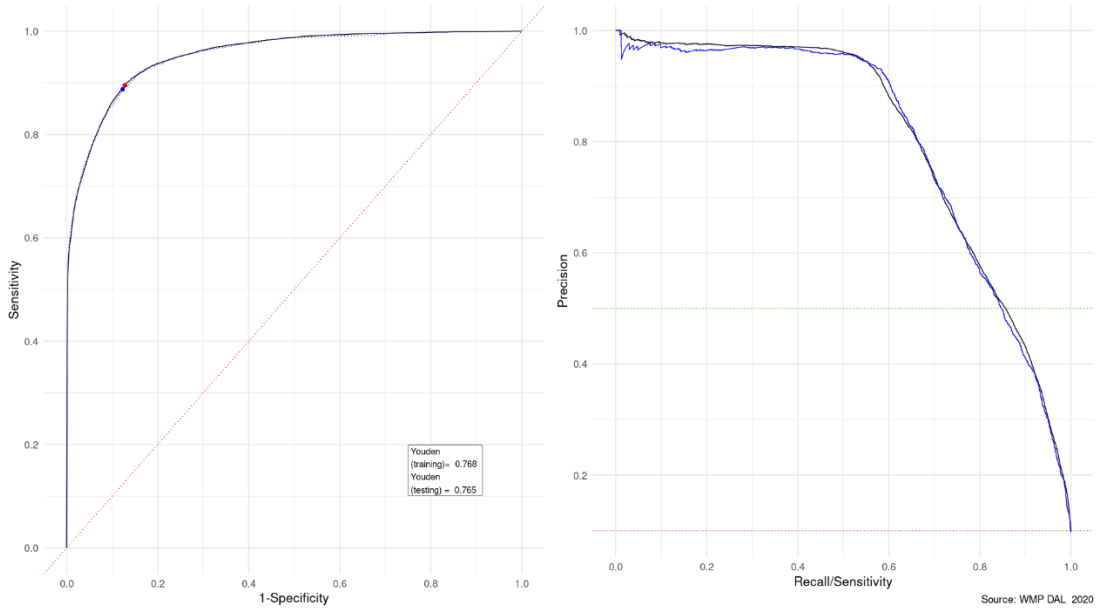


Figure 35 Model Metrics for Successful Incident Conclusion Model

The KS-statistics and plots reflect the imbalance in the data. In both the training and test data sets, the KS-statistic is around 0.77. This suggests a good degree of separation between the successful and unsuccessful outcomes.

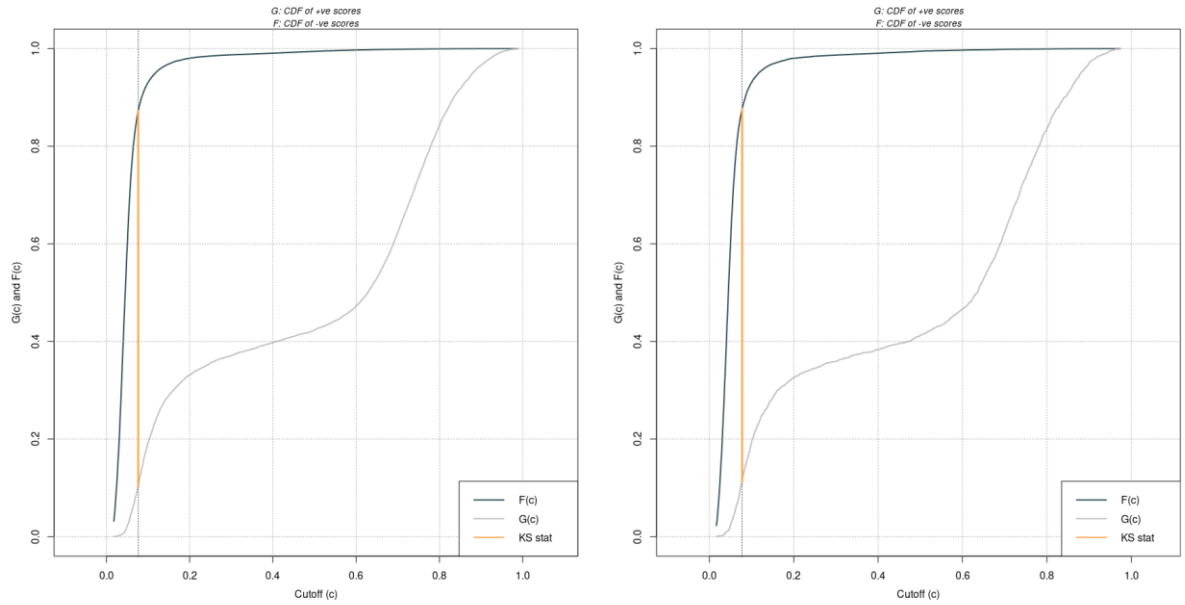


Figure 36 KS Charts for Successful Outcomes

Given these metrics, the estimated coefficients give us an understanding of what leads to successful outcomes for the incidents. These are estimated by the LASSO/ elasticnet algorithm. A positive coefficient reflects an increase in the odds (or log odds) of a positive outcome to the case.

The optimal cutoff based on the Youden score and the F1 score using the whole data set. This is in effect predicting which cases are going to be 'unsuccessful' which would

become the data for the second step which looks to model the specific issues with the incidents. The whole data set is required to be selected on this cut-off.

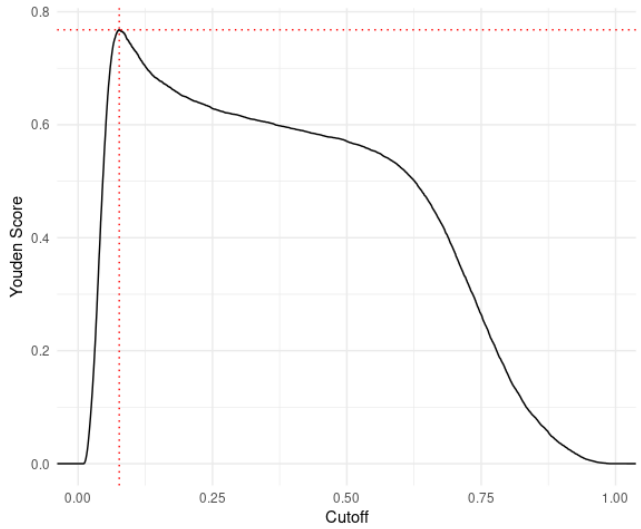


Figure 37 Choice of Cutoff for Secondary Model

The F-scores for this model are presented below. The Youden score cut-off is at the level where the false negatives are minimized, that is cases that should not be considered unsuccessful are not. The emphasis is on successfully categorizing the successful outcomes.

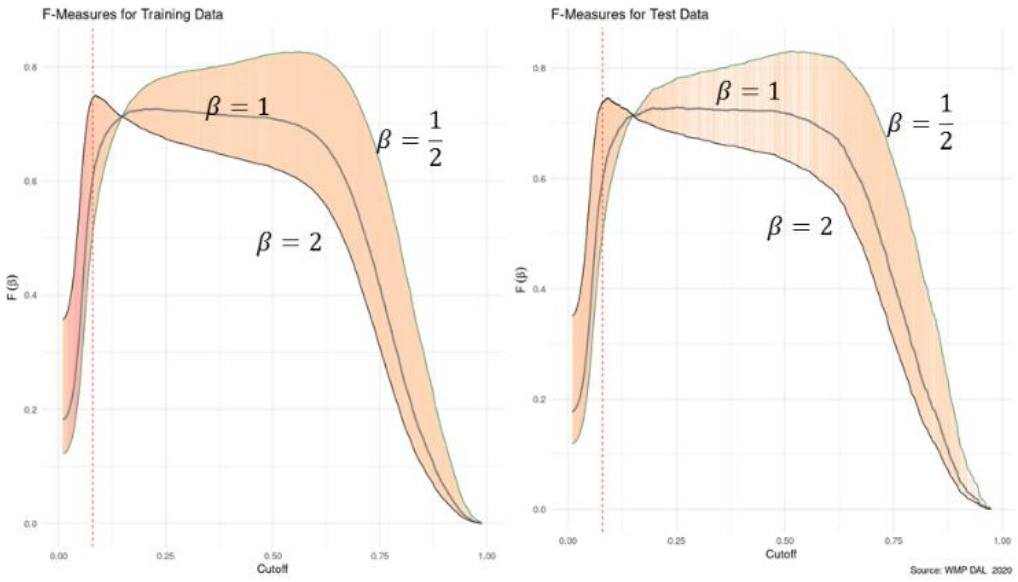


Figure 38 F Measures Successful Outcome Model

7.3.2 Second Stage: Evidential or Victim Difficulties

This model used the cutoff above, 0.0765248, to ascertain a predicted success[9]. Of those predicted to not succeed in achieving a caution or charge, this model examines the characteristics of those cases where the victim ceases co-operation or there are evidential difficulties. Again this was cross validated and the metrics calculated. In this case, these difficulties were considered as the positive outcome, i.e. the factors that have positive coefficients are likely to increase the odds of there being such a problem.

The usual model metrics are presented below. The training set had an AUCROC of 0.926 and the test set one of 0.925.

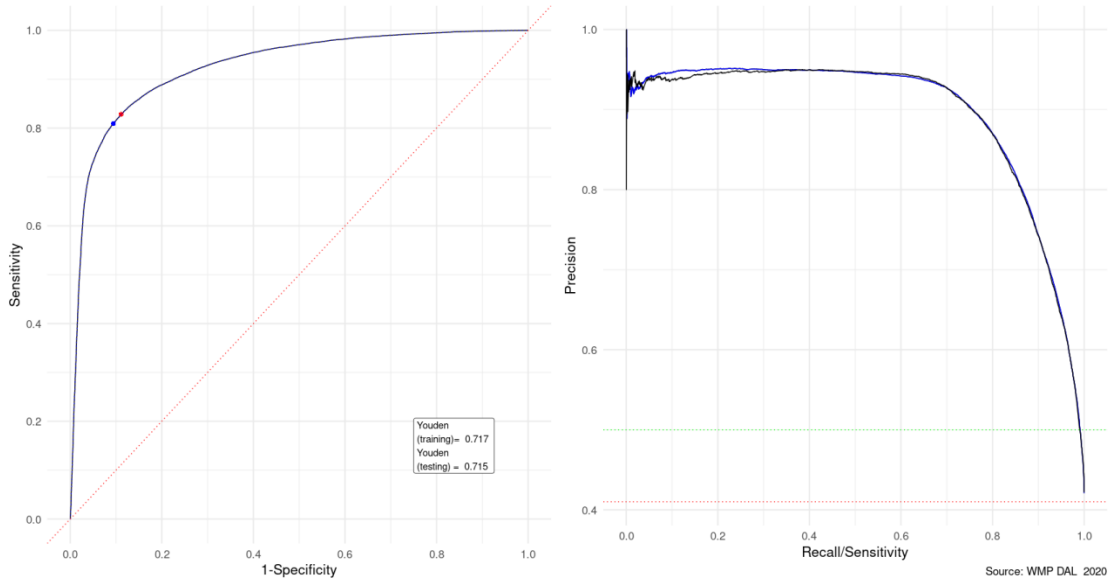


Figure 39 ROC & Precision-Recall for the Evidential Difficulties & Victim Withdrawal Model

The model also considered the optimal cutoff for the outcomes and the associated KS plots. These are presented for the training and test cases in Figure 40. These demonstrate good separation of the two distributions and that the model discriminates between the two outcomes well. The statistic for the training set is 0.717 and for the test set 0.715.

[9] The issue of sample selection (Heckman (1977)) is not considered as an issue in this case. The dependent variable has changed between the first and second stages and the estimation technique's interaction with the inverse Mills ratio has not been considered in the literature. In many regards, the statistical biases introduced, if they exist, can be dealt with inside the regularized regressions.

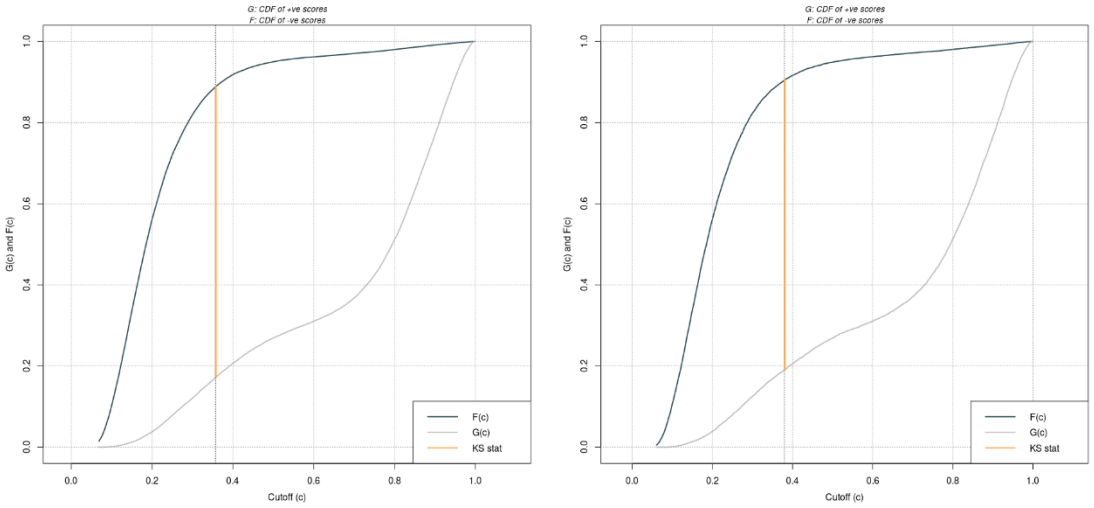


Figure 40 KS Chart for the Evidential Difficulties & Victim Withdrawal Model

Again looking at the F- measures, we can see that the cut-off for this model of 0.36 gives a good overall balance between the precision and recall.

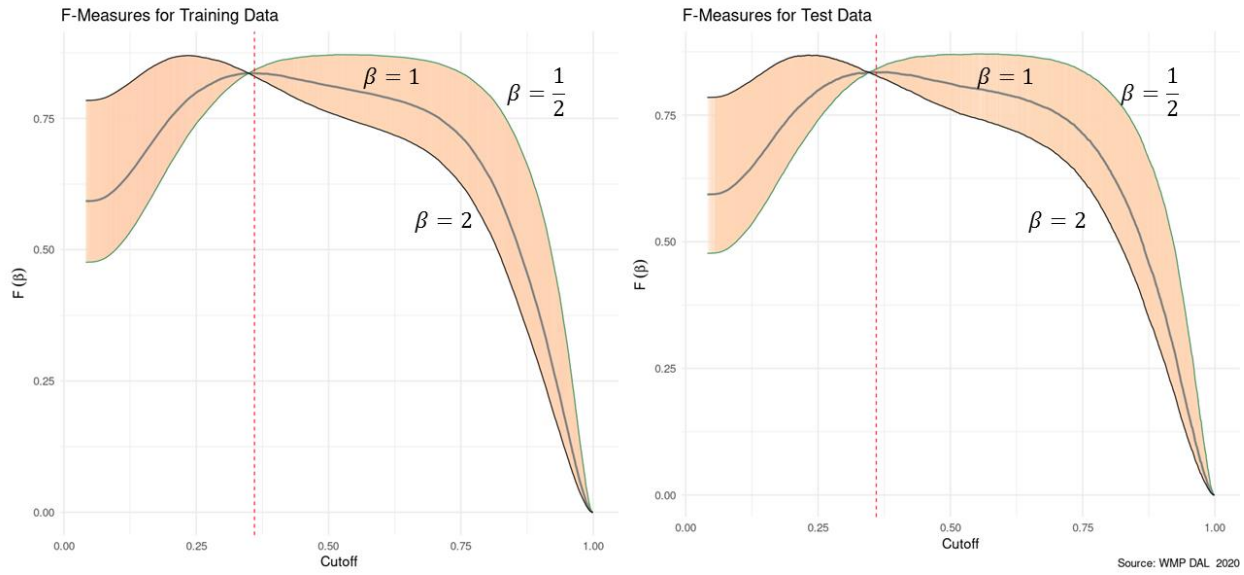


Figure 41 F-Measures for Evidential Difficulties Model

Each model's metrics suggest that they meet the requirements for sufficient explanatory power and are generally well balanced. There would be a possibility of tuning the models more to take advantage of a different requirement in terms of precision and recall, but on the whole the models perform well in and out of sample.

The outstanding offenders' models are as expected less able to explain the next offence, however they are consistent with the literature as described in the Section 4 where the coefficients are described fully and the narrative associated with the models discussed.

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1 Technical Appendix

A number of techniques were used in this study. A brief description of the approaches are useful in the understanding of the results and the meaning of the outcomes. The techniques described and used are:

1. Regularized Logistic Regression
2. Directed Acyclical Graph
3. Bayesian Optimization

1.1 Regularized (Logistic) Regression

One of the main problems with estimating the effect of one variable on another is that it is important to include only variables that are truly important or influential. We may not know for sure which variables are the most important. Statistical hypothesis testing *can* in certain circumstances be helpful, however the most effective method of variable selection is the use of a regularization term. This seeks to *pull* the coefficients towards zero, unless there is good evidence in the data that it should not be. There are a number of different (and related) methods of doing this. The two most widely used are ridge regression and LASSO with their combination, elasticnet, being a third. The method uses a regression with additional terms added to the estimation. This holds irrespective of it being a "normal" regression or a generalized linear model such as a logistic model. The closer α is to 1 the nearer the model resembles the LASSO regression rather than the ridge model. The estimated coefficients for a normal OLS regression are given by a path described by the equation below. For a logit type regression the underlying approach is the same.

$$\hat{\beta} = \text{argmin}(y - \beta^T X)^2 + \lambda\left(\alpha \mid \beta \mid^T 1 + \frac{1-\alpha}{2}\beta^T\beta\right)$$

$$\hat{\beta} = \text{argmin} - \log\left(\Pi_{y=+}p(x_i)\Pi_{y=-}(1-p(x_i))\right) + \lambda\left(\alpha \mid \beta \mid^T 1 + \frac{1-\alpha}{2}\beta^T\beta\right)$$

There is a problem of ascertaining the best values of the λ and α however a number of techniques such as cross-validation or optimisation can be used. The report used Bayesian optimisation and a direct derivative free algorithm to maximize the area under the ROC curve for the selection of the nuisance (hyper-) parameters.

In the modelling of the "successful" cases, a multinomial logistic regression is used. This differs from the approach above in that there are more than two possible outcomes. Though there is a degree of ordered-ness with the outcomes with the victim support & evidential issues as a half-way house between success and failure, the multitude of reasons this might happen are such that this model makes assumptions about the outcomes specifically Independence of Irrelevant Alternatives which enforces a di- or trichotomy of choice amongst the outcomes such that adding an extra outcome will have an impact equally across all outcome probabilities. Though it is possibly unlikely that this assumption holds with the data available, there are two considerations. The first is technical, a nested logistic equation with regularization on this scale is not trivial. The second is that it is not clear how the removal of the victim support variable would affect the outcomes- some investigations would move to successful potentially and thus the impact is not easy to specify *a priori*.

The probabilities are measured from a baseline category. The essential interpretation is the same, except that there is always a reference back to the baseline case. Thus two different outcomes are comparable only insofar as they have a common baseline. As before the outcomes are relative odds or probabilities.

1.2 Directed Acyclical Graphs

A (mathematical) graph is not the normal image one has of an Excel chart. In the case considered here, a graph is a set of corners or nodes and connections or paths. The nodes represent the variables and the connections the relationships between them. Not all variables will connect directly to the variable of interest, the dependent variable. As the graph is *directed*, there are directions associated with the connections and it is acyclical because variables are ordered: an early node leads to a later one but there is no returning. There is a degree of understanding about the structure of the DAG initially- we know what cannot cause what, e.g. Age cannot be a cause of Gender. These paths are blacklisted to ensure that they are not included in the relationship and likewise some relationships are known *a priori* and so are whitelisted.

These graphs are representations of the conditional dependence between the variables and the *d*- connection (connected directionally in the graph) of the variables helps us to determine possible causal links in addition to the identification of independent variables. The data is used to estimate a structural equation for each of the elements, giving rise to an adjacency matrix, which has natural parallels to the equivalent geo-spatial matrices. Where this approach differs from that, is that the acyclical nature of the graph requires constraints to be imposed. Combining these constraints with other constraints used in regression to select variables allows us to select only the most important nodes rather than all of them which can hide the underlying story inside the data. Examples of these graphs can be seen in the report. Specifically, the use of a LASSO-like penalty allows us to see how important each variable is for the dependent variable via a pathway of DAGs. The score for each step on the path is calculated for the likelihood estimate (following Aragam, Gu, and Zhou (2019)). The magnitude of the causal effects are based on the regression (be it OLS or multinomial, dependent on whether the child is continuous or discrete) of the parent nodes on to the child node.

1.3 Bayesian Optimization

There are a number of methods of finding global or local maxima (traditionally one might use Nelder and Mead (1965) or the like for a direct optimization without gradients). The algorithm used in the report is one termed *Bayesian optimization*. It can be thought of as a two-step process. The first step evaluates an approximation to the objective function and the second works out the next best step to evaluate. The objective function is sometimes called the maximand, that which is to be optimized. The first step is usually approximated by a Gaussian Process (equivalent of kriging). The second step uses an acquisition function that is an *easy* function to maximize. It represents a costing or loss associated with another (nearby) point. Using this method, the next point for the optimization is selected to minimize these costs. There are a number of different acquisition functions available.

This approach is used to score the cross-validated model with a decision based upon the Upper Confidence Bound, which is a utility approach (Srinivas et al. (2010)).

$U(x;\beta) = \mu(x) - \beta\sigma(x)$ where β is the trade-off parameter and $\sigma(x)$ is the marginal standard deviation of the function being maximised.

This approach gives an incentive for exploitation (evaluating points with a low mean) and discourages exploration (evaluating points with high uncertainty). The trade-off is based upon confidence bounds, commonly 99% (i.e.$\kappa = 2.58$) or 95% (ie $\kappa = 1.96$). Too little exploration and there is a danger of a local maximum being achieved, too much and there is danger of problems from the approximations of the maximand. There are a number of kernels that are used in the UCB approach. The kernel used here is the squared exponential kernel, which is a restricted form of the Matern kernel.

2 Data Dictionary

Note: most of these features were excluded as a result of the modelling.

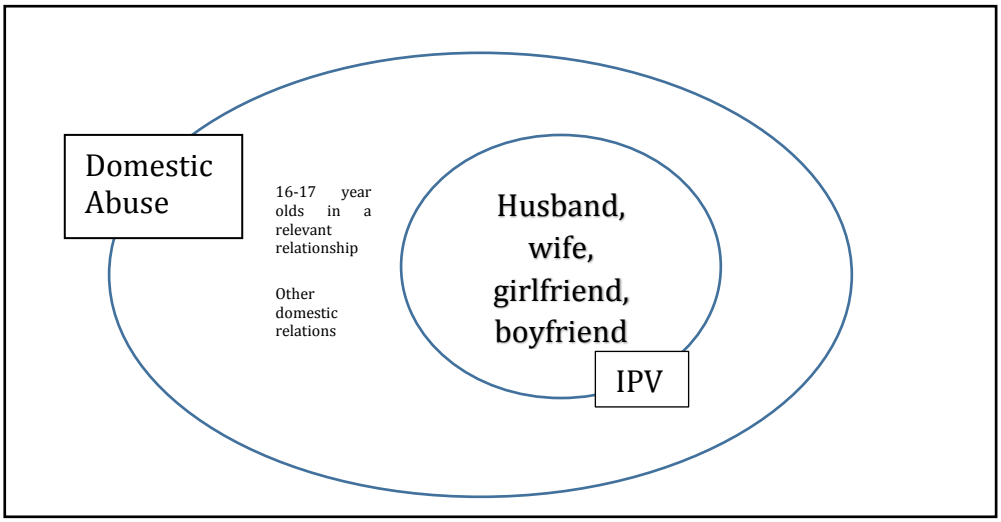
Feature	Description
area	Area
beat	Beat Code
easting	Geography
locale	Geography
northing	Geography
alc	Alcohol involved
argument	Argument occurring
Arrest_made	Arrest made
Ass_39	Assault 39 flag
Ass_47	Assault 47 flag
children	Children
Count_logs	Count of the logs entered for incident
critical_inc	Critical Flag
cuc_code	Clear Up Code
Dash_form	DASH
day	Day of week
disposal_code3	Disposal Code
drug	Drug mentioned or drug flags
ea_code	Ethnicity
ev_diff	Evidential Difficulty
Ex_Partner	Ex Partner involvement
focus	Officer Focus
forensics_sent	Forensics Sent to Incident
gang	Gang Mentioned
hate	Hate Crime Flags
honour	Honour Crime Flag
hour	Hour of Day
incident_date	Date of incident
incident_length_mins	Incident Length
INSP	Inspector Attended
lead_off	Lead Officer Calculation
LPU	NPU
mental	Mental Health involvement
month	Month
no_officer	No of Officers on Case
No_Previous	No of Previous Incidents
Non_mol	Non Molestation Order
number_of_arrests	Number of Arrests made
number_of_updates	Number of log updates
Outstanding	Whether offender is outstanding (PPU usage)
PC	PC attending

PCSO	PCSO attending
Persist_N	Persistent offender
PPU_Safeguarding	PPU Safeguarding flag
Response	Response Classification
sex	Gender
SGT	SGT attending
Sig_mark	Significance marker
SUPT	SUPT attending
taser_q	tasers attending
Threshold_test	Threshold test met
time_at_incident	Time at incident
time_occured	Time incident occurred
time_to_arrive	Time taken to arrive
tod	am/pm
vict_supp	Victim Supports Investigation
Violence	Violence Used
Weapon	Weapon Used
YEAR	Year
Age_at_inc	Age at incident
Age_group	Age group
DEF_less_than_TIME_SCALE_CRIME	Offender defendant in crime type inside time scale
SUSPECT_less_than_TIME_SCALE_CRIME	Suspect defendant in crime type inside time scale
VICTIM_less_than_TIME_SCALE_CRIME	Victim defendant in crime type inside time scale

Addendum [these were added to the original version, following comments from the committee]

Intimate Partner Violence vs Domestic Abuse

Domestic Abuse (DA) and IPV were used interchangeably, IPV is not specified in our data. IPV is violence between *intimate* partners rather than Domestic Abuse/ Violence, which can include any member of the household. The literature tends to focus often on IPV, though terms such as Domestic Abuse or Domestic Violence is commonly used. There is no necessity of intimacy in DA. The report looked at DA rather than only IPV.



'Successful' outcome

In April 2013, the Home Office[10] introduced the new crime outcomes framework, replacing a more narrowly focused one based on 'detections'. This new framework provides greater transparency on how all notifiable crimes recorded by the police are dealt with. The previous 'detections' framework gave only a partial picture of the work police do to investigate and resolve such crimes. The outcomes framework was designed to be more victim focused.

The common usage of the term 'successful' outcome in policing usually refers to criminal justice outcomes which mirror the old 'detected' definition. Therefore, in this analysis clear up codes for Caution, Charge or Community Resolution were used as the criteria for 'successful' outcome.

Crime Outcomes Framework (Home Office)	
Outcome	**Description**
1	Charge/Summons
2	Caution - youths
3	Caution - adults
4	Taken into consideration (TIC)
5	The offender has died (all offences)

[10] Home Office: Crime outcomes in England and Wales

https://www.gov.uk/government/statistics/crime-outcomes-in-england-and-wales-2019-to-2020

6	Penalty Notice for Disorder
7	Cannabis warning
8	Community Resolution
9	Prosecution not in public interest (CPS) (all offences)
10	Formal action against the offender is not in the public interest (police decision)
11	Prosecution prevented - named suspect identified but is below the age of criminal responsibility
12	Prosecution prevented - named identified suspect identified but is too ill (physical or mental health) to prosecute
13	Prosecution prevented - named suspect identified but victim or key witness is dead or too ill to give evidence
14	Evidential difficulties victim based - named suspect not identified but the victim declines or is unable to support further police action to identify the offender
15	Evidential difficulties - named suspect identified and the victim supports police action, but evidential difficulties prevent further action
16	Evidential difficulties victim based - named suspect identified - the victim does not support (or withdraws support from) police action
17	Prosecution time limit expired - suspect identified but the time limit for prosecution has expired
18	Investigation complete - no suspect identified. Crime investigated as far as reasonably possible - case closed pending further investigative opportunities becoming available
19	National Fraud Intelligence Bureau field (**NFIB only**). A crime or fraud has been recorded but has not been allocated for investigation because the assessment process at the NFIB has determined there are insufficient lines of enquiry to warrant such dissemination.
20	Further action, resulting from the crime report, will be undertaken by another body or agency subject to the victim (or person acting on their behalf) being made aware of the action to be taken (from April 2015)
21	Further action, resulting from the crime report, which could provide evidence sufficient to support formal action being taken against the suspect is not in the public interest - police decision (from January 2016)
22	Diversionary, educational or intervention activity, resulting from the crime report, has been undertaken and it is not in the public interest to take any further action (Voluntary from April 2019)

Outstanding Offenders

In this report, an 'outstanding offender' refers to when a crime has been recorded where there is a named suspect but where no arrest has been made. In WMP these suspects are commonly referred to as 'outstanding offenders'. The identity of the suspect who needs to be arrested is known in Domestic Abuse cases; whereas this is less likely in other offences such as burglary. The model used in the analysis does not assume guilt.