Candidate Number: Pol1125

Colin Paine

Wolfson College

Supervisor: Dr Barak Ariel

SOLVABILITY FACTORS IN DWELLING BURGLARIES IN THAMES VALLEY

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Abstract

This study replicates previous research aimed at identifying those factors associated with solved residential burglaries. This study analyses all cases of residential burglary in Thames Valley between 1st March 2010 and 31st October 2011.

Analysis identified a host of factors correlated to solved cases, but of these just 12 are recognised as effective solvability factors. This study confirms the findings of previous studies in identifying the following variables as effective solvability factors, a) fingerprints recovered; b) offender seen; c) witness recorded; d) offender's vehicle sighted; e) offender disturbed; f) description of the suspect is recorded. However, this study advances the list of known solvability factors further by identifying six new variables that were traditionally overlooked and some of which result from advances in science, these are a) footwear marks; b) DNA; c) citizens' reports on the burglary being in progress, d) the stolen property is recovered; e) articles left the scene by the offender and f) whether a vehicle was stolen in the crime. The magnitude of these effects, measured with standardised mean differences, suggest that the presence of these factors is strongly associated with solvability, some with very large effect sizes often exceeding Cohen's d = 1.0.

The analyses suggest that over 50% of all burglaries had one or more solvability factors present, and having one or more of these solvability factors was associated with over 60% accuracy in detection. If used as a screening tool, this solvability analysis approach Thames Valley Police would be required to investigate just over 40% of cases for investigation, as all other cases are unlikely to be solved.

The policy implications of using solvability factors analysis is clear; implementing this approach as a screening tool enables police leaders to choose a suitable cut-off point that will allow an optimal balance between resource usage and detection levels.

Sensitivity analysis identified that the geographical distribution of burglary solvability factors across Thames Valley is not even. The policy implication being that differential targets may offer a fairer and more effective incentive to police area commanders instead of force wide targets.

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INTRODUCTION

Burglary occupies a unique place in the public consciousness. It is a crime that is both sufficiently common to cause widespread public anxiety and at the same time serious enough to affect victims both financially and psychologically. During the 1980s and 1990s burglary rates in the UK rose inexorably pushing it to the top of the policy agenda. The case of Tony Martin, the anxious eccentric loner who shot two teenagers that broke into his rural farmhouse in August 1999, epitomises both the extent of public concern and the widespread empathy with his extreme course of action. Despite some respite from rising burglary levels over the past few years the British Crime Survey is now showing worrying signs that burglary may again be on the increase.

The police as the primary investigation agency for offences of burglary are under a duty to identify and bring offenders to justice. This is essential to ensure public confidence in the criminal justice system, to meet victim's expectations and to exert a deterrent effect on would be offenders. Nevertheless, burglary is an offence with stubbornly low detection levels. Few burglars are caught and even fewer are convicted of their crimes.

The literature on burglary solvability has consistently identified that certain factors are strongly correlated with positive case outcomes. These correlations enable judgements to be formed soon after the initial attendance by a patrol officer as to whether the case will be subsequently solved with a high degree of predictive accuracy. This research seeks to replicate these studies, but in a contemporary UK

context to determine the extent to which advances in forensic science and technology may have changed the way burglary is now solved.

To date there has been little explicit study of the solvability of attempted burglary. This study therefore seeks to analyse those factors associated with attempts and analyse any differences in the solvability of completed and attempted burglary. This need is more pertinent now, as the existing literature is nearly three decades old and almost exclusively in an American context.

Effect size analyses on each of the associated variables, as well as overall summary effect sizes will be used to measure the magnitude of the differences between solved and unsolved cases, in terms of the prevalence of these factors. This approach will enable the identification of the strongest associations, whereby these variables can then be tested to determine the extent of their predictive accuracy.

This dissertation begins with a review of the existing literature on burglary solvability and identifies the limitations in the research to date. Having identified the research aims the dissertation lays out the proposed methodology for the identification, acquisition and analysis of burglary data. The dissertation then presents the results in terms of an effect size analysis and a predictive analysis of the proposed solvability model. In the discussion section I will comment on the research findings with particular reference to existing research and their practical implications.

LITERATURE REVIEW

Previous Research on Solvability Factors

The literature review begins with a discussion of the difficulty of detecting residential burglary owing to the paucity of evidence in most cases. The review will then examine the 1970 study by the RAND Corporation which was highly sceptical of the work of detectives and concluded that the solution of most cases is more dependent on the circumstances of the crime than any subsequent investigation. The review will contrast this with Eck's Triage hypothesis, the view that there are some crimes that might be solved if there are both the right circumstances and the right investigative actions are taken. The review will then discuss the role of case screening in the literature, and in particular, the Stanford Research Institute screening model. The review will then identify how the present study intends to meet the gaps in the existing research.

Residential burglary accounted for 12.59% of all crime in England and Wales in 2010/11 (Taylor and Chaplin 2011). The overwhelming majority of burglaries have an emotional impact on the victim. Nearly 90% of residential burglary victims in the UK experienced a negative emotional effect (British Crime Survey 2011). The most common emotional reactions being anger (53%), annoyance (43%) and shock (41%). However, for some victims the emotional impact is even greater with 15% suffering subsequent anxiety and 13% episodes of depression. It is therefore no surprise that victim's levels of worry remain high 18 months later and that as many as 30% of victims "seriously consider moving home afterwards" (Coupe and Griffiths 1996).

Detecting crime is central to the police mission. It is critical to ensure that offenders are brought to justice and held to account for their actions. The

investigative process is essential to maintaining public confidence in the police and also exerts a not insignificant effect in deterring potential offenders from committing crime (Maguire 2003). It may also produce a secondary crime reduction effect through the arrest and incapacitation of offenders who would otherwise go on to commit crime (Jansson 2005). For these reasons the ability to detect crime is one of the key measures of UK police performance.

Beyond these public perceptions of the role of the police lay fundamental questions about police work and their ability to investigate and solve crime. Interestingly, prior to the 1970s there was virtually no research into police investigative practices. So rare was research in this area that some refer to investigative work as “cloaked in mystique” (Greenberg et al. 1977, p xv). The detective inscrutability as crime fighters was reinforced through popular TV dramas and movies. This changed with early studies into the investigative processes. For example, it was shown that the actions of the first patrol officer on scene were critical to case solution and furthermore, a large proportion of subsequent investigative time was inefficiently spent on investigations that were near impossible to solve (Issacs 1967; Greenwood 1970). This and similar realisations about the dynamics of crime detection and solvability opened the door to a host of questions about when crime can and cannot be solved.

The complexity around detection rates is even greater for property crimes, with burglaries in particular being overwhelmingly lower than most other crime categories. Interestingly, this is a global phenomenon. In the case of Thames Valley Police, for instance, detection rates were just over 15% in 2011/12, which are somewhat higher than the national average detection rate across England and Wales of just 13.3% (Taylor and Chaplin 2011).

While some of the older literature in the context of police-communities relations suggests institutional biases as a key factor to these low detection rates (Waegel, 1982), it now commonly argued that it is in fact the scarcity of evidence in these cases that is the reason for low detection and low solvability (Coupe and Griffiths 1996, p vi). At least until the introduction of more advanced forensic capabilities, the police would find it very difficult to trace burglars, when the offender and victim did not know each other or did interact during the burglary event. This of course is in contrast to violent crime and robberies where offender-victim interaction is almost certain, which increase the likelihood of identification of the offender. Burglaries, however, are “furtive crimes that occur in the dead of night in private places when the victim is not present and are unlikely to produce either witnesses or useful information” (Skogan and Antunes 1979, p219). This is why many researchers have suggested – and still do – that “burglary is a crime that is virtually impossible to solve” (Skogan and Antunes 1979, p220), because "the police investigator is forced to rely on a wide variety of time-sensitive fragmented information to come up with a suspect who can be legally charged with a specific crime." (Greenberg et al. 1973, p10). More recent studies have echoed similar concerns, saying that the biggest obstacle in these offences is identifying an offender (Robinson and Tilley 2009).

Even with advancements in science it is still the case that most offenders go undetected. Most burglars scrupulously check for occupancy before offending and take extensive steps to avoid being witnessed (Wright and Decker 1994). In fact, it has been suggested that burglary is so difficult to detect that those who get caught are not typical offenders, but are a subset; the particularly ineffective ones (Rengert and Wasilchick 1985).

The RAND Corporation Study

Early studies expressed some cynicism about the police's ability to solve crime, suggesting that detective work was not characterised by hard work and clever thinking leading to case solutions, but rather "the cases that get cleared are primarily the easy ones to solve" (Greenwood et al. 1976, p112). A nationwide study by the RAND Corporation identified that most arrests resulted from a witness who was able to identify the offender, patrol officers making an arrest at the scene or through routine procedures. They concluded that just 2.7% of case clearances resulted from clever detective work and the remaining "97.3% of cases would be cleared up no matter what the investigators do" (Greenwood et al. 1976, p7). This study was highly critical of the work of detectives, although the study itself was subsequently criticised for its methodology. Of the 153 police departments studied only 50% responded to the postal survey and where observations of investigation were conducted the sample sizes were small. Nevertheless, this study lent weight to Greenwood's initial conclusions that whether or not a crime is solved is largely due to the chance circumstances of its occurrence and that investigations contribute little to the outcome. This approach became termed the circumstances-result hypothesis (Eck 1983). Such an approach has received some support by subsequent studies. Indeed, Coupe and Griffiths (1996, p. vi) concluded that "most primary detections were attributable to activities carried out by the first officer at the scene". This was often the result of police detaining the offender at, or near the scene, or as a result of questioning witnesses at the scene. Other research seems to support this assertion (Brandl and Frank 1994). When burglaries are solved it is because the offender was either caught in the act (14%), apprehended near the scene (12%), shopped by an informant (12%), traced through stolen property or property left at the scene (10%),

were seen acting suspiciously (8%) or through a witness description (7%) (Farrington and Lambert 2000). Consequently these studies have shown that there is not a linear relationship between investigative effort and case solution; rather, whether or not a case is solved is largely influenced by the circumstances of the crime.

It follows that not all crimes have an equal likelihood of being solved. Detection rates are constrained by the circumstances of the crime from the very outset. Some crimes are "self solving" in that all the police have to do is turn up and follow some routine procedures to bring the offender to justice (Greenwood et al. 1976). Other crimes are near impossible to solve even if substantial resources are invested in the investigation because the circumstances are such that there is no information or leads to be followed (Issacs 1967; Greenwood 1970; Skogan and Antunes 1979).

The Triage Hypothesis

There is, however, a third category of crime. Eck (1983) identified that the methodology of the Rand Corporation study had not identified the context in which the crime occurred and the *stage* at which information was obtained. It might be that some of the information that led to case solution was only found as a direct result of investigative skill and effort. On this basis he questioned the conclusions drawn that crimes fall into one of two categories and that investigators play little part in crime solution. He proposed an alternate 'triage' hypothesis that between these two extremes are cases that *might* be solved if there are both the right 'solvability factors' *and* if the right investigative actions are undertaken with sufficient effort. This is the category of cases where police investigation would have the greatest impact. Eck's analysis of 3,360 burglaries identified a real relationship between follow up investigations and the likelihood of a subsequent arrest. This later finding supported

the triage hypothesis and the view that both preliminary and secondary investigations contribute significantly to case solution. He concluded that both patrol officers and detectives contributed to the solving of crime. Given this spectrum of solvability it has raised the legitimate question of whether all crimes should attract equal investigative effort.

Efficiency would suggest avoiding resourcing crimes that, statistically speaking, are impossible to solve (Greenberg et. al 1973; Eck 1979; Coupe and Griffiths 1996). Given that only a small percentage of all burglaries are detected this would indicate a high level of poor investigative resource usage by most police forces. On average each burglary attracts 3.7 hours of investigator time (Mawby 2001). The Rand Corporation study found that 40% of investigators time spent on casework was wasted and that 93% of investigators time was spent on activities that do not directly lead to solving crime (Greenwood et al. 1976). Given that around 17% of police resources are dedicated to the investigative function there is a real imperative to optimise value for money. Eck rightly stated that “it takes tremendous resources to investigate all burglaries, particularly when few are solved” (Eck 1983, p10). However, to avoid resourcing unsolvable crimes beyond the initial attendance of the patrol officer requires the ability to accurately predict the case outcome from the initial facts of the case.

Observational studies have found that detectives and supervisors will frequently conduct an informal, or clinical, case screening process in order to focus on the most promising investigations (Waegal 1982; Brandl and Frank 1984; Coupe and Griffiths 1996). The reality is that not every crime can receive the same level of investigation, unless the level of investigation is to be very cursory indeed. Even where the formal policy is to screen in all burglary investigations the reality is that

detectives will use their intuition and experience to carry out some level of case screening (Eck 1983). Many UK forces adopt a policy of case screening following the preliminary investigation, but these are not based on a statistical model of solvability, rather they are predominantly based on officer's judgements of solvability, seriousness and public interest (Gill et al. 1996). Therefore, the question is not whether case screening should occur, but whether it should occur on the basis of clinical or statistical judgements. Without a statistical screening model the collective judgements of officers will form the basis of a screening model. Such models will vary from place to place depending on the prevailing culture, wisdom and experience of the officers. This can result in inconsistencies with cases being screened out in one place and investigated in another (Coupe and Griffiths 1996). Indeed, such an approach also risks officer's prejudices entering the decision making process (Waegel 1982). There is a growing body of evidence that statistical judgements are frequently superior to those of even experienced clinicians (Kahneman 2011). It follows that a statistical case screening model might offer the holy grail of the ability to eliminate wasted effort with minimal detriment to detection rates.

The Stanford Research Institute study

The Stanford Research Institute (SRI) study into burglary solvability by Greenberg et al. (1973) sought to use statistical techniques to identify those informational elements of the initial investigation that are strongly correlated to the subsequent burglary clearances. The study used discriminant analysis of 2000 burglaries from across 6 police departments in Alameda County, California and identified 170 information elements, although just 6 were significantly related to the likelihood of subsequent clearance (Greenberg et al. 1973). It is "the elements with greatest disparity of occurrence in the cleared versus uncleared cases that

potentially have the most effect on the solution probability of a burglary case." (Greenberg et al. 1973, p37). These information elements were then tested against a new sample of 500 burglaries on the basis of information available during the preliminary investigation (i.e. following attendance by a patrol officer, but prior to work by an investigator). Each information element was weighted to reflect its predictive value. The total of the weighted elements gave a solvability score that could predict the case clearance with 67%-92% accuracy. The variation in predictive accuracy was attributed to the different department's "inconsistent policies governing the criteria by which a burglary case was cleared." (Greenberg et al. 1977, p.xxvii). Under this model whether or not a burglary is allocated for investigation depended on whether or not the solvability score exceeded a statistically derived threshold.

The SRI study identified a range of different variables that were related to the likelihood of subsequent case clearance, but found that just 6 "statistically dominate" (Greenberg et al. 1977, p iii) this relationship. These were i) the time range of the offence, ii) witness report of offence, iii) on view report of offence (i.e. was it discovered by police), iv) usable fingerprints, v) suspect information (description or name) and vi) vehicle description. Table 1 below lists these and other variables

The first SRI variable was the time range of the offence, that is, the time range between the earliest estimate of when the offence occurred and the latest estimate (Greenberg et al. 1973). This relationship might exist because the smaller the window in which the offence occurred the greater the likelihood that evidence will be recovered leading to suspect identification. However, Eck (1979) suggested that it was the time delay between the offence being discovered and the arrival of the police that was most significant because a rapid response would allow evidence capture. The relationship between the police response time and the likelihood of

identifying the offender has received considerable attention in the literature. Research has identified the existence of a relationship between quicker response times and an increased likelihood of arrest (Clawson and Chang 1977), however this relationship may only exist in cases in which the caller has some involvement rather than cases which are discovered some time after the event (Bieck and Kessler 1977). This finding relates not only to the increased likelihood of catching the offender at scene, but also to a greater likelihood of locating witnesses and other evidence. For offences reported as in progress catching burglars in the act is a surprisingly important method of crime detection as up to 43% of all burglary detections are obtained this way (Coupe and Griffiths 1996). Indeed, it may be that there is potential to solve even more burglaries this way as perhaps just one in ten burglaries reported as being in progress are solved this way (Blake and Coupe 2001). Interestingly whether the time range of the offence is understood in Greenberg's or Eck's sense made little difference to the outcome of Eck's replication (1979).

Table 1: SRI Burglary Decision Model

SRI Burglary Decision Model (Greenberg 1973)	
Information Elements	Weights
Estimated range of time of occurrence	
Less than one hour	5
One to twelve hours	1
Twelve to twenty four hours	0.3
More than twenty four hours	0
Witness report of offence	7
On-view report of offence	1
Usable fingerprints	7
Suspect information developed, description or name	9
Vehicle description	0.1
Other	0
Total Score	
Instructions Circle the weights for each information element that is present in the incident report Add the circles weights If the sum is less than or equal to 10, suspend the case; otherwise assign the case for follow up investigation.	

The suspect information variable was identified as critical to the success of the any subsequent investigation (Greenberg et al. 1973). Interestingly he made no distinction between whether a full name was provided for the offender or whether a description was provided. In almost half of detected cases the public were able to either provide the police with very direct leads or were even able to name the offender (Burrows 1986). Surprisingly up to one fifth of all burglaries are committed not by strangers, but by an offender known to the victim (Burrows et al. 2005). Brandl and Frank (1994, p156) noted that “suspect information is the most powerful, if not the only, evidence consideration *vis-a-vis* the solvability of burglaries and robberies". The availability of suspect information has been identified as closely associated with solved burglaries.

The presence of a witness is closely associated with the likelihood of subsequent case solution. Almost 14% of primary detections are achieved as the result of information provided by witnesses (Coupe and Griffiths 1996). In cases where a witness is present 23% result in detections, whereas in cases where there is no witness just 2% result in detections (Stevens and Stipak 1982). House to house enquiries, which are effectively a subset of witness enquiries, are frequently fruitful, but are rarely conducted as widely and comprehensively as could be expected. This may be because many officers perceive house to house enquiries as one of the least effective actions in burglary investigation (Gill et al. 1996).

SRI Replications

The SRI study has been subject to replications to assess its validity and generalisability. Eck (1979) conducted an assessment in a highly powered study and retrospectively applied to 12,000 cases across 26 US Police departments. The SRI model was compared against police departments with no pre-existing screening

process and those with a non-statistically derived screening process. The SRI model was found to outperform both, accurately predicting the case outcome in 85% of cases. In this regard the SRI model was found to be more effective than screening based on intuition and experience and by assigning fewer cases it conserved more resources. Table 2 below lists the frequency of the occurrence of the SRI variables.

Table 2: Average Frequency of Information Elements for 26 Agencies in the Sample

Table 2
Average Frequency of Information Elements for 26 Agencies
% of cases within the samples
(Eck 1979, p19)

Information Elements	Mean	Median	Standard Deviation
Estimated range of time of occurrence			
Less than one hour	15.4	15.9	5.0
One to twelve hours	56.0	54.4	8.2
Twelve to twenty four hours	11.9	12.2	4.5
More than twenty four hours	16.6	16.7	5.3
Witness report of offence	10.0	8.0	7.4
On-view report of offence	1.1	0.9	0.8
Usable fingerprints	9.1	8.5	7.9
Suspect information developed, description or name	21.3	19.1	10.6
Vehicle description	2.7	2.5	2.1

Although the SRI model predicts burglary case outcome accurately, as would be expected there is some margin of error. Around 6% of cases were lost clearances or false negatives, that is cases that were actually solved, but would have been screened out by the model. Under the model (Table 3), 9% of cases were wasted

investigations or false positives, that is cases that were not solved but which would have been allocated for investigation under the model.

Table 3: Screening Model Accuracy: SRI Screening Model Accuracy (Eck 1979)

		Real Case Outcome	
		Case detected	Case not detected
Model Predicted Case Outcome	Case Detected	Correct Prediction (True positive)	Wasted investigation (9%) (False positive)
	Case not detected	Lost clearance (6%) (False positive)	Correct prediction (True negative)

It is important to note that the purpose of the SRI model was not to increase detection rates, but to improve investigative efficiency (Greenberg et al. 1973). Given

that a significant proportion of investigative effort is wasted on investigations that are unsolvable from the start (Greenwood 1970) it follows that an effective screening model can reduce wasted effort. Such an approach would allow greater regulation of detectives caseload. Burrows and Tarling (1982) found that there is a clear relationship between investigator workload and clear up rates. It follows that "if much of the paperwork for unsolvable cases were removed, it seems logical that detectives would have a better chance of clearing the smaller number of remaining solvable cases" (Williams and Sumrall 1982, p112). Consequently a lower investigative caseload may result in greater effort per case. If Eck's (1983) triage hypothesis holds true then it follows that greater investigative effort applied to a smaller number of cases should improve detection levels. This hypothesis gained some support from the Rochester system (Bloch and Bell 1976) which adopted an early case closure procedure and found that detection rates improved *without* an increase in resources. However, the conclusions that can be drawn from this quasi-experiment are limited because simultaneous changes to team structure may also have had an effect on detection rates. Nevertheless, Brandl and Frank (1994) found a clear relationship between the amount of investigator time applied to cases with moderate suspect information and case outcome. On the face of it this supports Eck's triage hypothesis as cases with stronger suspect information would require less effort and cases with minimal leads cannot be solved no matter how much effort is expended. Therefore, whilst the SRI model was principally designed to improve investigative efficiency it may be that improvements in effectiveness may also result. It is not the case that screened out crimes are of negligible value. The information from these crimes can still be used to analyse offence patterns or offender modus operandi. Indeed, it may

well follow that a great many screened out crimes are subsequently cleared up through secondary detections.

The Metropolitan Police experimented with the SRI model, but decided against implementation on the basis that it would result in a drop in arrest rates of up to 5% (Chappell et al. 1982). However, such an approach fails to acknowledge the level of managerial discretion available by setting the cut-point for use in the model. The SRI cut-point of 10 can be varied between 0 and 29.1 to produce a different balance between resource wastage and overall detection rates. A cut-point of 29.1 would result in no cases being assigned for investigation and therefore no resource would be wasted on failed investigations. A cut-point of 0 would result in full assignment of cases. As the cut-point increases the accuracy rate improves, but the level of lost detections also rises. By moving the cut-point police managers can determine the optimal balance between resource usage and detection levels (Eck 1979).

The SRI model is limited given the scientific development of its time. For example, it makes no reference to closed circuit television (CCTV) which is unsurprising as it has proliferated only over the past decade or so. In addition, forensic evidence now contributes substantially more than thirty years ago, and only ten years ago it accounted for to almost one quarter or all detections for volume crime (Bradbury and Fiest 2005). It is estimated that scenes of crime officers now attend 85% of burglary scenes and as such it is not unreasonable to suppose that the contribution of forensic evidence has increased considerably since the SRI model was developed. Given these investigative developments over recent years it is likely that the identified solvability factors have changed. With this in mind, we move forward to the present study.

Present Research Aims

Given the understandable limitations of earlier work, this study seeks to advance our understanding of solvability factors in three major ways. First, it is looking to assess which factors contribute the most to residential burglary solvability. Using descriptive analysis of solvability factors prevalence in solved and unsolved cases of burglary, the aim is to identify the variables most strongly associated with solved cases.

Second, the literature thus far has placed limited emphasis on modern forensic scientific advancements. The use of DNA, footwear marks, and similar remains of the offender that can now be used to identify the offender reliably and (arguably) more easily than before, have not been introduced in any of the published work on solvability factors analysis.

Third, this study uses an unusually large cohort of cases, which enables a more sensitive analysis of the solvability factors. The entire dataset of burglaries in a major force in England and Wales is used for the analysis, which provides a rich source of information, particularly for some variables that may only bear a small yet non-insignificant effect of case clearance.

Lastly, to the best of my knowledge this will also be the first time that an assessment of completed burglaries separate from attempted burglaries is carried out. Previous work only looked at completed burglaries, however a great deal of cases are closed as attempted though the criminal act was not fully materialised. Yet we can learn a great deal from these offences.

METHODS

The methodology will begin by defining burglary and determining the most appropriate outcome measure. The data for this study will be obtained from 4 seperate computer systems with start and end dates determined by the reliability of data capture and the inclusion of sufficient charged offences. This will produce a single dataset of 14306 burglaries within Thames Valley over an 18 month period. This data will then be subject to checks for quality of recording and systematic bias in missing data. Once complete the data will be subject to descriptive analysis for both completed and attempted burglaries by solved and unsolved cases. Each variable will be subject to effect size analysis and the most powerful variables will be used to form a solvability checklist which will then be tested for its predictive accuracy against the full data set.

Operationalisation of "Burglary"

The term burglary can have different meanings in different places and contexts. Even in the current UK context it can incorporate a substantial range of different acts from those based on deception, such as distraction burglary, to those based on violence, such as aggravated burglary. Prior to the theft act burglary had to involve breaking and entering. However, since burglary was defined in s 9 of the theft act 1968 it was no longer a requirement for there to be a physical break in, merely that entry to the premises was as a trespasser. Interestingly there is also no requirement under law for anything to actually be stolen for a burglary to occur, rather it is the intent of the offender that is critical (Mawby 2001). An attempted burglary, under the Criminal Attempts Act 1981, occurs when a person does any act that is more than merely preparatory to committing the completed offence of burglary. In the US context a burglary is defined as "any unlawful entry of a structure

to commit a felony or a theft" (Greenwood 1970, p5). The legislation together with the home office counting rules explicitly defines when an offence of burglary should be recorded (see appendix 1). These rules specifically include an inhabited vehicle or vessel, but exclude vacant properties where they are unfit for habitation owing to lack of connected utilities (Home Office 2011).

In contrast to the SRI research this study will specifically exclude burglaries to premises other than residential dwellings. This is because the solvability factors may well vary between commercial and residential burglaries. For the same reasons this study will also exclude distraction burglaries and offences involving violence against the occupants. The study will also exclude those offences that, after investigation, have been proved not to have happened on balance of probabilities. However, this study will include both completed offences of residential burglary and attempted offences.

Between "Detection", "Clearance" and "Solvability"

Burglary solvability studies have adopted different outcome measures. The SRI study used case clearances as the outcome measure of success. However, case clearances can vary considerably according to the administrative standards of the police department. Clearances were rejected by a number of studies as they are subject to "manipulation" (Bloch and Bell 1976, p7), "bias" (Greenwood 1970, p5) and distortion (Brandl and Frank 1994). Cases can be cleared in the absence of hard evidence on the basis of offender MO, location or other offence similarity. For this reason Greenwood concludes that "the number of cases cleared by an arrest in any unit is probably influenced by how important the unit commander feels his clearance rate is" (1970, p18). Consequently a cleared crime cannot be considered synonymous with a solved crime. Other studies have adopted arrest as the primary

outcome measure (Eck 1979, Bloch and Bell 1976). Clearances are primarily an administrative outcome and by contrast arrest is of greater operational importance. In a US context many arrests are preceded by obtaining charging authority from a prosecutor. However, in the UK many arrests are made on the basis of a *reasonable suspicion* the subject has committed an offence and many of these cases do not subsequently result in charges. Consequently, not all arrests are equally productive. Other studies (Williams and Sumrall 1982) have considered using conviction rates as the primary outcomes measure, but rejected this on the basis that too many other variables, such as prosecutor efficiency, are involved in bringing a case all the way through the criminal justice system to the point of conviction. A number of UK studies have adopted sanction detection as the outcome measure (Burrows et al. 2005, Donnellan 2010). That is detections that are associated with the imposition of a sanction on the offender. Such an approach resembles the US approach inasmuch as the prosecutor is the decision maker in most cases and the decisions are made against objective evidential thresholds. Owing to its operational meaningfulness and greater objectivity of decision making this study will use sanction detection as the primary outcome measure.

There is an important distinction between direct and indirect detections. Direct detections follow an investigation by police which leads to the identification of an offender. Indirect detections follow from direct detections, often by way of offences 'taken into consideration' (TIC). Offences are 'taken into consideration' when an offender is charged with an offence and asks for other offences to be put before the court. TICs are a common means of detecting volume crime. At a force level there is significant variation in the number of offences TIC'd, although nationally around one third of detections are achieved by means of TIC (Robinson and Tilley 2009). Around

40% of sanction detections for offences of burglary result from offences being 'taken into consideration' (Tilley and Burrows 2005). Given that indirect detections are obtained when there is insufficient evidence to charge it is likely that the solvability factors for those offences charged or cautioned by police differ significantly from those solved by means of TIC because for the most part, TICs are admitted by offenders when the police have insufficient evidence to charge. Consequently this study excludes TICs from the sanction detections analysed as the case outcome.

Data Sources

The data will be drawn from the Thames Valley Police crime recording system (CEDAR), the investigation management application (IMM), the incident resourcing system (Command and Control) and the forensic recording system (Socrates). The police service is a data rich environment and by automating the extraction of data it is possible to have a substantial data set that covers the entire population of residential burglaries within Thames Valley.

The analysis used all residential burglaries that were charged in Thames Valley from 1st January 2010 to 31st December 2011 (which is the earliest date that forensic data began being reliably captured on Socrates). Forensic data was not consistently or reliably recorded in an easily accessible format prior to this date. To go back further than this would prevent analysis of forensic variables. The data set is sufficiently recent to capture changes in solvability factors as a result of technological changes, such as the proliferation of CCTV and the increased use of DNA.

The end date for data capture needs to balance the competing need to maximize the size of the available data set with ensuring that the data set does not exclude cases that will be subsequently solved. To assist in selecting the date of data capture a 12 month sample of 868 charged residential burglaries was selected

and analysed to determine the time lag between the offence and the date of charge. The mean time to charge being 67.7 days (SD 171.93), the median being 20 days and the mode being 2 days. The minimum number of days to charge was 0 days and the maximum 2118 days (5 years and 293 days). However, of all the cases that are detected 96% are charged within 8 months (see table 4 below). This finding is broadly consistent with that of Coupe and Griffiths who found that "80% of primary detections are made within 10 days" (1996, p26). Consequently the decision is that the end date for capture of the data will be 31st October 2011 which will enable 18 months of burglaries whilst excluding just 4% of charges with the data capture in June 2012. Using these parameters produced a substantial data set of 14,306 residential burglaries across Thames Valley.

Using these data sources and limitations of Thames Valley Police recording systems, we have identified a total of 14306 burglary cases of which 1401 were solved and 12905 were unsolved. A further breakdown shows that of these 11769 were completed burglary cases, of which 1257 were solved and 10512 were unsolved. Therefore the remaining 2537 were attempted burglary cases of which 144 were solved and 2393 were unsolved.

Data Issues

The data held by Thames Valley Police has been captured for operational policing purposes and not for the purpose of research. The data sets will have some level of inaccuracy owing to inputting errors and perhaps the subjective interpretation of the crime recording rules by inputters. However, the data is subject to regular checks by auditors and Thames Valley Police was ranked as 'outstanding' for the accuracy of its crime recording by Her Majesty's Inspectorate of Constabulary (HMIC 2012). However, the recording of some of the variables by officers on CEDAR is

more doubtful; for example, it is not clear how often officers record suspect description or document all witnesses. For example, it may often be the case that officers do not document a suspect description if they are able to immediately identify the suspect on the basis of that information. In addition, some of the recorded variables are not defined in the same way as the existing studies. For example, whilst CEDAR records witness details the meaning of witness in this context will vary considerably. On occasion a witness will mean someone who has observed the commission of the offence, however, it can also refer to someone who discovered the crime or even to someone who has provided a list of stolen property. The way the data is recorded prevents a detailed analysis of the meaning of witness in this context. Similar differences in interpretation may exist in relation to the recording of suspects or descriptions.

A manual review of each set of burglary case papers would enable much greater precision and overcome the issue of data input accuracy. However, such an approach is beyond the resources available to this study. Therefore I will begin the research by undertaking a data quality review of 100 randomly selected burglaries from the sample. This is the largest sample my research resources allow and will enable greater precision in quantifying the data quality of the sample. The data quality review will not review each of the 129 variables to be used in this study owing to resource limitations, but will assess the accuracy of recording for some of the key variables. This review indicates that overall the data quality of the 4 systems is reasonably good. However, the data held for the offender MO variable, extent of search is 24% inaccurate. The data held for the offence duration is 36% inaccurate. However, other fields have surprisingly high levels of accuracy; for example, fingerprint recovery has a 100% level of accuracy.

Furthermore, the data in relation to the burglaries was originally provided by the victims for the purpose of reporting the matter for investigation. As such there is a duty to protect their personal data. In addition the relevant systems also hold extensive personal details of witnesses, charged offenders and suspected offenders. To avoid any risk of data loss all personal data including names, addresses, ages, gender, ethnicity and phone numbers will be removed from the dataset. However, the fact that there was a witness or offender will be been retained to enable the analysis. The location data will be retained at Local Police Area (LPA) only to enable effective analysis of the geographic distribution of crime and its detection.

Each available variable from the police records (see Table 5 below) has been analysed to determine the extent of missing data, for both solved and unsolved cases to determine whether there is any systematic bias in the recording of case data. as shown (Table 5), for the most part the frequency of missing data are relatively low and where the data were missing the difference does not seem to be attributable to whether the case was solved or not .

Table 5; Missing Data – Burglary (Completed Offences)

Variables	missing data in solved cases (N=1,257)	missing data in unsolved cases (N=10,512)
Time to attend:	206 (16%)	686 (7%)
Offence Duration:	151 (12%)	1338 (13%)
Witness report of offence	N/a	N/a

Suspect named	N/a	N/a
Suspect description recorded	N/a	N/a
Offender disturbed / seen	274 (22%)	2058 (20%)
Description of offenders vehicle recorded	N/a	N/a
CCTV Preserved	N/a	N/a
Media appeal completed	N/a	N/a
House to house completed	N/a	N/a
Reported as burglary in progress	206 (16%)	686 (7%)
Any stolen property recovered.	N/a	N/a
Forensic - DNA / fingerprint / footwear mark recovered	0	0
Vehicle stolen in crime	274 (22%)	2058 (20%)
Property stolen	N/a	N/a
Anything left at scene by the offender.	477 (38%)	4146 (39%)
Premises was subject to a previous burglary	564 (45%)	4212 (40 %)

Offender MO: Tidy / untidy search / thorough search / whole house	373 (30%)	3299 (31 %)
Committed during darkness or. Daylight	468 (37%)	4991 (48%)
Premises occupied	208 (17%)	1603 (15%)
Dwelling type	317 (25%)	2379 (23%)
Location type	318 (25%)	2390 (23%)

Discretionary variables not marked as blank indicated with N/a

Additional (Structural) Limitations of the Data

As this will be a quantitative study its outcomes will be limited in terms of its ability to tease out the context of the variables that contribute to the case outcome and to what extent investigator effort led to uncovering the variables that solved the case. There is an inherent risk with such quantitative studies of presenting investigation as a largely task based activity of identifying the presence of various factors, which may be a crude oversimplification. Nevertheless, whilst this study alone would not be sufficient to understand the full investigative process for burglary it will add a valuable highly powered quantitative dimension to the existing body of research.

By analysing a highly powered sample of burglaries this study, like many before it, is limited in the depth to which it can analyse the variables. For example, many studies of solvability factors have assessed whether or not suspect information is present in the initial report, but has not gone on to assess the origin and reliability

of this information (Brandl and Frank 1994). An eyewitness who identifies and provides the burglar's name is quite different from a victim who may guess at the possible identity of the offender. Unfortunately this study will be limited in this regard. This would not be the case if files were pulled for each case and the data manually recovered. However, to do so would massively reduce the size of the sample owing to the limited research resources available to undertake such a task. On balance, it is considered that a highly powered sample, with its associated limitations, offers greater research benefits.

This study uses data sources in relation to reported burglary and consequently the analysis will only be able to explore the relationships between variables for reported crimes. There is some evidence that the more serious the offending the greater the likelihood of it being reported (Greenwood et al. 1970). However, the findings of the British Crime Survey are that there were 745,000 burglaries in 2010/11 in contrast to 258,148 reported burglaries, which indicates that two thirds of burglaries go unreported (Chaplin et al. 2011). It is possible, indeed likely, that the solvability factors differ for reported and unreported burglaries (Skogan and Antunes 1979). It is an unavoidable limitation of this study that it is only able to report on burglaries known to the police.

Unfortunately owing to resource constraints the study will be unable to assess a number of significant variables such as the presence of intelligence in individual cases, the presence of informant intelligence and the use of automatic number plate recognition technology (ANPR) as an investigative tactic. Whilst obtaining the data and subsequent analysis is theoretically possible for each of these variables the time and resources required are beyond the scope of this study. Other variables, such as Greenberg's "on view report of offence" (Greenberg et al. 1973, px) have proved

impossible to replicate with this design as the Thames Valley systems do not lend themselves to searches for whether the offence was initially discovered by police. A related limitation is the extent to which this study will be able to tease out the complex interplay between multiple variables in solving cases. Indeed, "many detections are the result of the interplay of a range of factors rather than attributable to a single investigation method." (p. 6, Coupe and Griffiths 1996).

Lastly, this study will only capture data in relation to whether one or more offenders have been charged with a crime. It will not be able to differentiate between crimes in which a single offender and those in which multiple offenders have been charged. Equally the TVP systems are unable to separate those cases where offenders are named by the victim or a witness and those in which the suspects name is later discovered by the police perhaps even at the point of arrest. As such this study is unable to explore the extent of the correlation between the suspect being named (Greenberg, 1973) and case solution. This is a significant and disappointing limitation of the way the data is recorded on the TVP systems.

Planned Analysis

I will undertake a descriptive analysis of the sample for both detected and undetected crimes for both completed and attempted burglaries. This will include an analysis of the temporal and geographical features. This will be followed by a frequency distribution for each of the variables for both detected and undetected burglaries to determine the presence of each of the variables. This analysis will be conducted separately for both attempted burglaries and completed burglaries as it is possible that the solvability factors will differ. The analysis will seek to determine if there is a real difference between detected and undetected burglaries in terms of the measured variables or whether any differences could be due to chance (i.e. $p<0.05$).

At this stage a Pearson chi-square analysis will be undertaken for each dichotomous variable. For the scalar variables independent t-tests will be undertake to examine the extent and significance of any differences between detected and undetected burglaries.

If such differences exist then the study will seek to determine if it is big enough to be meaningful by comparing the means of the variables of the detected and undetected burglaries. The results will then be subject to effect size analysis to determine the magnitude of the difference for each variable between solved and unsolved cases.

The results will then be presented in the form a forest plot. The confidence intervals will be calculated to indicate the reliability of the estimate for each variable. The study will then identify which variables can most effectively predict the case outcome by reference to their effect size.

The most powerful variables will be selected to form a solvability checklist which could be used to predict case outcomes. A predictive analysis will be run against each variable to determine its effectiveness in predicting case outcome and the most effective variables will form a list of solvability factors. Those solvability factors will then together be assessed against the existing dataset of 14306 burglaries to determine their effectiveness in predicting case outcomes.

It is recognised that best practice would be to test the predictive accuracy of the model against a fresh set of burglaries rather than against the original sample. However, the time and resources required to mine fresh data are beyond the scope and capability of this study.

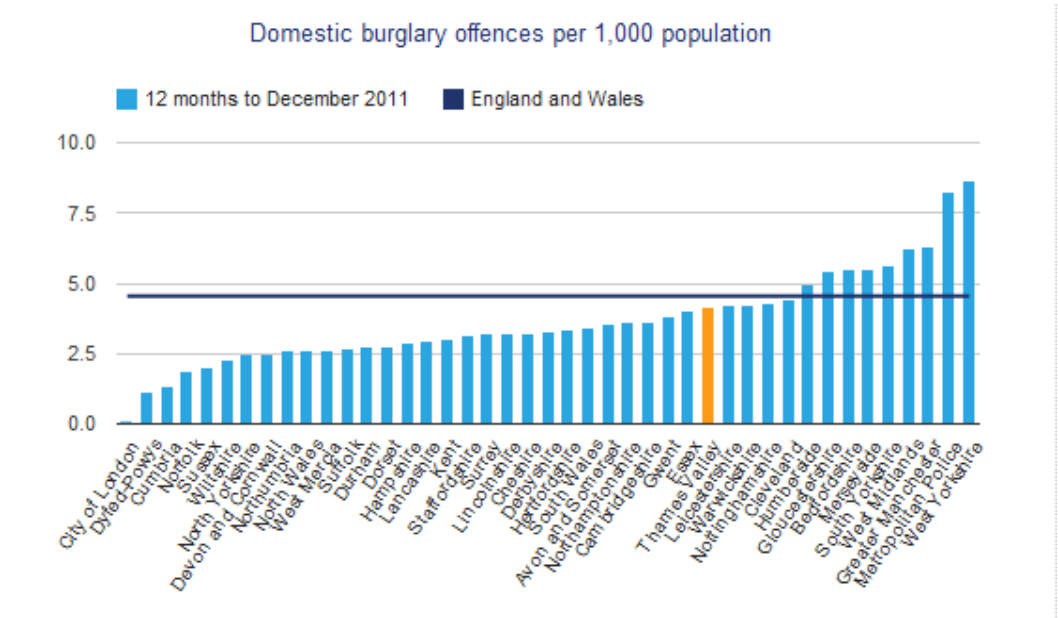
The study will then seek to analyse the geographical and temporal distribution of solvability factors by police area across Thames Valley.

External Validity

The study will use a sample of 14,306 burglaries across the Thames Valley area over an 18 month period. Thames Valley is geographically large, diverse area covering 3 counties with a population of 2.3 million people. It covers 5,700km and includes large urban towns and cities such as Slough, Reading, Oxford, Wycombe and Milton Keynes together with large rural areas such as Aylesbury Vale, South Oxfordshire and West Oxfordshire.

Thames Valley has just below the average number of domestic burglary offences by force per 1000 of population. As such it is likely that the results of the analysis can be generalized to the entire population of UK burglaries.

Figure 1: Domestic Burglary Offences per 1000 population

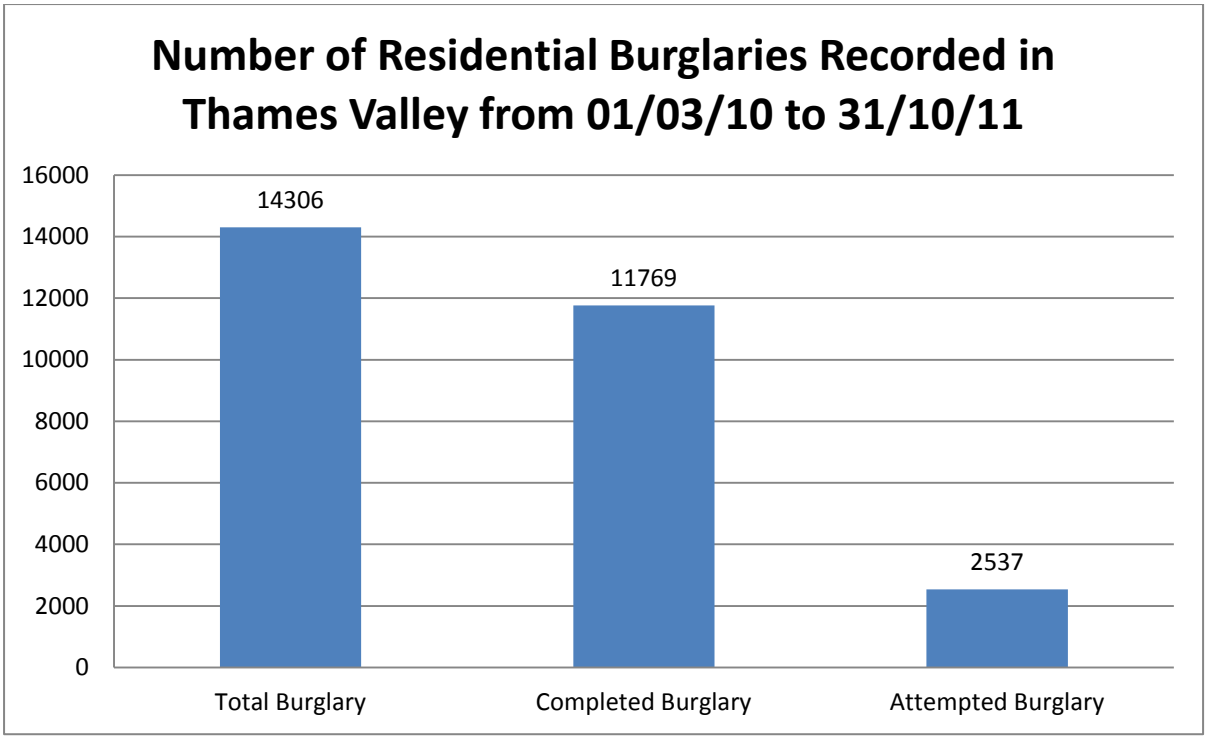


RESULTS

Description of Sample

The sample included all residential burglaries recorded in Thames Valley Police area from 1st March 2010 to 31st October 2011 (n=14,306). This total included 2,537 (17.73%) attempted burglaries and 11,769 (82.26%) completed burglaries. Residential burglary constituted 14,306 offences out of a total of 289,764 crimes recorded in Thames Valley from 1st March 2010 to 31st October 2011. That is, residential burglary constituted 4.93% of the total recorded crime in this period.

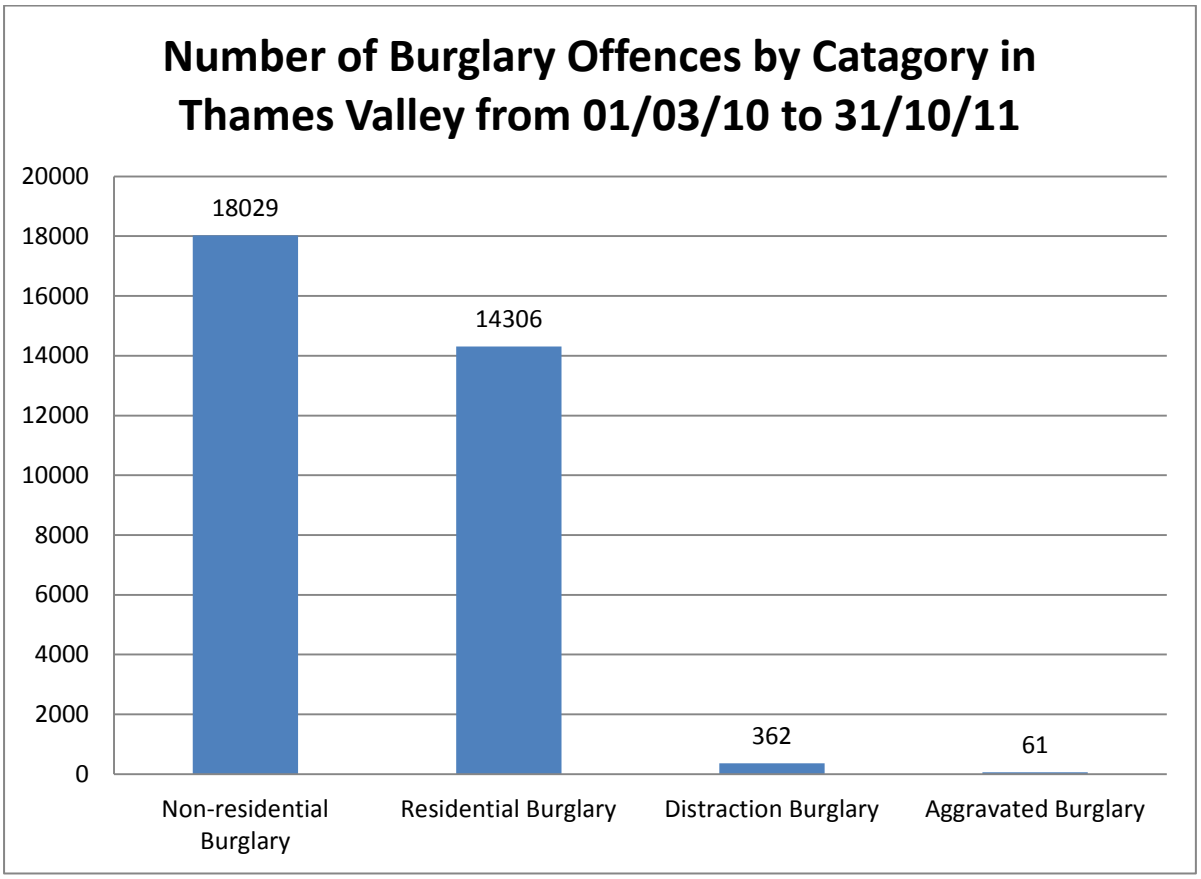
Figure 2: Number of recorded attempted and completed burglaries



The sample excluded non-residential (n= 18,029), attempted distraction burglaries (n=83), completed distraction burglaries (n= 279), attempted aggravated burglaries (n=1) and completed aggravated burglaries (n=60). The sample also

excluded ‘no crimes’, that is, offences that after investigation are proven not to have occurred (n=329).

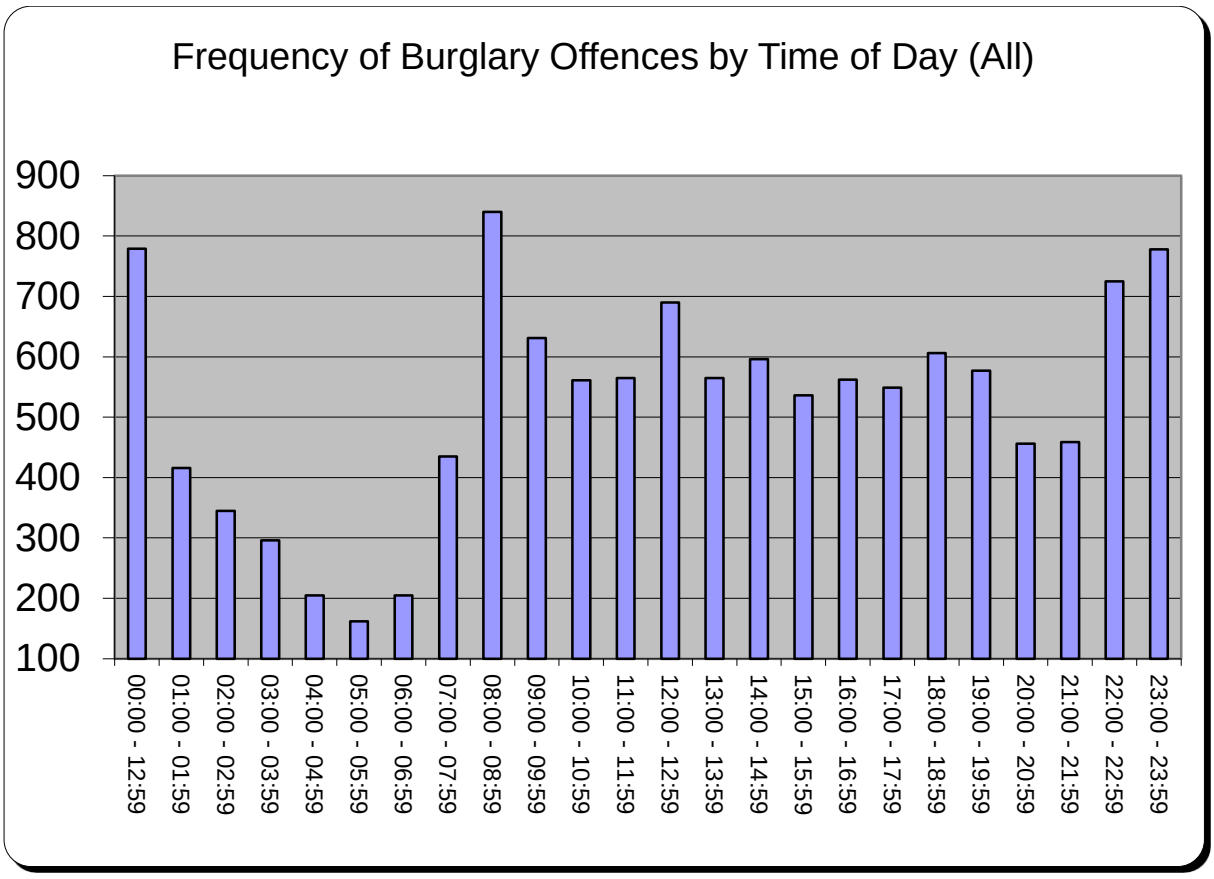
Figure 3: Total number of burglary offences by category



Temporal Distribution of Burglary Sample

The majority of burglary offences in the sample occur during the daytime with a dip in the early evening between 2000 and 2200. The numbers fall off considerably after 0100 until 0700.

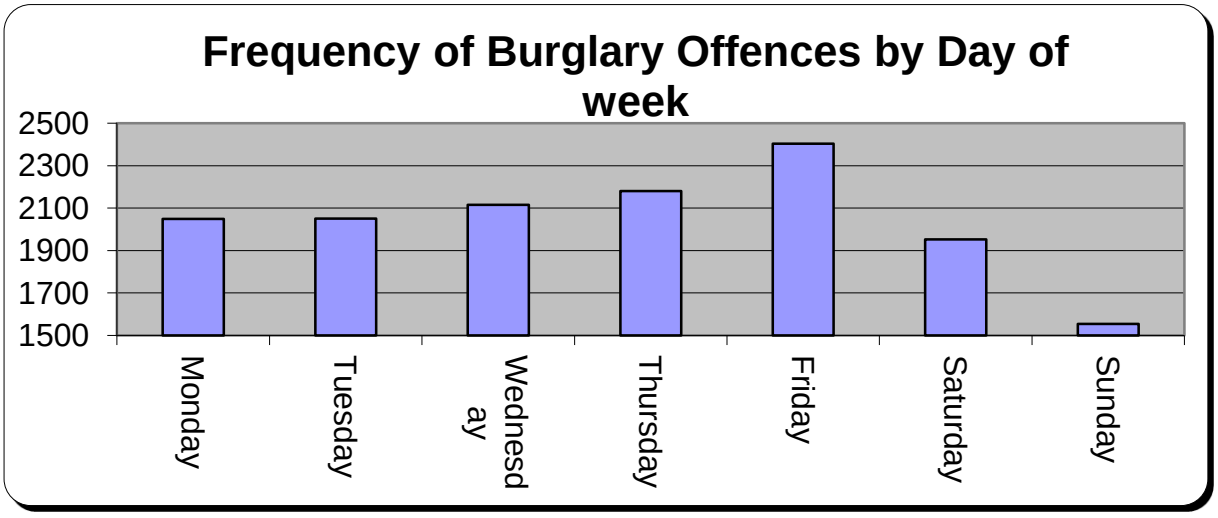
Figure 4: Frequency of Burglary Offences by time of day



Frequency of Burglaries by Day of the Week

Most burglaries within the sample occur on a Friday (n=2404) with the least burglaries occurring on a Sunday (n=1554).

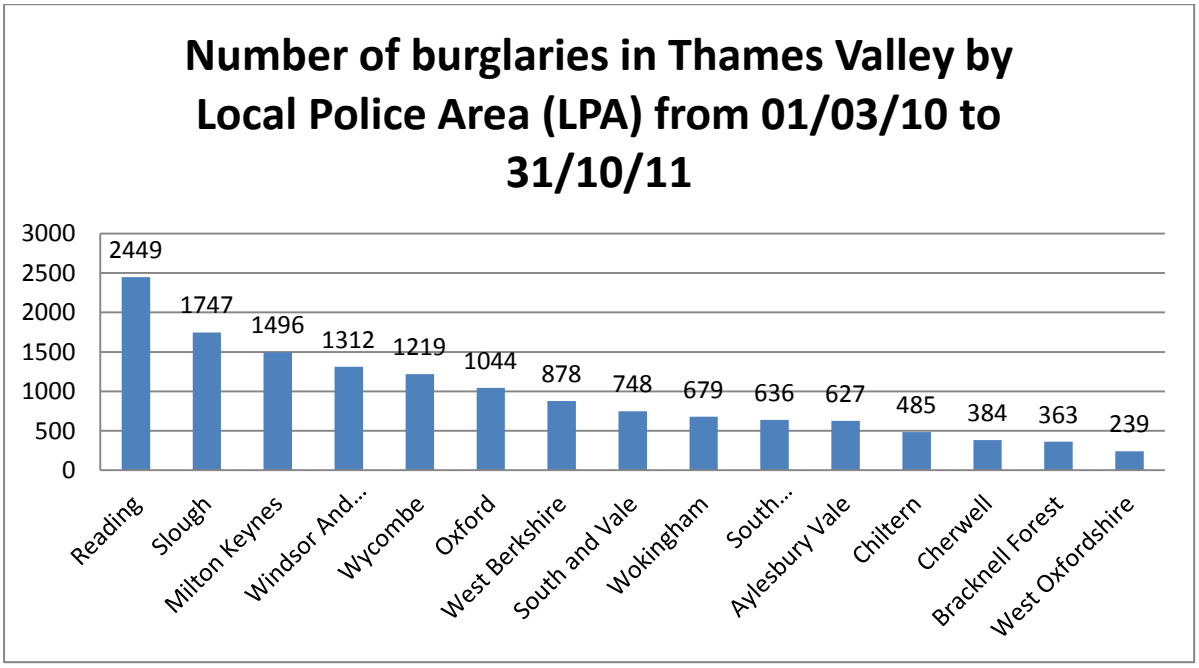
Figure 5: Frequency of Burglary Offences by day of the week



Geographic Distribution

The burglaries in the sample are distributed across the 15 Local Police Areas (LPAs) in Thames Valley Police. The highest number of burglaries in any police area is Reading (n=2449) and the lowest is in West Oxfordshire (n=239).

Figure 6: Number of burglaries by LPA



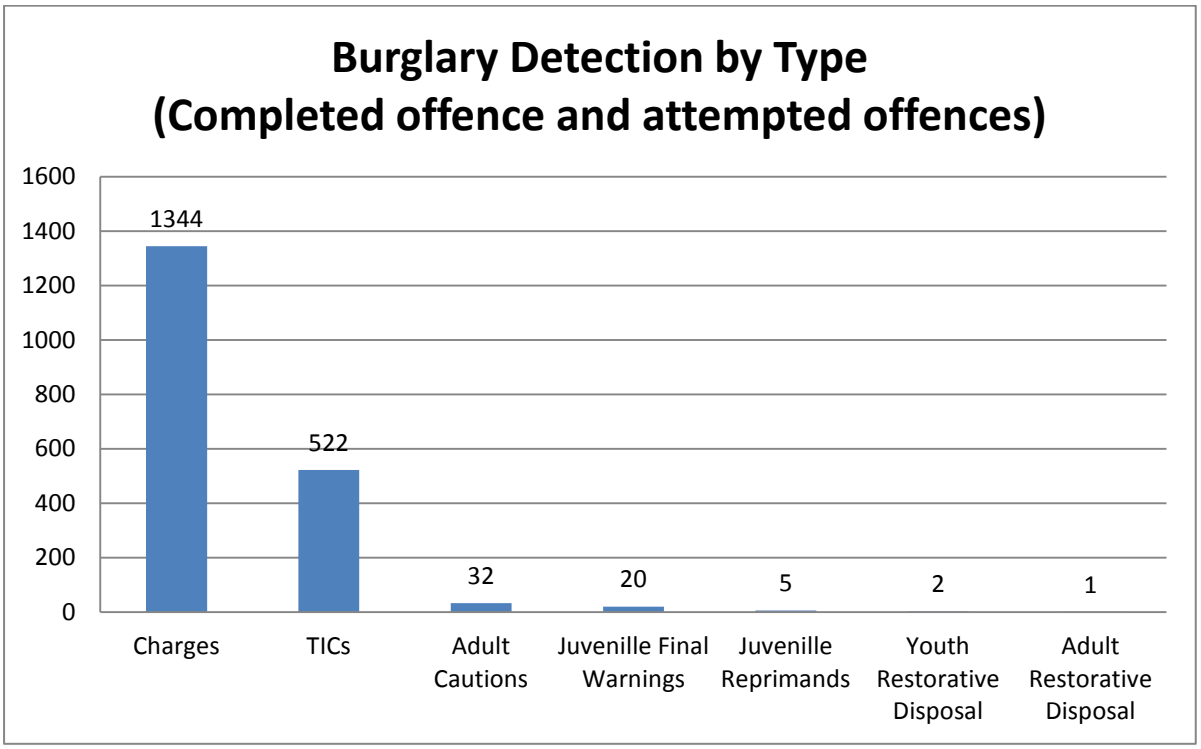
Solvability Variables

For each of the 14306 burglaries in the sample data was captured for 128 variables. The variables captured include a series around the date and time of the offence, the type of premises attacked and its location, the offender's MO, the property stolen, the investigative actions undertaken, the presence of witnesses and the speed of the police response. A comprehensive list of the variables is attached in the Appendix.

Solved Crime

Of the 14306 total burglaries 1926 were recorded as detected with a named offender, that is 13.46%. Of these 1344 were charges, 522 offences taken into consideration (TIC's), 5 juvenile reprimands, 20 juvenile final warnings, 32 adult cautions, 2 youth restorative disposals and 1 adult restorative disposal.

Figure 7: Burglary Detection by Type



The 522 TICs and the 3 restorative disposals were removed from the sample leaving a total of 1401 detected offences for analysis from the sample of 14306 burglaries, that is, an overall 9.79% burglary detection rate.

Of the 1401 detected offences 1257 were completed residential burglaries and 144 attempted residential burglaries. That is a detection rate for completed burglary of 10.68% and a detection rate for attempted burglary of 5.67%.

Table 44: Comparison of Detected Burglary (completed offences and attempted offences)

Comparison of Detected Burglary (completed offence) and Detected Burglary (attempted)				
	Detected	Not detected	Total	Percentage detection rate
Residential Burglary (Completed offence)	1257	10512	11769	10.68%
Residential Burglary (attempted)	144	2393	2537	5.67%
Total	1401	12905	14306	9.79%

Temporal Detection Data

The detection rates are relatively stable through the course of the day, but with a noticeable increase to 18.5% for offences of burglary that occur between 0400 and 0500. Furthermore, the detection rates remain relatively stable during the course of the week, with the lowest percentage being detections for offences that occur on Fridays (8.73%) and the highest percentage being detections for offences that occur on a Tuesday (10.88%).

Figure 8: Percentage of Burglary Detected by hour of the day

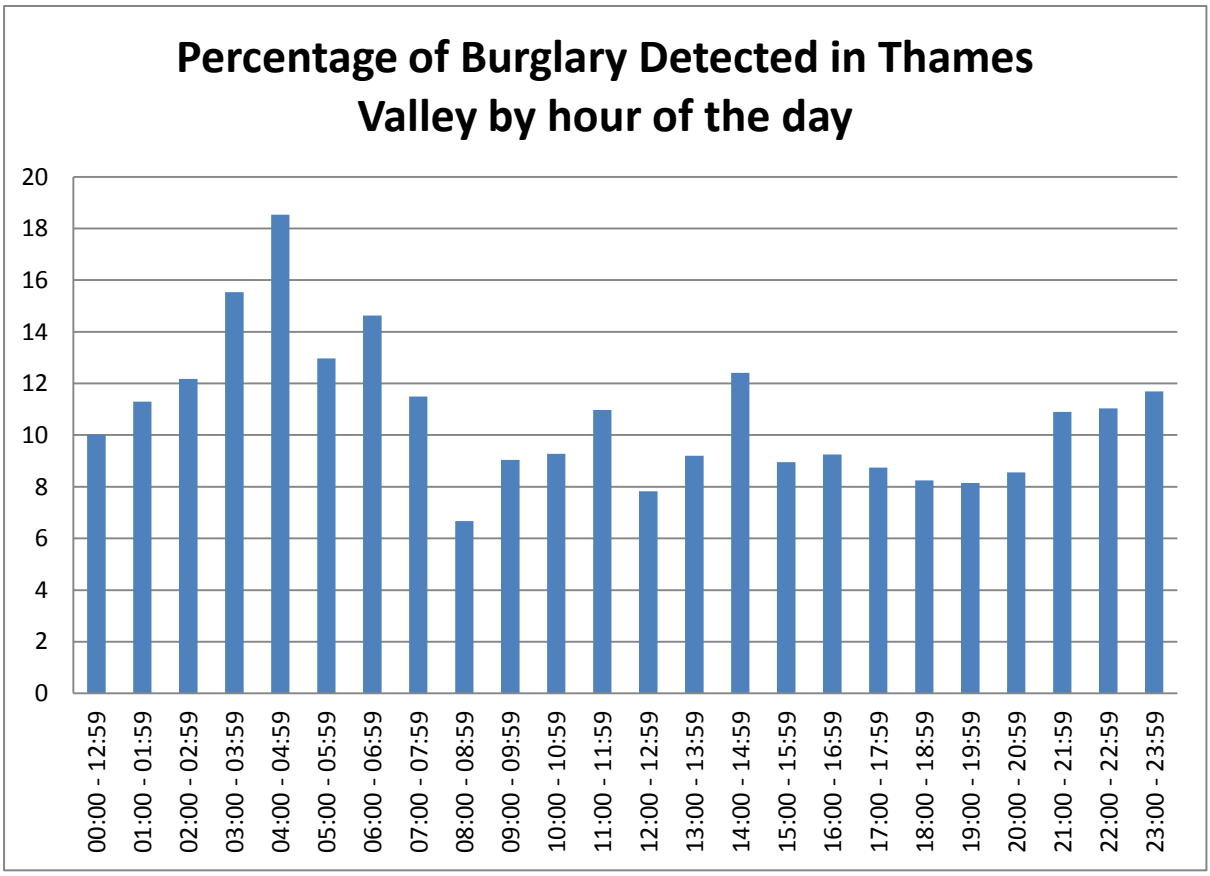


Table 5: Detection Rates by Day of the Week

Detection Rates by Day of the Week					
Day of week	Detected	Undetected	Total	Percent detected	Percent Undetected
Monday	204	1845	2049	9.96	90.04
Tuesday	223	1827	2050	10.88	89.12
Wednesday	191	1924	2115	9.03	90.97
Thursday	222	1959	2181	10.17	89.82
Friday	210	2194	2404	8.73	91.26
Saturday	183	1770	1953	9.37	90.63
Sunday	168	1386	1554	10.81	89.19

Geographic detection rates

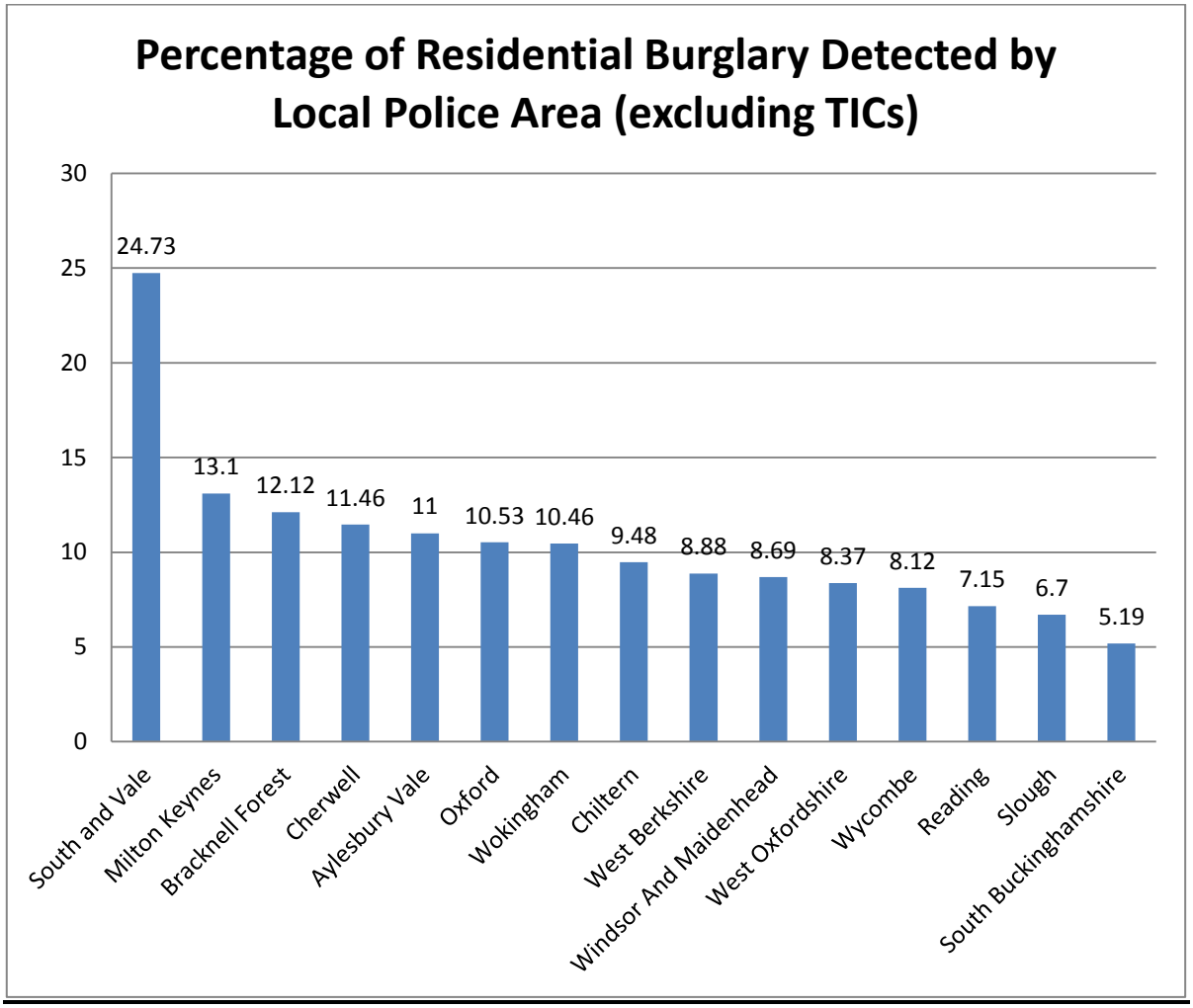
The detection rates vary across the Local Police Areas (LPAs). The highest being South Oxfordshire and Vale of White Horse Police Area with a detection rate of 24.73%. The lowest being South Buckinghamshire with a detection rate of 5.19%.

Table 6: Burglary Detection Rate by LPA

Residential Burglary Detection Rate by LPA in Thames Valley					
LPA	Detected	Undetected	Total	Percent Detected	Percent Undetected
Aylesbury Vale	69	558	627	11.00	88.99
Bracknell Forest	44	319	363	12.12	87.88
Cherwell	44	340	384	11.46	88.54
Chiltern	46	439	485	9.48	90.51
Milton Keynes	196	1300	1496	13.10	86.89
Oxford	110	934	1044	10.53	89.46
Reading	175	2274	2449	7.15	92.85
Slough	117	1630	1747	6.70	93.30
South and Vale	185	563	748	24.73	75.27
South Buckinghamshire	33	603	636	5.19	94.81
West Berkshire	78	800	878	8.88	91.11

West Oxfordshire	20	219	239	8.37	91.63
Windsor And Maidenhead	114	1198	1312	8.69	91.31
Wokingham	71	608	679	10.46	89.54
Wycombe	99	1120	1219	8.12	91.88
Grand Total	1401	12905	14306	9.79	90.21

Figure 9: Detection Rate by LPA



Frequency of Solvability Variables

The frequency with which the key variables occur varies considerably. For completed burglaries the offender is likely to be disturbed in 10.8% of cases and hence there are recorded witnesses in 10.6% of cases. In contrast the forensic variables occur much less frequently. DNA is recovered in just 2.2% of completed burglaries and fingerprints recovered in 5.6% of cases. The frequency of variables is however quite different for attempted burglaries. In 23.6% of attempted burglaries the offender is disturbed. However, in just 1.5% of attempted burglaries is DNA recovered and in a mere 1.7% of cases are fingerprints recovered.

Table 7: Frequency of Variables

Frequency of Variables in sample of Residential Burglaries in Thames Valley					
Variable	Completed Burglaries (n)	Percent Completed Burglaries	Attempted Burglaries (n)	Percent Attempted Burglaries	Chi-square
DNA Recovered	262	2.2	38	1.5	57.600***
Footwear Ident	91	.8	5	.2	19.765***
Fingerprint ident	655	5.6	44	1.7	148.114***
Witness Recorded	1242	10.6	281	11.1	14309.600***
Burglary in Progress	512	4.4	171	6.7	142.474***

Detached House	1460	12.4	301	11.9	129.303**
Bungalow	258	2.2	58	2.3	129.303**
Caravan	24	.2	2	.1	129.303**
Farmhouse	16	.1	2	.1	129.303**
Flat Other	434	3.7	100	3.9	129.303**
Flat Ground Floor	497	4.2	99	3.9	129.303**
Semi-detached	1487	12.6	319	12.6	129.303**
Terraced House	991	8.4	222	8.8	129.303**
Multi-occupancy dwelling	341	2.9	20	.8	129.303**
Offender disturbed	1272	10.8	598	23.6	798.375***
Offender seen	1181	10	434	17.1	412.119***
Unoccupied	6755	57.4	1024	40.4	247.666***
Occupied	3652	31	902	35.6	21.080***
Vehicle sighted	257	2.2	67	2.6	234.403***
Anything left at scene by offender	976	8.3	184	7.3	3.297

House to house completed	10461	88.9	2187	86.2	14323.653***
Media appeal completed	475	4.0	61	2.4	14324.410***
Property Stolen	8850	75.2	107	4.2	18809.070***
CCTV Preserved	3888	33%	734	28.9	14325.078***

Analysis of Individual Variables

The findings section will report individually on those 8 variables with the greatest effect size; namely, footwear marks recovered, DNA recovered, fingerprints recovered, whether the offender was seen, whether a witness has been recorded, reported as a burglary in progress, whether the offenders vehicle was seen, whether any stolen property was recovered. The findings will also report individually on both the offence duration (Greenberg et. al 1973) and the time until the arrival of the first police officer (Eck 1979).

Each of these variables will be analysed with reference to its presence in the detected cases in comparison to the undetected cases for both completed and attempted burglaries. Chi-sqaure or Pearson t-tests will be undertaken to determine the statistical significance of the findings. The effect sizes will also be calculated for each variable.

Suspect Named

In the analysis it became clear that this variable is unusable as it is always added once a case is detected. It was present in 1257 cases out of 1257 detected cases. Therefore any analysis terms of the victim or another person naming the suspect has not been possible.

Footwear marks Recovered

This variable relates to whether a footwear mark was recovered at or near the scene. For the detected cases of the completed burglaries there were 62 cases where a footwear mark was recovered out of a total of 1257 detected cases (4.93%). For the undetected completed burglaries there were 29 cases in which a footwear mark was recovered out of a total of 10512 undetected cases (0.27%). A chi-square

test was conducted in order to test whether the difference is statistically significant (chi-square=317.300, p=.000). The effect size was calculated as very large and this finding was statistically significant (d=1.616, p=.000).

For the detected cases of the attempted burglaries there were 2 cases where a footwear mark was recovered out of a total of 144 detected cases (1.39%). For the undetected attempted burglaries there were 3 cases where a footwear mark was recovered out of a total of 2393 undetected cases (0.12%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=352.954, p=.000). The effect size was calculated as very large and this finding was statistically significant (d=1.333, p=.008)

Table 8: Footwear Mark Recovered Detected and Undetected Cases

Footwear Mark Recovered								
	Detected cases			Undetected Cases				
	n	N	%	n	N	%	Chi-square	d
Footwear mark Recovered (completed burglaries)	62	1257	4.93%	29	10512	0.27%	317.300***	1.616***
Footwear mark Recovered (attempt	2	144	1.39%	3	2393	0.12%	352.954***	1.333**

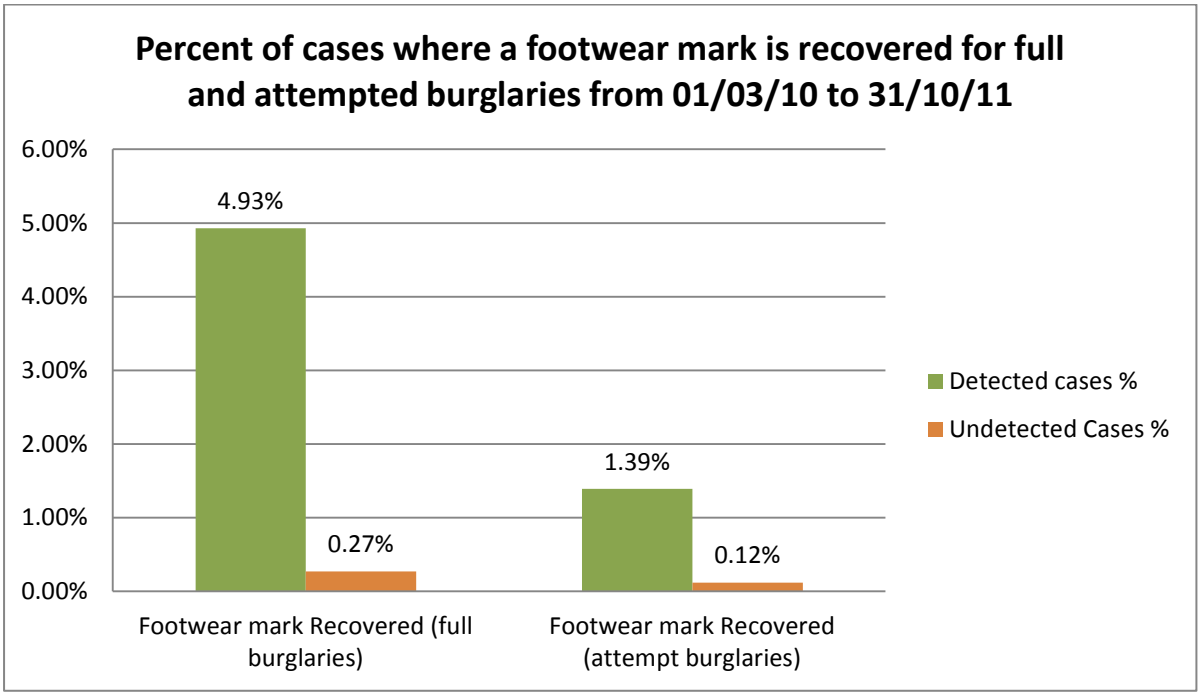
burglaries)								

* p<.05

** p<.01

*** p<.001

Figure 10: Footwear Marks Recovered Detected and Undetected Cases



DNA Recovered

This variable relates to whether an article has been recovered at or near the scene that has the potential to contain DNA. the For the detected cases of the completed burglaries there were 167 cases where DNA was recovered out of a total of 1257 detected cases (13.29%). For the undetected completed burglaries there were 95 cases in which DNA was recovered out of a total of 10512 undetected cases (0.9%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=790.805, p=.000). The effect size was calculated as very large and this finding was statistically significant (d=1.556, p=.000).

For the detected cases of the attempted burglaries there were 20 cases where DNA was recovered out of a total of 144 detected cases (13.89%). For the undetected attempted burglaries there were 24 cases where DNA was recovered out of a total of 2393 undetected cases (1.00%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=879.481,

p=.000). The effect size was calculated as very large and this finding was statistically significant (d=1.303, p=.000).

Table 9: DNA Recovered Detected and Undetected Cases

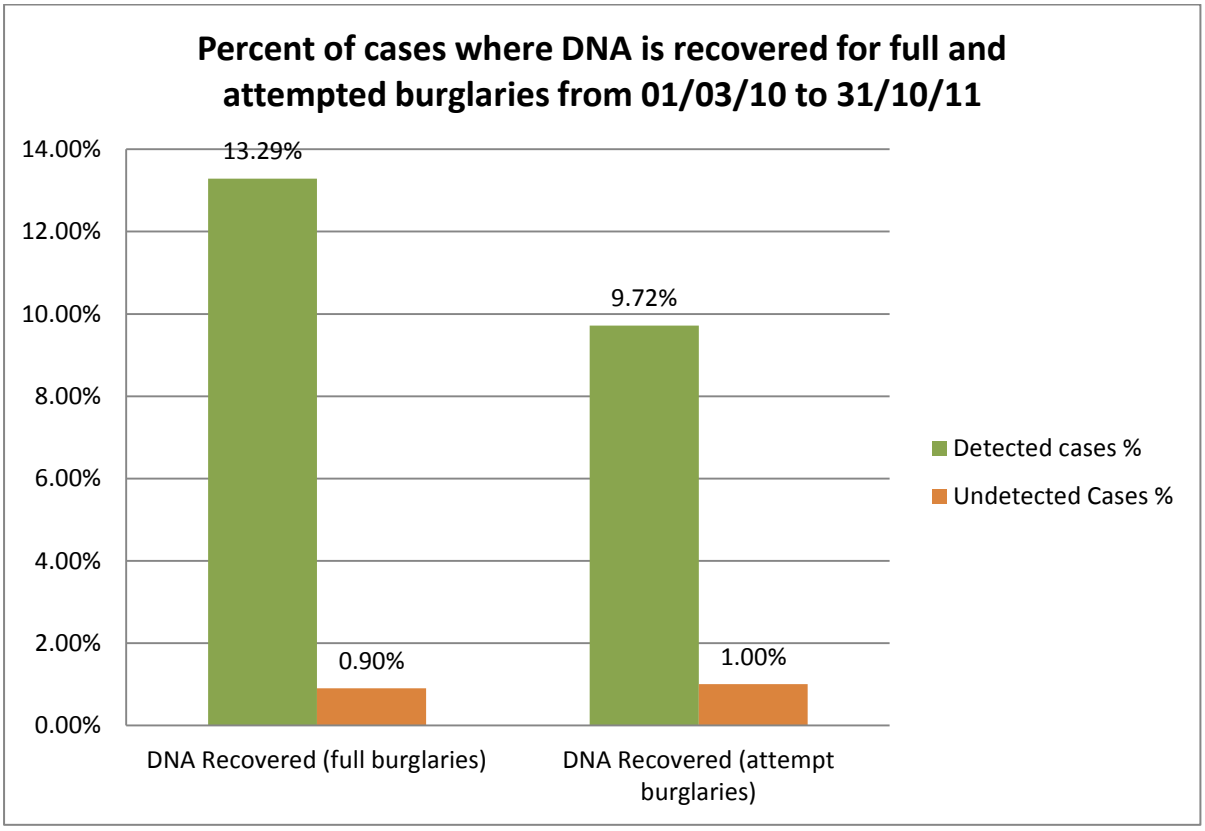
DNA Recovered								
	Detected cases			Undetected Cases				
	n	N	%	n	N	%	Chi-square	d
DNA Recovered (completed burglaries)	167	1257	13.29%	95	10512	0.90%	790.805***	1.556***
DNA Recovered (attempt burglaries)	14	144	9.72%	24	2393	1.00%	879.481***	1.303***

* p<.05

** p<.01

*** p<.001

Figure 11: DNA Recovered Detected and Undetected Cases



Fingerprints Recovered

This variable relates to whether one or more fingermarks were recovered from inside or outside the scene and have not yet been compared to eliminate the aggrieved party. For the detected cases of the completed burglaries there were 267 cases where a fingerprint was recovered out of a total of 1257 detected cases (21.24%). For the undetected completed burglaries there were 388 cases in which a fingerprint was recovered out of a total of 10512 undetected cases (3.61%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=657.967***, p=.000). The effect size was calculated as very large and this finding was statistically significant (d=1.076, p=.000).

For the detected cases of the attempted burglaries there were 20 cases where a fingerprint was recovered out of a total of 144 detected cases (13.89%). For

the undetected attempted burglaries there were 24 cases where a fingerprint was recovered out of a total of 2393 undetected cases (1.00%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=745.583, p=.000). The effect size was calculated as very large and this finding was statistically significant (d=1.526, p=.000).

Table 10: Fingerprint Recovered Detected and Undetected Cases

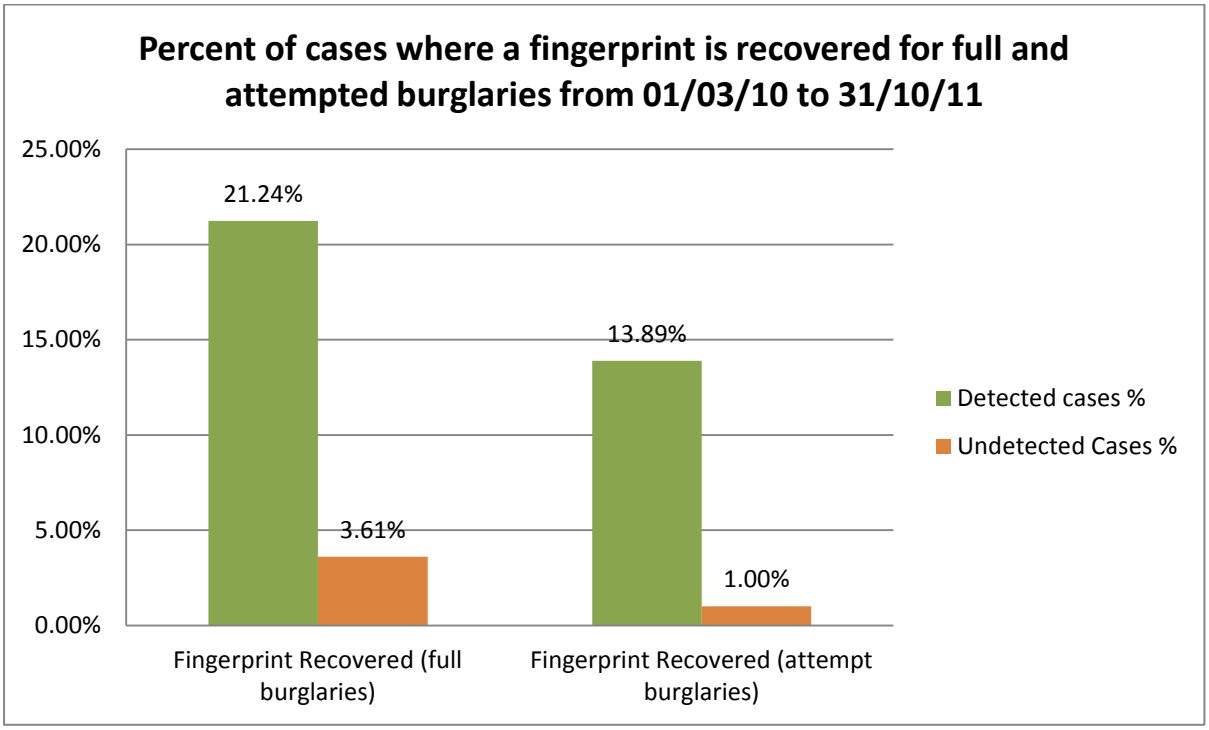
Fingerprint Recovered								
	Detected cases			Undetected Cases				
	n	N	%	n	N	%	Chi-square	d
Fingerprint Recovered (completed burglaries)	267	1257	21.24%	388	10512	3.61%	657.967***	1.076***
Fingerprint Recovered (attempt burglaries)	20	144	13.89%	24	2393	1.00%	745.583***	1.526***

* p<.05

** p<.01

*** p<.001

Figure 12: Fingerprint Recovered Detected and Undetected Cases



Offender Seen

A record is made of an offender being seen when any person believes they have seen the suspect in the act or soon after the burglary. For the detected cases of the completed burglaries there were 277 cases where the offender was seen out of a total of 1257 detected cases (22.03%). For the undetected completed burglaries there were 904 in which the offender was seen out of a total of 10512 undetected cases (8.59%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=270.795, p=.000). The effect size was calculated as medium and this finding was statistically significant (d=0.606, p=.000).

For the detected cases of the attempted burglaries there were 56 cases where the offender was seen out of a total of 144 detected cases (38.88%). For the

undetected attempted burglaries there were 378 where the offender was seen out of a total of 2393 undetected cases (15.79%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=58.834, p=.000). The effect size was calculated as medium and this finding was statistically significant (d=0.673, p=.000).

Table 11: Offender Seen Detected and Undetected Cases

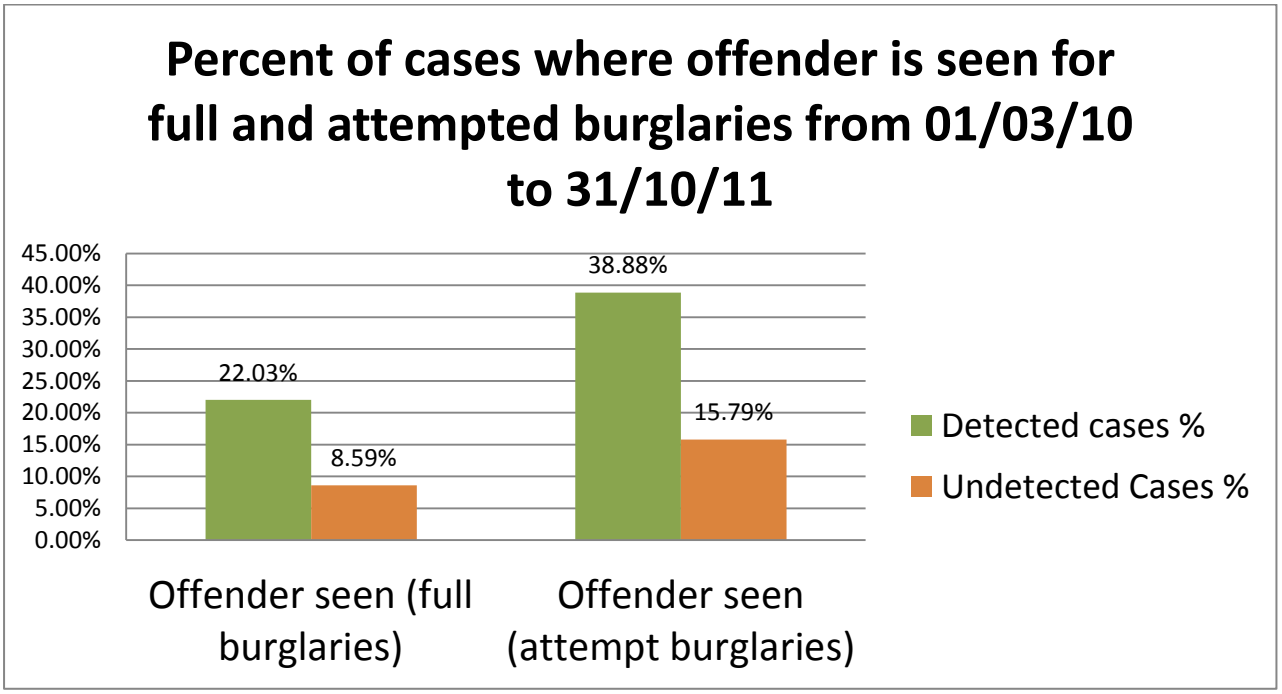
Offender Seen								
	Detected cases			Undetected Cases				
	n	N	%	n	N	%	Chi-square	d
Offender seen (completed burglaries)	277	1257	22.03%	904	10512	8.59%	270.795***	0.606***
Offender seen (attempt burglaries)	56	144	38.88%	378	2393	15.79%	58.834***	0.673***

* p<.05

** p<.01

*** p<.001

Figure 23: Offender Seen Detected and Undetected Cases



Witness Recorded

Whether an offence is recorded as witnessed is much broader than Greenberg's original definition of "anyone who sees or hears a suspicious circumstance at or near the time of the occurrence and in close proximity of the crime scene."(Greenberg 1973, p A-6). A witness is recorded against a burglary if anyone other than the victim has witnessed the offence or if they have had any evidential role in relation to the offence. Therefore this is a much broader variable than "offender seen". For the detected cases of the completed burglaries there were 279 with one or more witnesses recorded out of a total of 1257 detected cases (22.19%). For the undetected completed burglaries there were 963 with one or more witnesses recorded out of a total of 10512 undetected cases (9.16%). A chi-square test was conducted in order to test whether the difference is statistically significant (chi-square=202.087, p=.000). The effect size was calculated as medium and this finding was statistically significant (d=-0.573, p=.000).

For the detected cases of the attempted burglaries there were 44 with one or more witnesses recorded out of a total of 144 detected cases (30.55%). For the undetected attempted burglaries there were 237 with one or more witnesses recorded out of a total of 2393 undetected cases (9.90%). A chi-square test was completed in order to test whether the difference is statistically significant (chi-square=58.815, p=.000). The effect size was calculated as large and this finding is statistically significant (d=0.765, p=.000).

Table 12: Witness recorded Detected and Undetected Cases

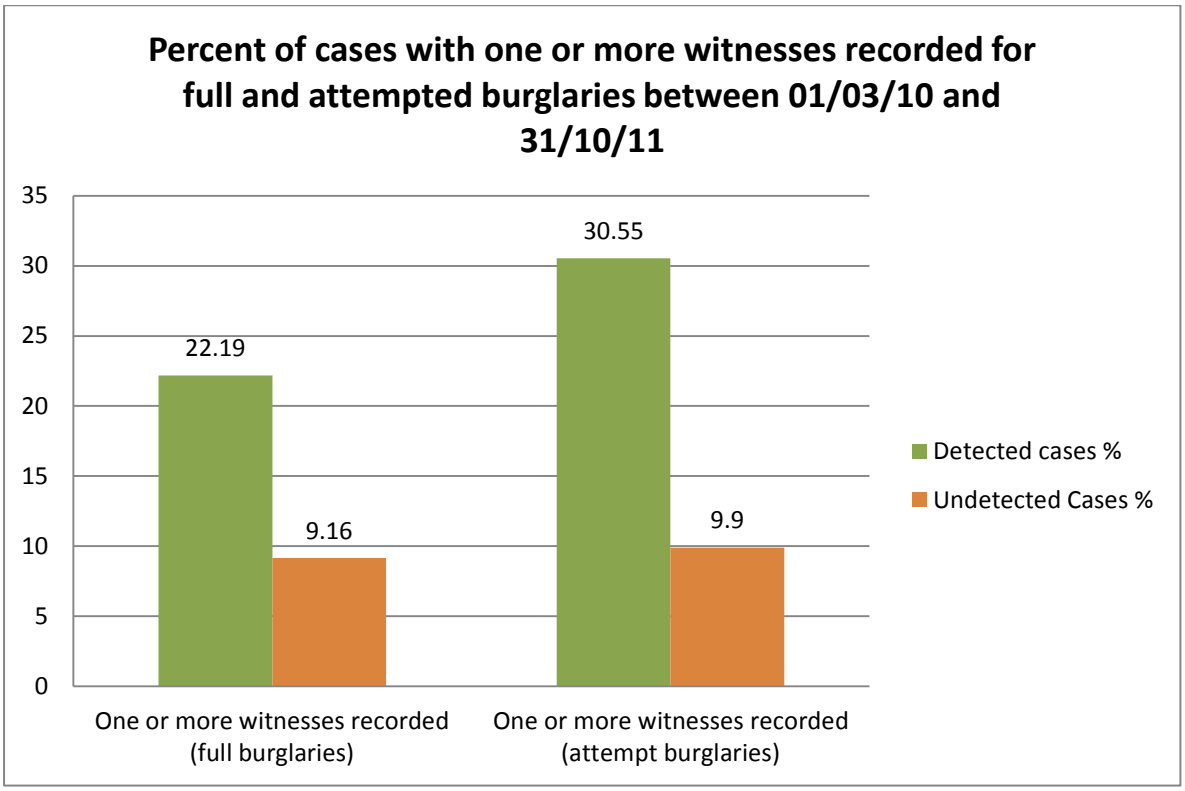
Witness Recorded								
	Detected cases			Undetected Cases			Chi-Square	d
	n	N	%	n	N	%		
One or more witnesses recorded (completed burglaries)	279	1257	22.19	963	10512	9.16	202.087***	0.573***
One or more witnesses recorded (attempt burglaries)	44	144	30.55	237	2393	9.90	58.815***	0.765***

* p<.05

** p<.01

*** p<.001

Figure 14: Witness Recorded Detected and Undetected Cases



Reported as a Burglary in Progress

This variable relates to whether the crime initially came to police attention as a report from any person that it was a crime in progress. For the detected cases of the completed burglaries there were 106 cases where it was reported as such out of a total of 1257 detected cases (8.43%). For the undetected completed burglaries there were 406 in which it was reported as a burglary in progress out of a total of 10512 undetected cases (3.86%). A chi-square test was completed in order to test whether the difference is statistically significant (chi-square=224.552, p=.000). The effect size was calculated as medium and this finding is statistically significant (d=0.457, p=.000).

For the detected cases of the attempted burglaries there were 28 cases where it was reported as a burglary in progress out of a total of 144 detected cases (19.44%). For the undetected attempted burglaries there were 143 cases where house to house enquiries were completed out of a total of 2393 undetected cases (5.97%). A chi-square test was completed in order to test whether the difference is statistically significant (chi-square=76.770, p=.000). The effect size was calculated as large and this finding is statistically significant (d=0.736, p=.000).

Table 135: Burglary in Progress Detected and Undetected Cases

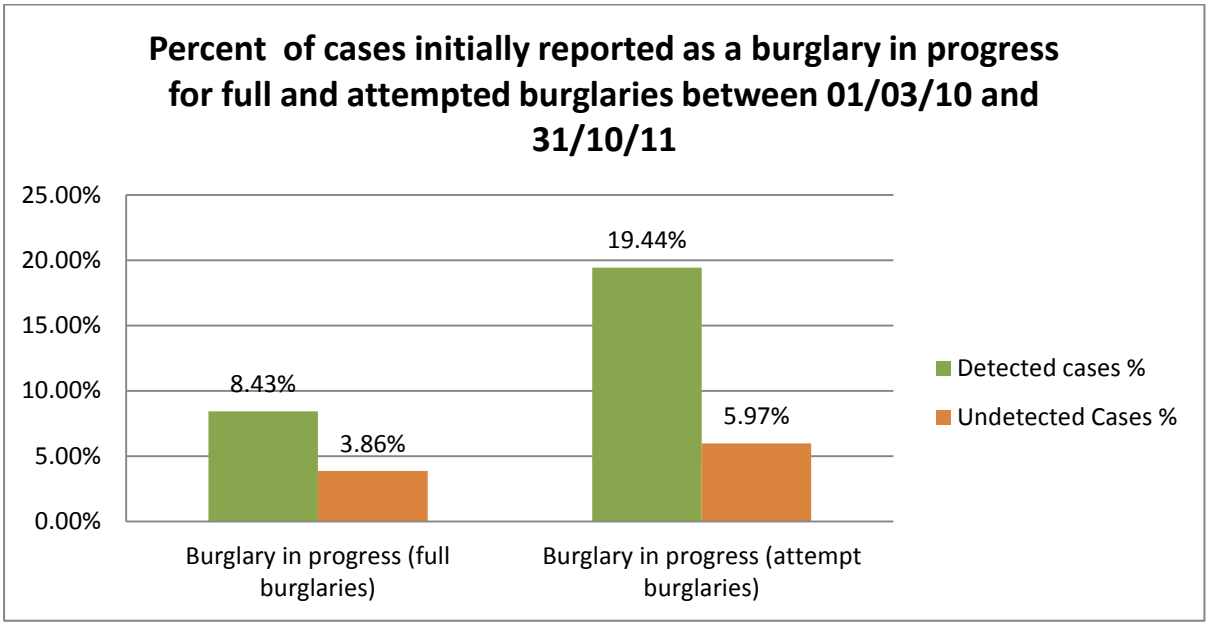
Burglary in Progress								
	Detected cases			Undetected Cases				
	n	N	%	n	N	%	Chi-square	d
Burglary in progress (completed burglaries)	106	1257	8.43%	406	10512	3.86%	224.552***	0.457***
Burglary in progress (attempt burglaries)	28	144	19.44%	143	2393	5.97%	76.770***	0.736***

* p<.05

** p<.01

*** p<.001

Figure 15: Burglary in Progress Detected and Undetected Cases



The number of reported burglaries in progress varies significantly by the hour of the day. The highest numbers are reported between 0300 and 0400 and the lowest numbers between 0700 and 0800. The number of burglaries in progress that are subsequently detected also varies significantly by the hour of the day. The highest number of burglaries in progress detected occur between 1400 and 1500.

Table 14: Burglary in Progress Detected and Undetected Cases by Hour of the Day

Number of Burglaries in Progress Detected by hour of the day			
Hour of the day	Detected	Undetected	Total
00:00 - 00:59	4	21	25
01:00 - 01:59	6	30	36
02:00 - 02:59	2	39	41
03:00 - 03:59	10	37	47
04:00 - 04:59	11	23	34
05:00 - 05:59	1	12	13
06:00 - 06:59	3	4	7

07:00 - 07:59	1	6	7
08:00 - 08:59	2	7	9
09:00 - 09:59	3	13	16
10:00 - 10:59	3	7	10
11:00 - 11:59	9	15	24
12:00 - 12:59	4	18	22
13:00 - 13:59	5	27	32
14:00 - 14:59	14	25	39
15:00 - 15:59	4	22	26
16:00 - 16:59	6	28	34
17:00 - 17:59	8	26	34
18:00 - 18:59	4	31	35
19:00 - 19:59	5	21	26
20:00 - 20:59	9	27	36
21:00 - 21:59	6	31	37
22:00 - 22:59	5	34	39
23:00 - 23:59	5	17	22

There is a significant variation in the geographic distribution of burglaries in progress within the sample. The highest numbers occurred within Reading LPA.

Table 15: Distribution of Burglaries in Progress by LPA

Geographic Distribution of Burglaries in Progress by Local Police Area (LPA)					
LPA	Number Detected	Percentage Detected	Number undetected	Total Number	Percentage of all burglaries in Progress
Aylesbury Vale	2	13.33	13	15	2.19
Bracknell Forest	5	27.77	13	18	2.63
Cherwell	5	20.83	19	24	3.51
Chiltern & South Bucks	11	19.64	45	56	8.19
Milton Keynes	12	20	48	60	8.78
Oxford	15	27.77	39	54	7.90
Reading	24	21.05	90	114	16.69
Slough	9	10.58	76	85	12.44
South and Vale	6	22.22	21	27	3.95
West Berkshire	10	20.40	39	49	7.17
West Oxfordshire	3	21.42	11	14	2.05
Windsor And Maidenhead	14	19.44	58	72	10.54

Wokingham	7	21.87	25	32	4.68
Wycombe	11	17.46	52	63	9.22

Offenders Vehicle Sighted

A record is made of the offenders vehicle being sighted if any person sees what they believe is the offender's vehicle. For the detected cases of the completed burglaries there were 51 cases where the offender's vehicle was seen out of a total of 1257 detected cases (4.06%). For the undetected completed burglaries there were 206 in which the offender was seen out of a total of 10512 undetected cases (1.96%). A chi-square test was completed in order to test whether the difference is statistically significant (chi-square=48.995, p=.000). The effect size was calculated as medium and this finding is statistically significant (d=0.457, p=.000).

For the detected cases of the attempted burglaries there were 9 cases where the offenders vehicle was seen out of a total of 144 detected cases (6.25%). For the undetected attempted burglaries there were 58 cases where the offenders vehicle was seen out of a total of 2393 undetected cases (2.42%). A chi-square test was completed in order to test whether the difference is statistically significant (chi-square=8.734, p=.033). The effect size was calculated as medium and this finding is statistically significant (d=0.544, p=.007).

Table 16: Offenders Vehicle Sighted Detected and Undetected Cases

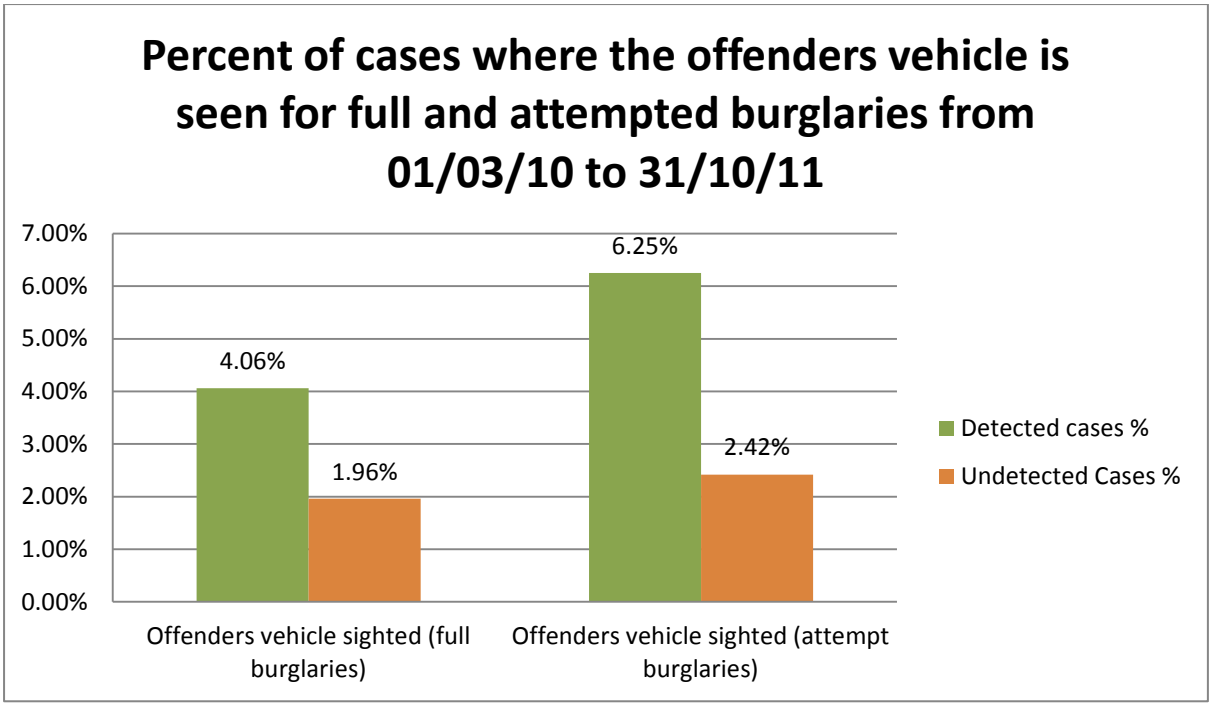
Offenders Vehicle Sighted								
	Detected cases			Undetected Cases				
	n	N	%	n	N	%	Chi-square	d
Offenders vehicle sighted (completed burglaries)	51	1257	4.06%	206	10512	1.96%	48.995***	0.413***
Offenders vehicle sighted (attempt burglaries)	9	144	6.25%	58	2393	2.42%	8.734*	0.544**

* p<.05

** p<.01

*** p<.001

Figure 3: Offenders Vehicle Sighted Detected and Undetected Cases



Stolen Property Recovered

This variable relates to whether the any of the property stolen in the burglary was subsequently recovered, either before or after the arrest of any suspect. For the detected cases of the completed burglaries there were 248 cases where property was recovered out of a total of 1257 detected cases (19.72%). For the undetected completed burglaries there were 1145 in which property was recovered out of a total of 10512 undetected cases (10.89%). A chi-square test was completed in order to test whether the difference is statistically significant (chi-square=13.728, p=.001). The effect size was calculated as small to medium and this finding is statistically significant (d=0.385, p=.000).

For the detected cases of the attempted burglaries there were 6 cases where property was recovered out of a total of 144 detected cases (4.17%). For the undetected attempted burglaries there were 70 cases where property was recovered out of a total of 2393 undetected cases (2.93%). A chi-square test was completed in

order to test whether the difference is statistically significant (chi-square=4.113, p=.128). The effect size was calculated as small, but this finding is not statistically significant (d=0.202, p=0.399).

Table 17: Stolen Property Recovered Detected and Undetected Cases

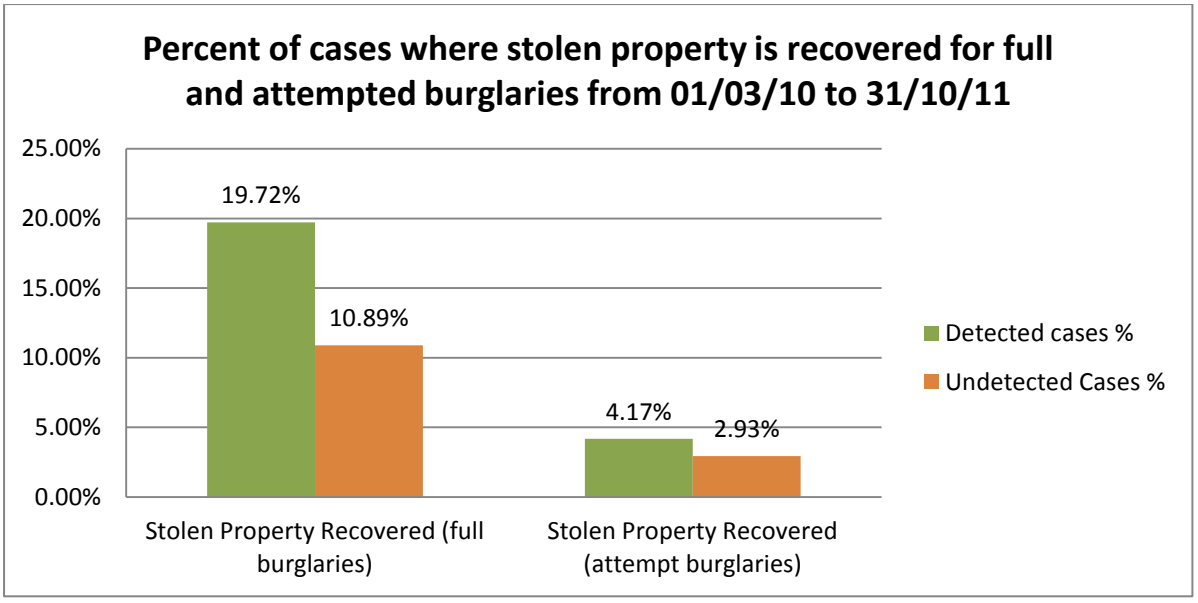
Stolen Property Recovered								
	Detected cases			Undetected Cases				
	n	N	%	n	N	%	Chi-square	d
Stolen Property Recovered (completed burglaries)	248	1257	19.72%	1145	10512	10.89%	13.728**	0.385***
Stolen Property Recovered (attempt burglaries)	6	144	4.17%	70	2393	2.93%	4.113*	0.202

* p<.05

** p<.01

*** p<.001

Figure 4: Stolen Property Recovered Detected and Undetected Cases


Percent of cases where stolen property is recovered for full and attempted burglaries from 01/03/10 to 31/10/11
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
19.72%
10.89%
4.17%
2.93%
Stolen Property Recovered (full burglaries)
Stolen Property Recovered (attempt burglaries)
Detected cases %
Undetected Cases %

Offence Duration

The offence duration is calculated from the difference between when the premises was last left secure to the time when the burglary was discovered. For the detected cases of the completed burglaries the mean offence duration was 23.12 hours (SD 175.57). For the undetected completed burglaries the mean offence duration was 15.48 hours (SD 68.99). An independent samples t-test was conducted in order to measure the difference between the mean offence durations for both detected and undetected burglaries (t=-2.164, p=0.030). The effect size was calculated as very small and this finding was statistically significant (d=-0.069, p=.030).

For the detected cases of the attempted burglaries the mean offence duration was much shorter at 6.26 hours (SD 22.53). For the undetected attempted burglaries the mean offence duration was much greater at 37.62 (SD 354.22). An independent samples t-test was conducted in order to measure the difference between the mean offence durations for both detected and undetected cases(t=-1.001, p=.317). The effect size was calculated as very small and this finding was not statistically significant (d=-0.0914, p=.317).

Table 186: Average Offence Duration Detected and Undetected Cases

Offence Duration								
	Detected Cases			Undetected Cases				
	Mean	Standard Deviation	n	Mean	Standard Deviation	n	t-test	d

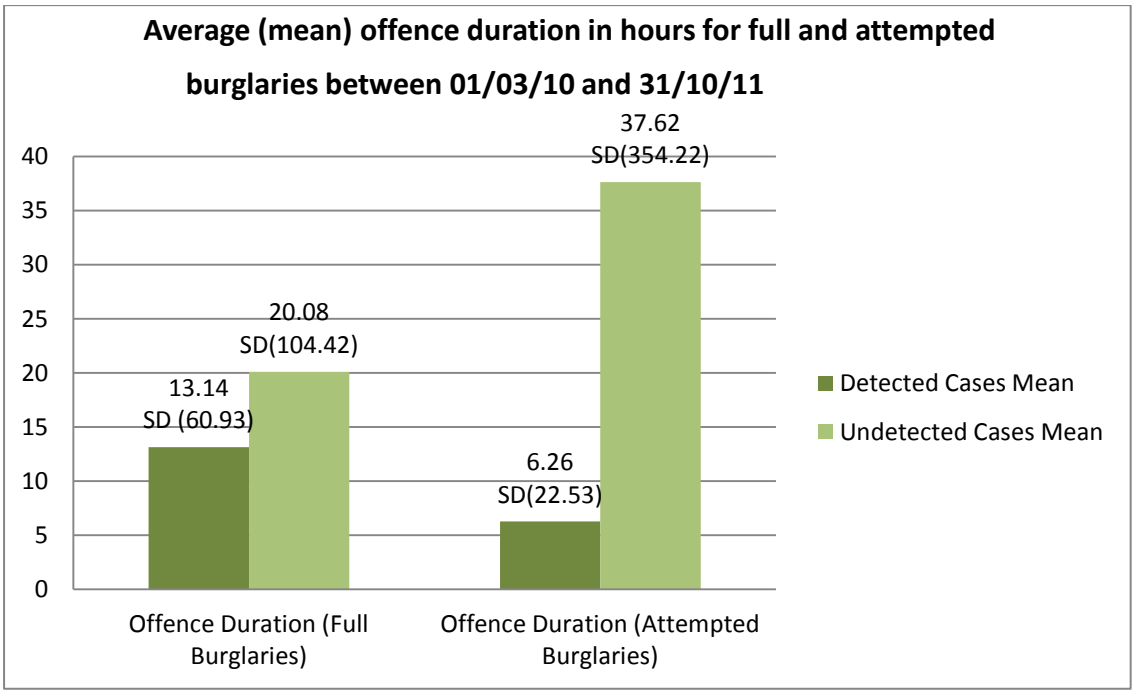
Offence Duration (Completed Burglaries)	13.14	60.93	1106	20.08	104.42	9174	-2.164*	-0.0614*
Offence Duration (Attempted Burglaries)	6.26	22.53	128	37.62	354.22	1927	-1.001	-0.0914

* p<.05

** p<.01

*** p<.001

Figure 15: Average offence duration detected and undetected cases



Time to Attendance of First Officer

The time to the attendance of the first is calculated in minutes from the difference between when the offence was reported until the time when the first member of police personnel arrived on scene. For the detected cases of the completed burglaries the mean time to attendance was 134.35 minutes (SD 456.41). For the undetected completed burglaries the mean offence duration was 184.08 minutes (SD 502.29). An independent samples t-test was conducted in order to measure the difference between the mean offence durations for both detected and undetected burglaries (t=-2.418, p=.016). The effect size was calculated as very small and this finding was statistically significant (-0.078, p=.016).

For the detected cases of the completed burglaries, excluding burglaries in progress, the mean time to attendance was 144.94 minutes (SD 559.817). For the undetected completed burglaries, excluding burglaries in progress, the mean time to attendance was 178.17 minutes (SD 502.184). An independent samples t-test was conducted in order to measure the difference between the mean time to attend for both detected and undetected cases (t=-1.918, p=.030). The effect size was calculated as very small and this finding is statistically significant. (d=-0.0655, p=.030).

For the detected cases of the attempted burglaries the mean time to attendance was much quicker at 86.95 (SD 189.47). For the undetected attempted burglaries the mean time to attendance was much greater at 184.08 (SD 502.29). An independent samples t-test was conducted in order to measure the difference between the mean times to attend for both detected and undetected cases (t=-2.957, p=.003). The effect size was calculated as small and this finding is statistically significant. (d=-0.297, p=.003).

For the detected cases of the attempted burglaries, excluding burglaries in progress, the mean time to attendance 86.95 minutes (SD 189.47). For the undetected attempted burglaries the mean time to attendance was 260.51 (SD 555.259). An independent samples t-test was conducted in order to measure the difference between the mean times to attend for both detected and undetected cases (t=-2.258, p=.003). The effect size was calculated as small and this finding is statistically significant. (d=-0.264, p=.003).

Table 19: Time to attendance of first officer detected and undetected cases

Time to attendance of first officer (minutes)								
	Detected Cases			Undetected Cases				
	Mean	Standard Deviation	n	Mean	Standard Deviation	n	t-test	d
Time to attendance (Completed Burglaries)	134.35	456.41	1640	184.08	502.29	11930	-2.418*	-0.078*
Time to attendance (excluding burglaries in progress) Completed Burglaries	144.94	559.817	945	178.17	502.184	9420	-1.918*	-0.0655*
Time to	86.95	189.47	104	243.95	539.80	2104	-	-0.297**

attendance (Attempted Burglaries)							2.957**	
Time to attendance (excluding burglaries in progress) Attempted burglaries	116.22	214.649	76	260.51	555.259	1961	-2.258**	-0.264**

* p<.05

** p<.01

*** p<.001

Figure 16: Average time to attendance of first officer detected and undetected cases

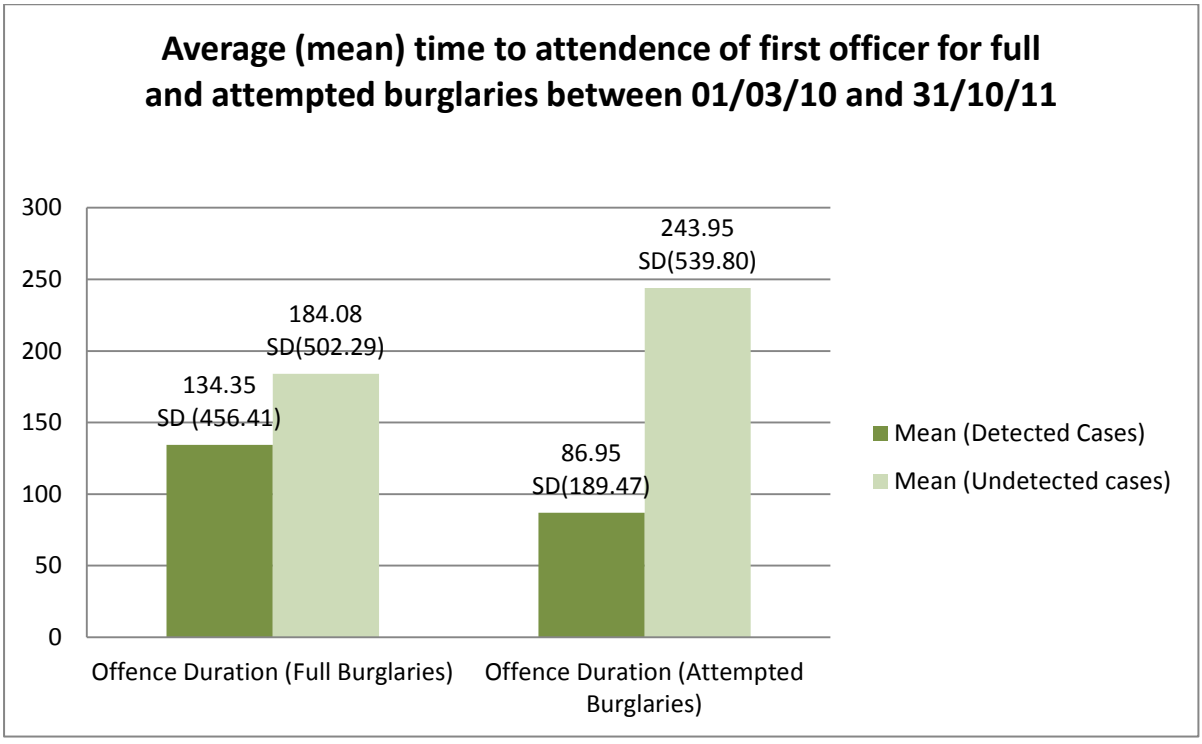


Figure 17 : Average (mean) time to attendance of first officer (minutes) excluding burglaries in progress

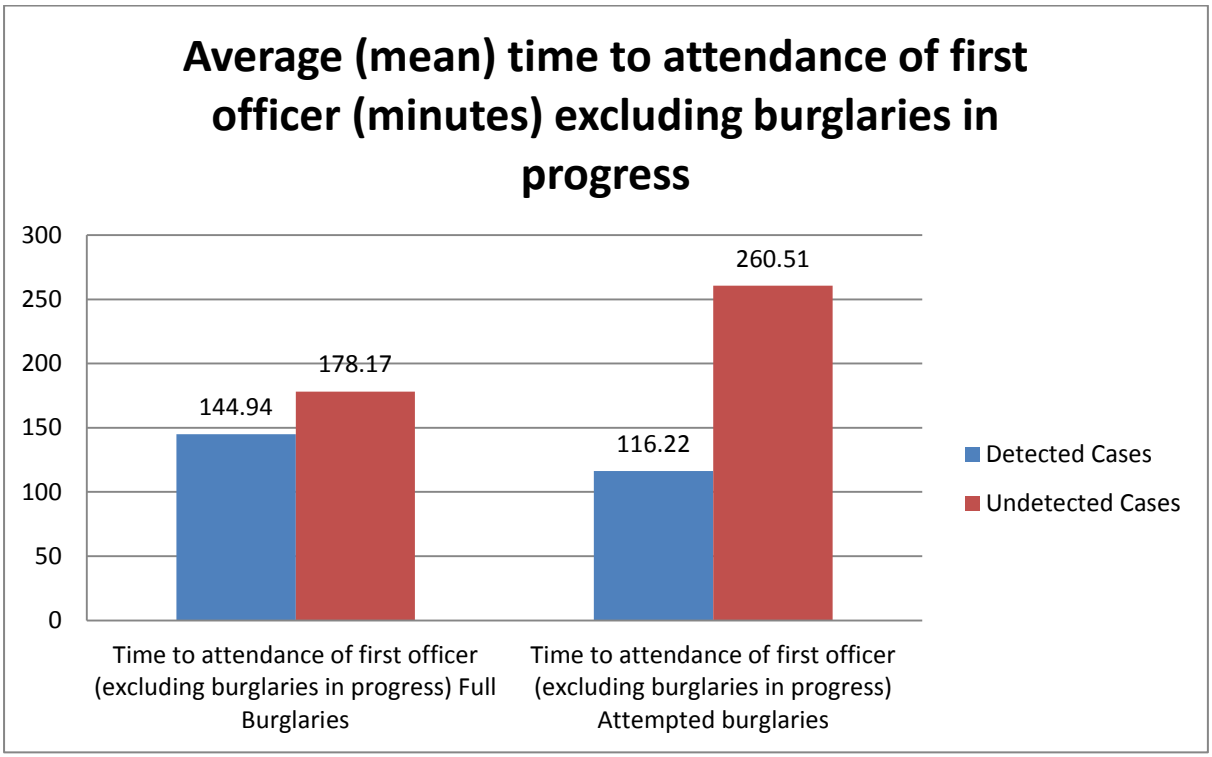
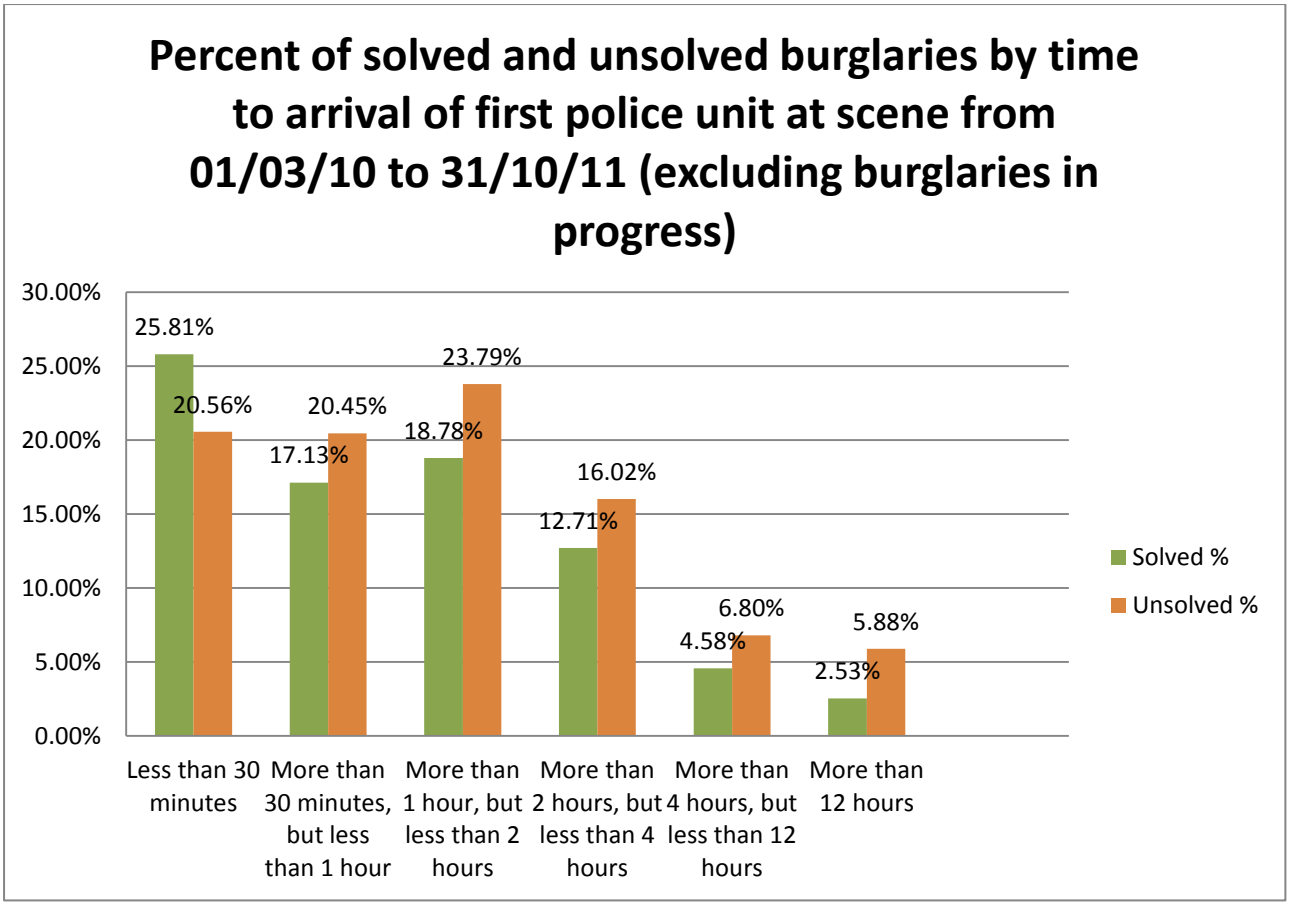


Table 20: Time to at scene excluding burglaries in progress detected and undetected cases

Time to at scene excluding burglaries in progress						
	Solved			Unsolved		
	n	N	%	n	N	%
Less than 30 minutes	327	1267	25.81%	2541	12356	20.56%
More than 30 minutes, but less than 1 hour	217	1267	17.13%	2527	12356	20.45%
More than 1 hour, but less than 2 hours	238	1267	18.78%	2939	12356	23.79%
More than 2 hours, but less than 4 hours	161	1267	12.71%	1980	12356	16.02%
More than 4 hours, but less than 12 hours	58	1267	4.58%	840	12356	6.80%
More than 12 hours	32	1267	2.53%	727	12356	5.88%

Figure 17: Time to at scene excluding burglaries in progress detected and undetected cases


Percent of solved and unsolved burglaries by time to arrival of first police unit at scene from 01/03/10 to 31/10/11 (excluding burglaries in progress)
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
25.81%
20.56%
17.13%
20.45%
18.78%
23.79%
12.71%
16.02%
4.58%
6.80%
2.53%
5.88%
Less than 30 minutes
More than 30 minutes, but less than 1 hour
More than 1 hour, but less than 2 hours
More than 2 hours, but less than 4 hours
More than 4 hours, but less than 12 hours
More than 12 hours
Solved %
Unsolved %

Effect Size Analysis

An effect size analysis was completed for each of the variables for both the completed and the attempted burglaries. The results were then presented in the form of forest plots (see figures 27 to 34 below).

There were a substantial range of effect sizes for the variables. The effect size for the forensic solvability factors are very large for both completed and attempted burglaries. DNA recovered has a very large effect size for completed burglaries (1.556***) and for attempted burglaries (1.303**). Fingerprints recovered also has a large effect size for completed burglaries (1.076***) and an even larger effect size for attempted burglaries (1.526***). Surprisingly however footwear marks recovered has the largest effect size of any of the variables for completed burglaries (1.616***) and it is also very large for attempted burglaries (1.333**).

The effect sizes for the offender being seen are medium for both completed (0.606***) and attempted burglaries (0.673***). The effect size for burglaries reported as in progress is larger for attempted burglaries (0.736***) than for completed burglaries (0.457***). The same is true for witness reports of the offence in the case of attempted burglaries (0.765***) and completed burglaries (0.573***).

The effect sizes for the majority of the offender MO variables are not statistically significant with the exception of anything being left at the scene by the offender in completed burglaries (0.326***), whether a vehicle was stolen (0.300***), whether the premises were occupied at the time of the offence (0.184***) and, bizarrely, whether clothing was stolen only in the case of attempted burglaries (2.157*).

Interestingly the effect size for CCTV being preserved is very small and not statistically significant for both completed (-0.007) and attempted burglaries (-0.033). It is also of interest that the effect size for house to house being completed is negative for both completed (-0.635***) and attempted burglaries (-0.685***).

Figure 18: Effect Size Analysis all variables for Completed Residential Burglaries

Variable	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
House to house completed	-0.635	0.040	0.002	-0.714	-0.556	-15.714	0.000
Antiques Stolen	-0.547	0.399	0.159	-1.329	0.234	-1.372	0.170
Premises were unoccupied.	-0.256	0.033	0.001	-0.321	-0.192	-7.764	0.000
Jewellery stolen	-0.236	0.049	0.002	-0.333	-0.139	-4.784	0.000
Offender MO: Untidy search	-0.190	0.038	0.001	-0.265	-0.116	-4.993	0.000
Offender MO; Search whole house	-0.162	0.036	0.001	-0.233	-0.090	-4.451	0.000
Power tools stolen	-0.139	0.175	0.030	-0.481	0.204	-0.794	0.427
Time to attend	-0.078	0.032	0.001	-0.142	-0.015	-2.418	0.016
Offence Duration	-0.069	0.032	0.001	-0.131	-0.007	-2.166	0.030
Camcorda / camera stolen	-0.066	0.067	0.004	-0.196	0.065	-0.986	0.324
Premises was subject to a previous burglary	-0.044	0.048	0.002	-0.138	0.049	-0.931	0.352
Number of supervisory reviews	-0.035	0.030	0.001	-0.094	0.023	-1.176	0.240
Offender MO: Thorough search	-0.028	0.067	0.005	-0.160	0.103	-0.422	0.673
Household electrical stolen	-0.025	0.095	0.009	-0.211	0.160	-0.268	0.789
Offender MO: Tidy search	-0.013	0.033	0.001	-0.078	0.052	-0.400	0.689
Computer stolen	-0.011	0.039	0.001	-0.087	0.065	-0.283	0.777
CCTV Preserved	-0.007	0.035	0.001	-0.076	0.061	-0.207	0.836
Committed during daylight	0.015	0.036	0.001	-0.055	0.085	0.419	0.675
Cheque book / credit cards stolen	0.017	0.072	0.005	-0.124	0.157	0.231	0.818
Property stolen	0.029	0.039	0.001	-0.047	0.104	0.744	0.457
Cash stolen	0.079	0.094	0.009	-0.106	0.264	0.838	0.402
Committed during darkness	0.081	0.034	0.001	0.014	0.149	2.366	0.018
Clothing stolen	0.155	0.141	0.020	-0.121	0.431	1.102	0.270
Description of offenders vehicle recorded	0.160	0.180	0.032	-0.193	0.512	0.889	0.374
Premises were occupied	0.184	0.034	0.001	0.117	0.251	5.397	0.000
Media appeal completed	0.223	0.073	0.005	0.080	0.366	3.054	0.002
Vehicle stolen in crime	0.300	0.063	0.004	0.177	0.423	4.782	0.000
Anything left at scene by the offender.	0.326	0.050	0.003	0.228	0.425	6.492	0.000
Suspect description recorded	0.365	0.138	0.019	0.095	0.635	2.648	0.008
Offender disturbed	0.381	0.044	0.002	0.294	0.468	8.617	0.000
Any stolen property recovered.	0.385	0.043	0.002	0.301	0.469	9.015	0.000
Offenders vehicle sighted.	0.413	0.088	0.008	0.241	0.585	4.703	0.000
Reported as burglary in progress	0.457	0.063	0.004	0.335	0.580	7.314	0.000
Witness report of offence	0.573	0.042	0.002	0.491	0.655	13.713	0.000
Offender seen	0.606	0.042	0.002	0.524	0.689	14.393	0.000
Fingerprints recovered	1.076	0.048	0.002	0.983	1.169	22.634	0.000
DNA recovered	1.556	0.073	0.005	1.412	1.699	21.311	0.000
Footwear marks recovered	1.616	0.125	0.016	1.371	1.862	12.912	0.000
Suspect named	5.170	0.780	0.608	3.642	6.699	6.629	0.000
	0.201	0.059	0.004	0.084	0.317	3.376	0.001

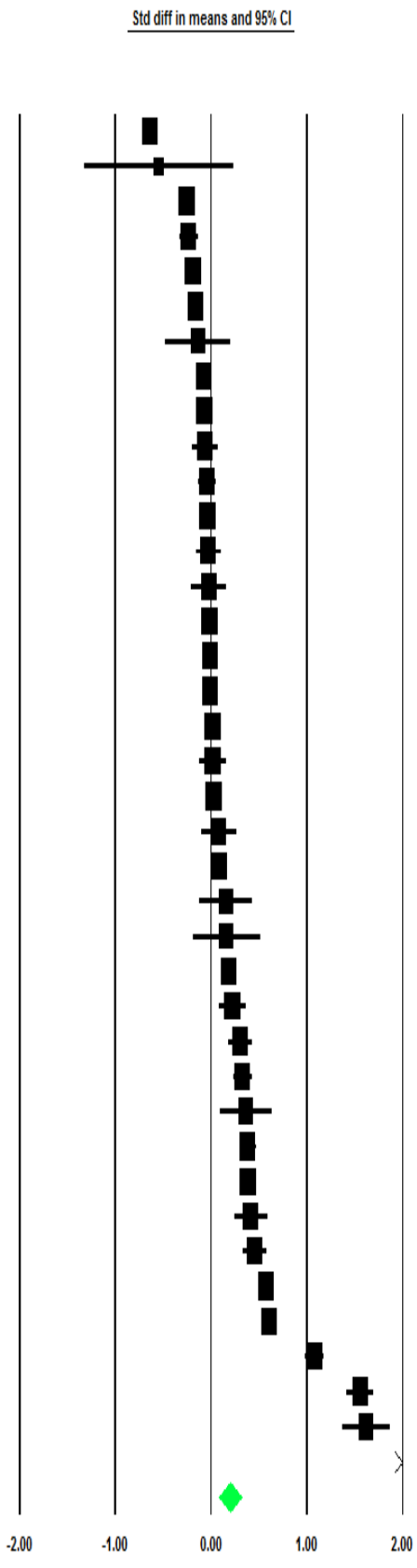


Figure 19: Effect Size Analysis for Attempted Residential Burglaries

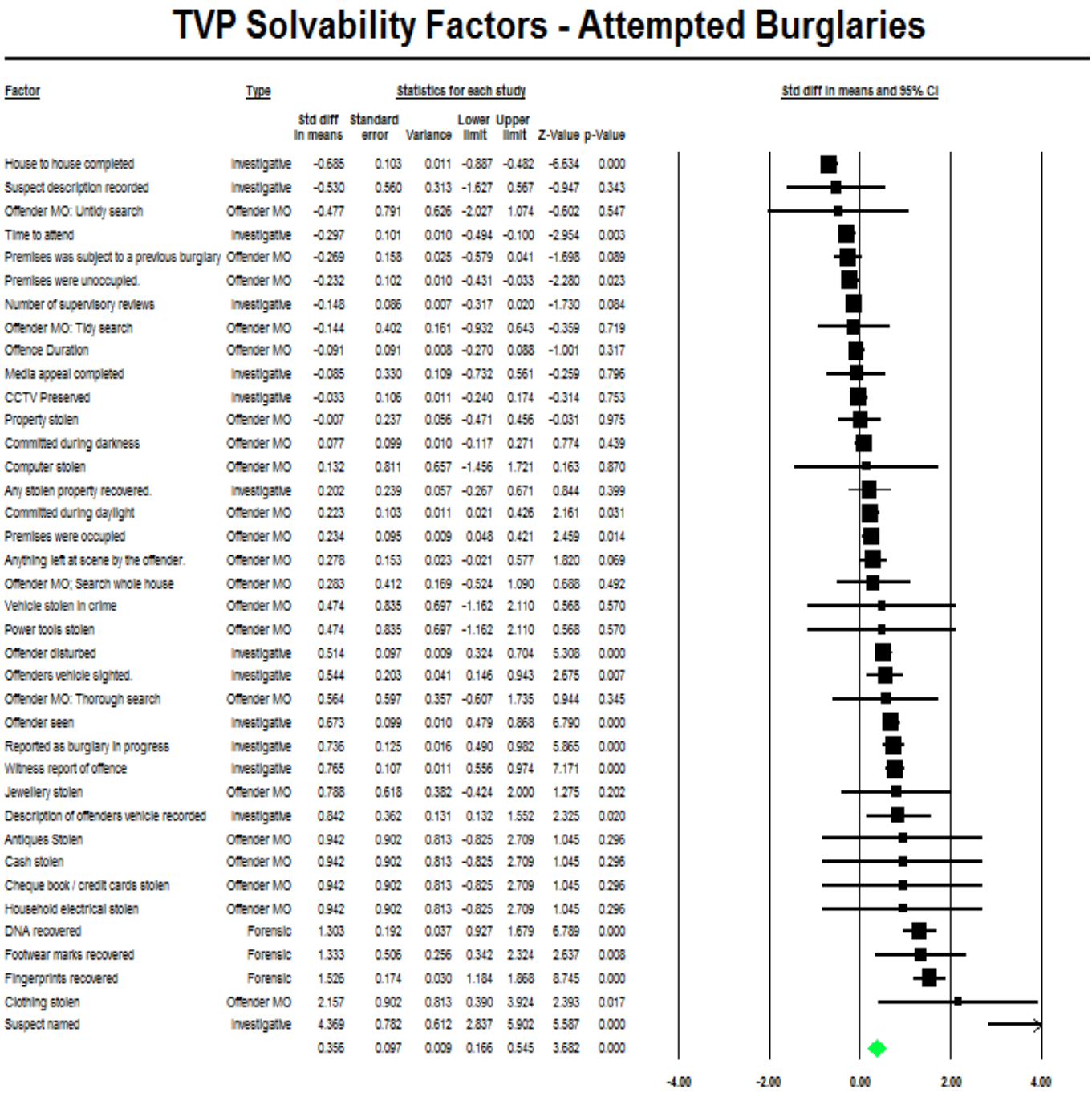


Figure 20: Attempted Burglary Effect Size Analysis - forensic subgroup

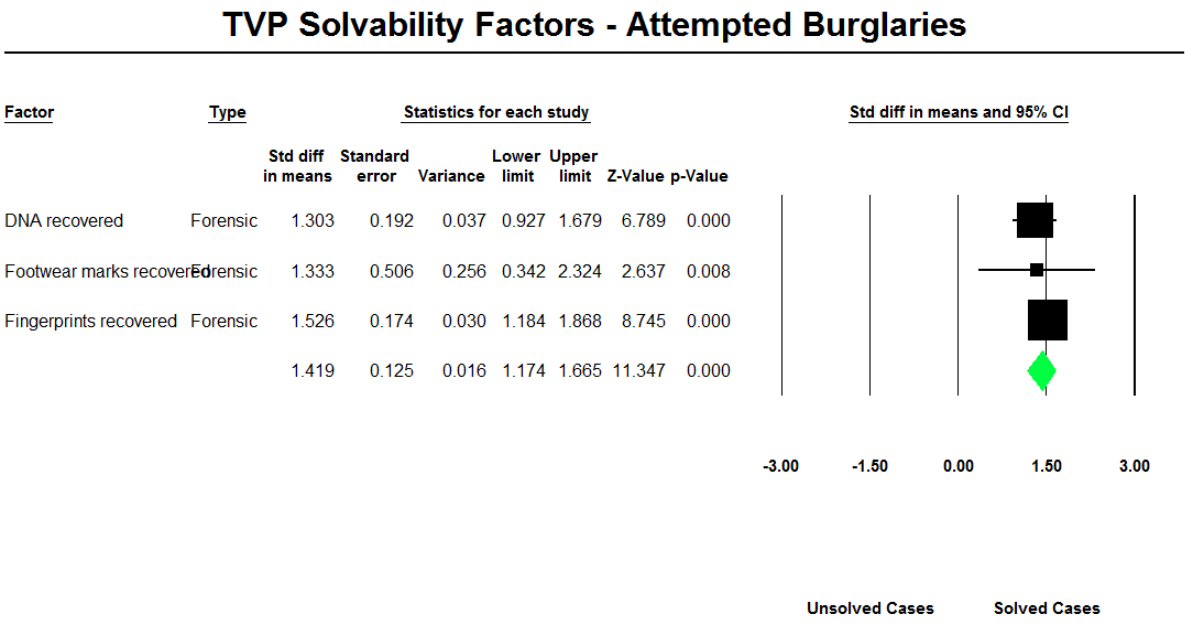


Figure 51 : Completed Burglary Effect Size Analysis - forensic subgroup

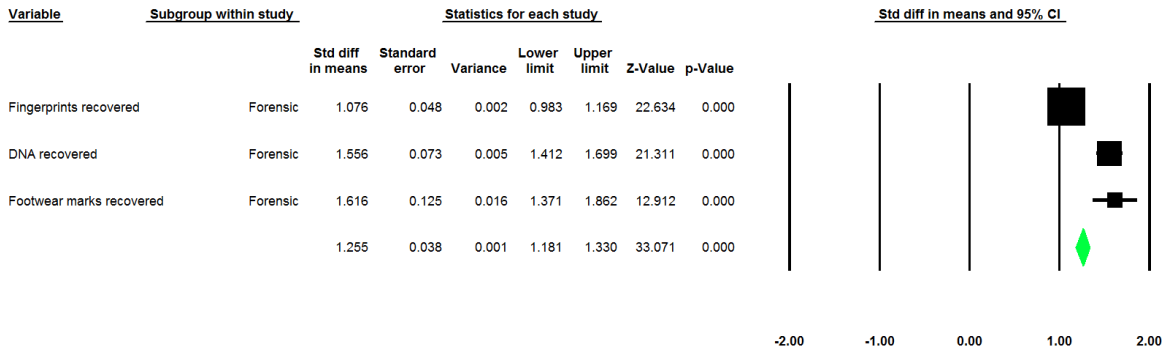
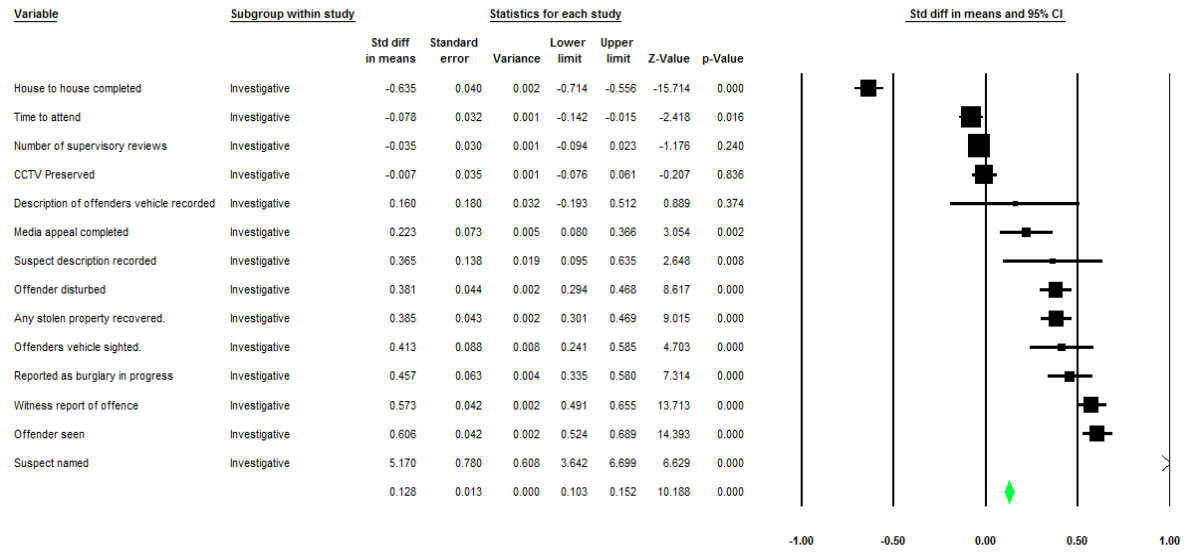
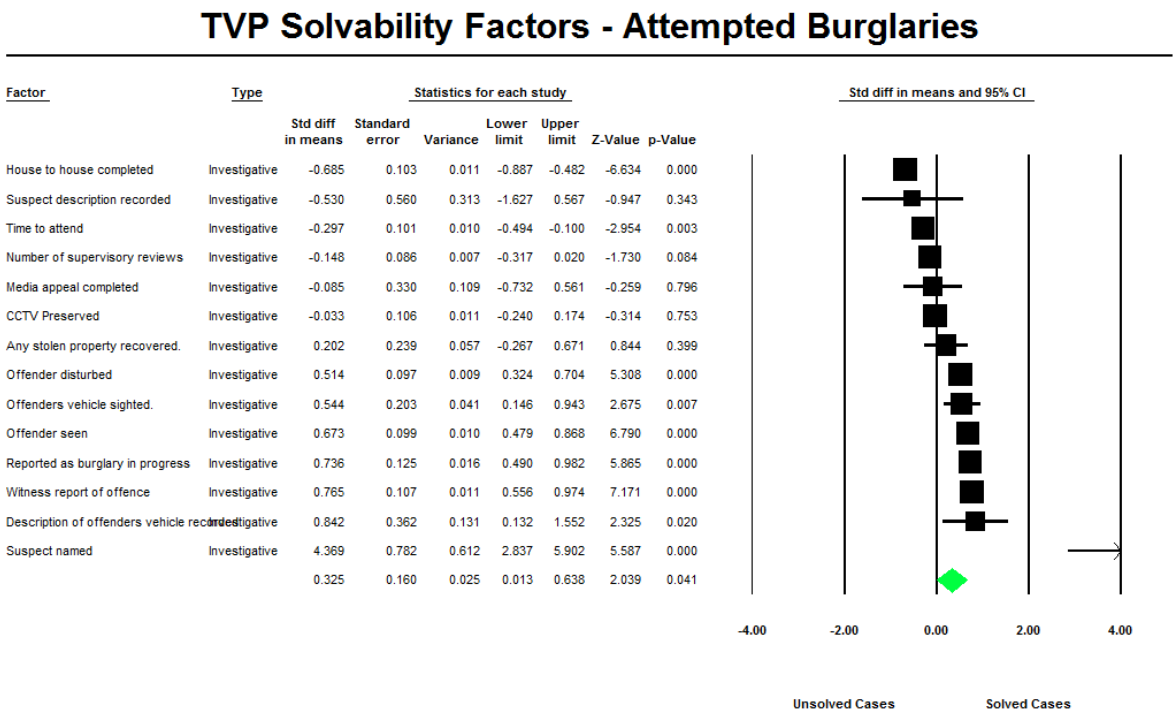


Figure 22 : Completed Burglary Effect Size Analysis - Investigative Subgroup



Variable	Subgroup within study	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
House to house completed	Investigative	-0.635	0.040	0.002	-0.714	-0.556	-15.714	0.000
Time to attend	Investigative	-0.078	0.032	0.001	-0.142	-0.015	-2.418	0.016
Number of supervisory reviews	Investigative	-0.035	0.030	0.001	-0.094	0.023	-1.176	0.240
CCTV Preserved	Investigative	-0.007	0.035	0.001	-0.076	0.061	-0.207	0.836
Description of offenders vehicle recorded	Investigative	0.160	0.180	0.032	-0.193	0.512	0.889	0.374
Media appeal completed	Investigative	0.223	0.073	0.005	0.080	0.366	3.054	0.002
Suspect description recorded	Investigative	0.365	0.138	0.019	0.095	0.635	2.648	0.008
Offender disturbed	Investigative	0.381	0.044	0.002	0.294	0.468	8.617	0.000
Any stolen property recovered.	Investigative	0.385	0.043	0.002	0.301	0.469	9.015	0.000
Offenders vehicle sighted.	Investigative	0.413	0.088	0.008	0.241	0.585	4.703	0.000
Reported as burglary in progress	Investigative	0.457	0.063	0.004	0.335	0.580	7.314	0.000
Witness report of offence	Investigative	0.573	0.042	0.002	0.491	0.655	13.713	0.000
Offender seen	Investigative	0.606	0.042	0.002	0.524	0.689	14.393	0.000
Suspect named	Investigative	5.170	0.780	0.608	3.642	6.699	6.629	0.000
		0.128	0.013	0.000	0.103	0.152	10.188	0.000

Figure 23 : Attempted Burglary Effect Size Analysis - Investigative Subgroup



Factor	Type	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
House to house completed	Investigative	-0.685	0.103	0.011	-0.887	-0.482	-6.634	0.000
Suspect description recorded	Investigative	-0.530	0.560	0.313	-1.627	0.567	-0.947	0.343
Time to attend	Investigative	-0.297	0.101	0.010	-0.494	-0.100	-2.954	0.003
Number of supervisory reviews	Investigative	-0.148	0.086	0.007	-0.317	0.020	-1.730	0.084
Media appeal completed	Investigative	-0.085	0.330	0.109	-0.732	0.561	-0.259	0.796
CCTV Preserved	Investigative	-0.033	0.106	0.011	-0.240	0.174	-0.314	0.753
Any stolen property recovered.	Investigative	0.202	0.239	0.057	-0.267	0.671	0.844	0.399
Offender disturbed	Investigative	0.514	0.097	0.009	0.324	0.704	5.308	0.000
Offenders vehicle sighted.	Investigative	0.544	0.203	0.041	0.146	0.943	2.675	0.007
Offender seen	Investigative	0.673	0.099	0.010	0.479	0.868	6.790	0.000
Reported as burglary in progress	Investigative	0.736	0.125	0.016	0.490	0.982	5.865	0.000
Witness report of offence	Investigative	0.765	0.107	0.011	0.556	0.974	7.171	0.000
Description of offenders vehicle recorded	Investigative	0.842	0.362	0.131	0.132	1.552	2.325	0.020
Suspect named	Investigative	4.369	0.782	0.612	2.837	5.902	5.587	0.000
		0.325	0.160	0.025	0.013	0.638	2.039	0.041

Figure 24 : Attempted Burglary Effect Size Analysis - Offender MO subgroup

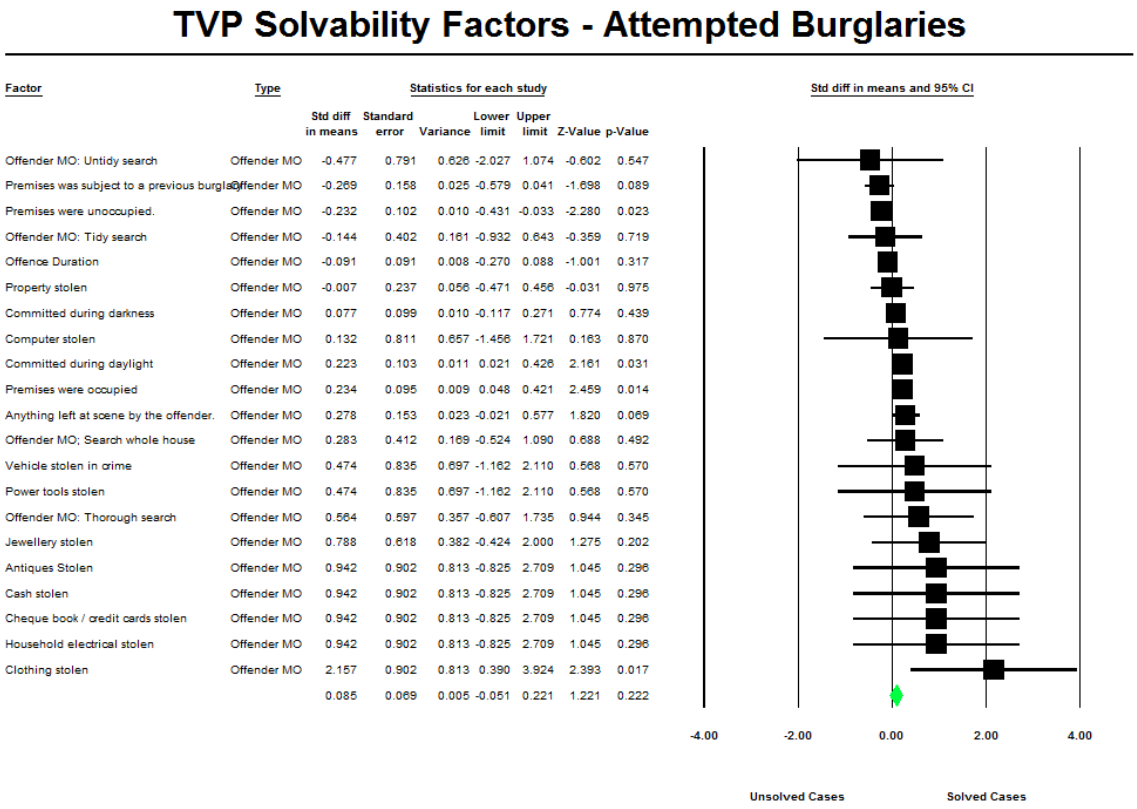


Figure 256 : Completed Burglary Effect Size Analysis - Offender MO Subgroup

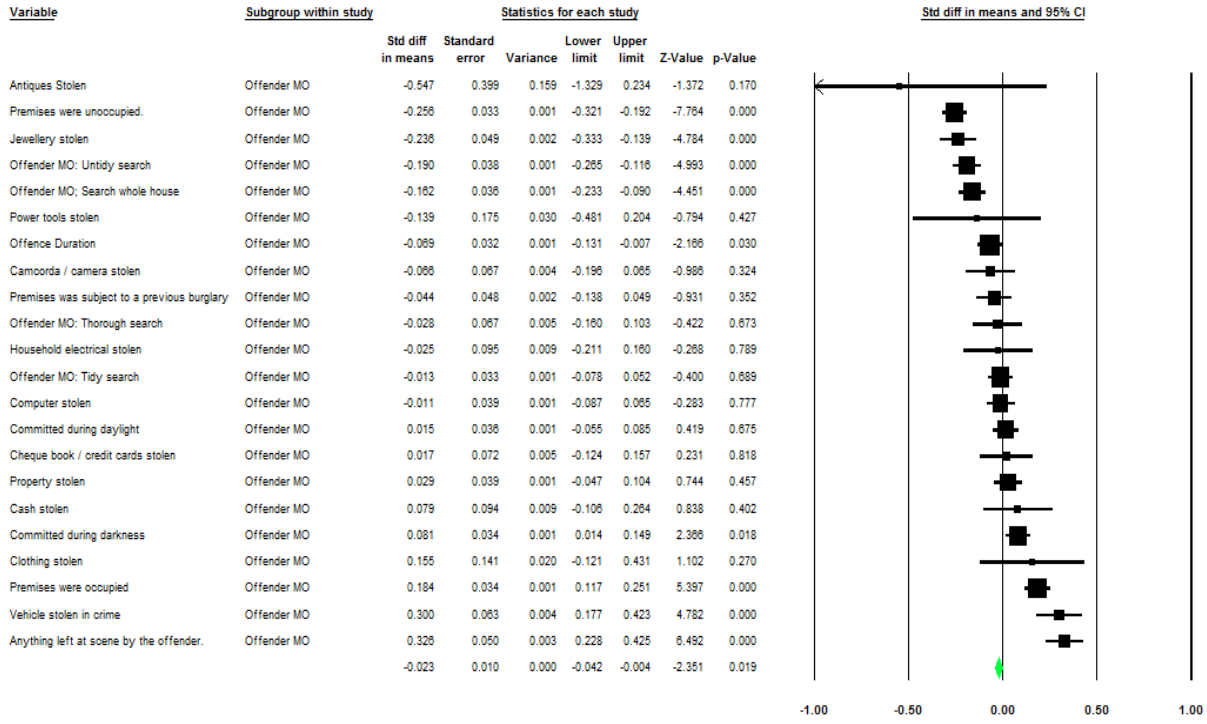


Table 21: Comparison of Solvability Factors by Effect Sizes for Completed and Attempted Burglary

Comparison of Solvability Factors by Effect Sizes for Completed and Attempted Burglary		
Variable	Completed Burglary	Attempted Burglary
Footwear Impressions Recovered	1.616***	1.333**
DNA Recovered	1.556***	1.303***
Fingerprints Recovered	1.076***	1.526***
Offender Seen	0.606***	0.673***
Witness Report of Offence	0.573***	0.765***
Reported as Burglary In Progress	0.457***	0.736***
Offenders Vehicle Sighted	0.413***	0.544**
Any stolen Property Recovered	0.385***	0.202
Offender Disturbed	0.381***	0.514***
Suspect description recorded	0.365**	-0.530
Anything left at scene by	0.326***	0.278

offender		
Vehicle stolen in crime	0.300***	0.474
Media Appeal Completed	0.223**	-0.085
Premises were occupied	0.184***	0.234*
Description of offenders vehicle recorded	0.160	0.842*
Clothing Stolen	0.155	2.157*

Identification of Solvability Factors for completed Burglaries

The top 14 factors were identified as solvability factors by reference to their effect size. Those factors with a more than trivial effect size were included. These are footwear marks recovered, DNA recovered, FP recovered, offender seen, witness report of offence, burglary in progress, offenders vehicle sighted, stolen property recovered, offender disturbed, offender description recorded, anything left at scene, vehicle stolen in crime, media appeal completed and premises were occupied. Of these 14 factors analysis was conducted to determine the total predictive accuracy of each of these solvability factors alone. Each factor had a surprisingly high predictive accuracy of final case outcome with all but one of the factors predicting final case outcome with over 80% accuracy. The only exception being premises were occupied which accurately predicted just 61% of final case outcomes and was therefore eliminated as a solvability factor. Media appeal completed was also eliminated as a solvability factor as to admit it could produce 100% case assignment as officers could conduct a media appeal on *any* case they

wish to investigate. The description of the offender's vehicle and whether clothing was stolen were not included as the findings were not statistically significant. Whether the offence was committed during the hours of darkness and the offence duration were not included as the effect sizes were too small to be practically meaningful.

Frequency Analysis of Solvability Factors

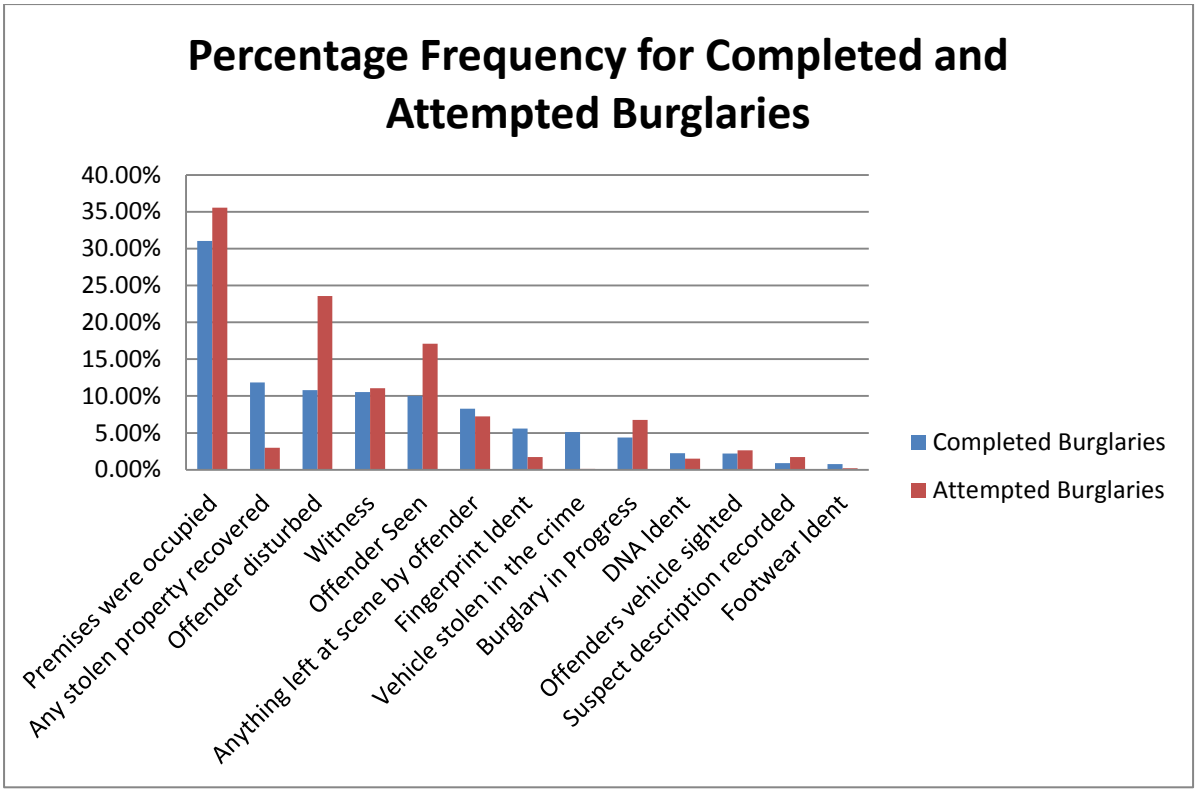
I then conducted an analysis of the frequency with which these solvability factors occur within the sample for both completed and attempted burglaries. The most powerful solvability factors, the recovery of forensic material, occur infrequently. However, these occur more frequently for the completed offence of burglary than for attempted offences. The offender is disturbed in cases of attempted burglary far more frequently than in completed burglaries.

Of the total sample of 14306 burglaries 7946 (55.54%) had one or more solvability factors present. Of the 1401 solved burglaries 1161 (82.87%) had one or more solvability factors present and 240 (17.13%) had no solvability factors present. Of the 11769 completed burglaries 6589 (55.99%) had one or more solvability factors present. Of the 1257 solved completed burglaries 1036 (82.42%) had one or more solvability factors present and 221 (17.58%) had no solvability factors present. Of the 2537 attempted burglaries 1357 (53.49%) had one or more solvability factors present. Of the 144 solved attempted burglaries 125 (86.81%) had one or more solvability factors present and 19 (13.20%) had no solvability factors present.

Table 21: Frequency of Solvability Factors

Frequency of Solvability Factors for Full Residential Burglary and attempted Burglary		
Solvability Factor	Full Burglary	Attempted Burglary
Footwear Ident	0.77% (91)	0.20% (5)
DNA Ident	2.23% (262)	1.50% (38)
Fingerprint Ident	5.57% (655)	1.73% (44)
Offender Seen	10.03% (1181)	17.11% (434)
Witness	10.55% (1242)	11.08% (281)
Burglary in Progress	4.35% (512)	6.74% (171)
Offenders vehicle sighted	2.18% (324)	2.64% (67)
Any stolen property recovered	11.84% (1393)	3% (76)
Offender disturbed	10.81% (1272)	23.57% (598)
Suspect description recorded	0.91% (107)	1.73% (44)
Anything left at scene by offender	8.29% (976)	7.25% (184)
Vehicle stolen in the crime	5.12% (602)	0.12% (3)
Premises were occupied	31.03% (3652)	35.55% (902)

Figure 267: Frequency of Solvability Factors



Summary

The descriptive analysis identified that the geographic distribution of residential burglary is uneven with some police areas having as much as 10 times the levels of burglary of others. The number of completed burglaries is significantly greater than the number of attempted burglaries. Most burglaries are solved either by way of a charge or by the offence being taken into consideration (TIC). Interestingly the detection rate for completed burglaries is almost twice that for attempted burglaries. The detection rates for burglary vary considerably during the course of the day and during the course of the week. There are also considerable differences in the detection rates when analysed by reference to police area.

The analysis identified a range of variables correlated to solved cases. Those variables with the greatest effect sizes were identified as recovery of footwear marks, recovery of DNA, recovery of fingerprints, offender seen, witness report of offence,

reported as burglary in progress, the offenders vehicle being sighted, the recovery of stolen property, the offender was disturbed, the suspect description being recorded, anything being left at the scene by the offender, vehicle stolen in the crime, media appeal being completed and whether the premises were occupied. Many of the effect sizes are similar for both completed and attempted burglaries. However, the solvability factors with the greatest effect sizes occur less frequently than those solvability factors with much smaller effect sizes.

The effect sizes for the offence duration and time to the arrival of first officer were smaller than expected and so not selected as solvability factors. Interestingly however even when burglaries in progress were removed from the sample the average time to arrival of first officer was much lower for solved cases than for unsolved cases.

Predictive Analysis of Solvability Variables

To determine the effectiveness of these solvability factors in predicting the outcome of burglary investigations each solvability factor was tested against the sample of 11769 completed burglaries. All the solvability factors, except whether the premises were occupied, had a total predictive accuracy in excess of 80%. On this basis premises being occupied was eliminated as a solvability factor.

Table 227: Effectiveness of Individual Solvability Factors in Predicting Case Outcomes for Completed Burglary Offences

Effectiveness of Solvability factors in predicting case outcomes for completed burglary offences											
	Correctly predicted to be solved	% Correctly predicted to be solved	Correctly predicted not to be solved	% Correctly predicted not to be solved	Total predictive accuracy	% total predictive accuracy	Predicted to be solved, but was not solved wasted investigations	% wasted investigations	Predicted not to be solved, but was solved lost detections	% lost detections	Total cases assigned for investigation
All cases	1257	100	10512	100			10512	100	0	0	11769
Footwear Impression recovered	64	5.09	10483	99.724	10547	89.617	29	0.2759	1195	95.068	91
DNA recovered	167	13.286	10417	99.096	10584	89.931	95	0.9037	1090	86.714	262
Fingerprint	267	21.241	10124	96.309	10391	88.291	388	3.691	990	78.759	655
Offender Seen	277	22.037	9608	91.4	9885	83.992	904	8.5997	980	77.963	1181
Witness	279	22.196	9549	90.839	9828	83.508	963	9.161	978	77.804	1242
Burglary in Progress	106	8.4328	10106	96.138	10212	86.77	406	3.8623	1151	91.567	512
Offenders vehicle sighted	51	4.0573	10306	98.04	10357	88.002	206	1.9597	1206	95.943	257
Any stolen property recovered	248	19.73	9367	89.108	9615	81.698	1145	10.892	1009	80.27	1393
Offender disturbed	227	18.059	9467	90.059	9694	82.369	1045	9.941	1030	81.941	1272
Suspect description recorded	20	1.5911	10425	99.172	10445	88.75	87	0.8276	1237	98.409	107
Anything left at scene by offender	165	13.126	9701	92.285	9866	83.83	811	7.715	1092	86.874	976
Media appeal completed	71	5.6484	10108	96.157	10179	86.49	1186	11.282	404	32.14	475
Vehicle stolen in the crime	100	7.9554	10010	95.225	10110	85.904	502	4.7755	1157	92.045	602
Premises were occupied	474	37.709	7234	68.817	7708	65.494	100	0.9513	770	61.257	3652

The 12 remaining solvability factors were then tested against the full sample of 11769 burglaries to determine the accuracy of any one or more of these factors in predicting case outcomes. As the number of solvability factors per case increases the number of cases predicted to be solved and are solved falls as does the number of wasted investigations. However, as the number of solvability factors increases the number of cases predicted not to be solved and in fact are not solved increases as does the number of lost detections. The total number of cases assigned for investigation falls until it reaches the point where it becomes a no case assignment model.

Table 23: Effectiveness of Multiple Solvability Factors in Predicting Case Outcomes for completed burglary offences

Effectiveness of Solvability factors in predicting case outcomes for full burglary offences						
Number of solvability factors	Correctly predicted to be solved (True positive)	Correctly predicted not to be solved (True negative)	Total predictive accuracy	Predicted to be solved, but was not solved (wasted investigations)	Predicted not to be solved, but was solved (lost detections)	Total cases assigned for investigation
All cases	1257	10512	11769	10512	1257	11769
1	73.35% 922	61.41% 6455	62.68% 7377	38.59% 4057	26.65% 335	42.31% 4979
2	41.29% 519	85.43% 8980	80.71% 9499	14.57% 1532	58.71% 738	17.43% 2051
3	22.75% 286	93.75% 9855	86.17% 10141	6.25% 657	77.25% 971	8.01% 943
4	12.25% 154	97.56% 10256	88.45% 10410	2.44% 256	87.75% 1103	3.48% 410
5	5.17% 65	99.35% 10444	89.29% 10509	0.65% 68	94.83% 1192	1.13% 133
6	1.51% 19	99.90% 10502	89.40% 10521	 10	98.50% 1238	0.25% 29
7	0.32% 4	99.99% 10511	89.34% 10515	 1	99.68% 1253	 5

Figure 26: Solvability Factors: Relationship between predictive accuracy, lost detections and case assignment

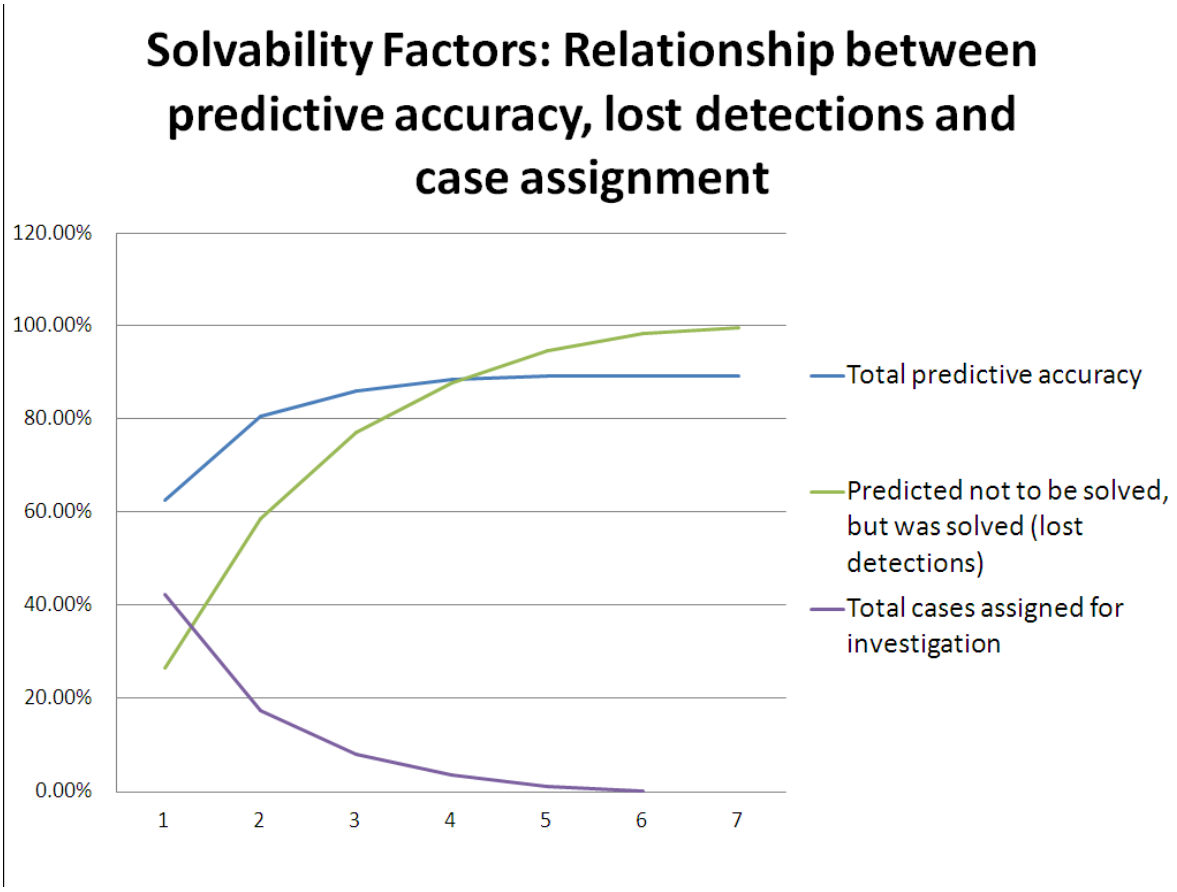
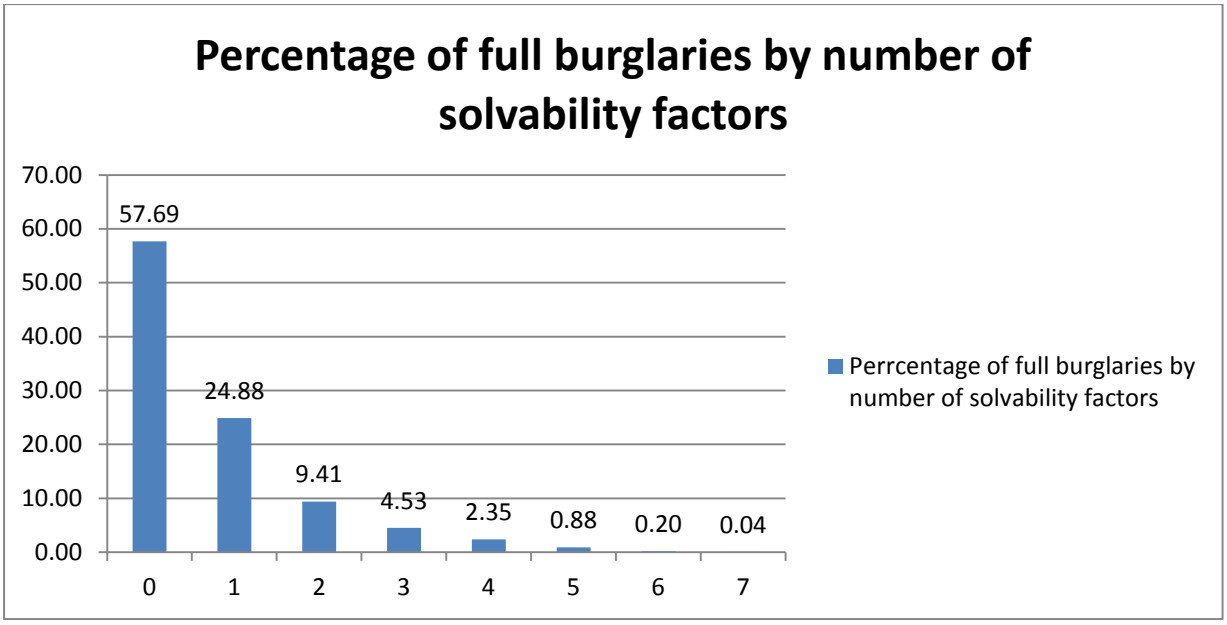


Figure 27 : Percentage of completed burglaries by the number of solvability factors present



Burglaries Solved in the Absence of Solvability Factors

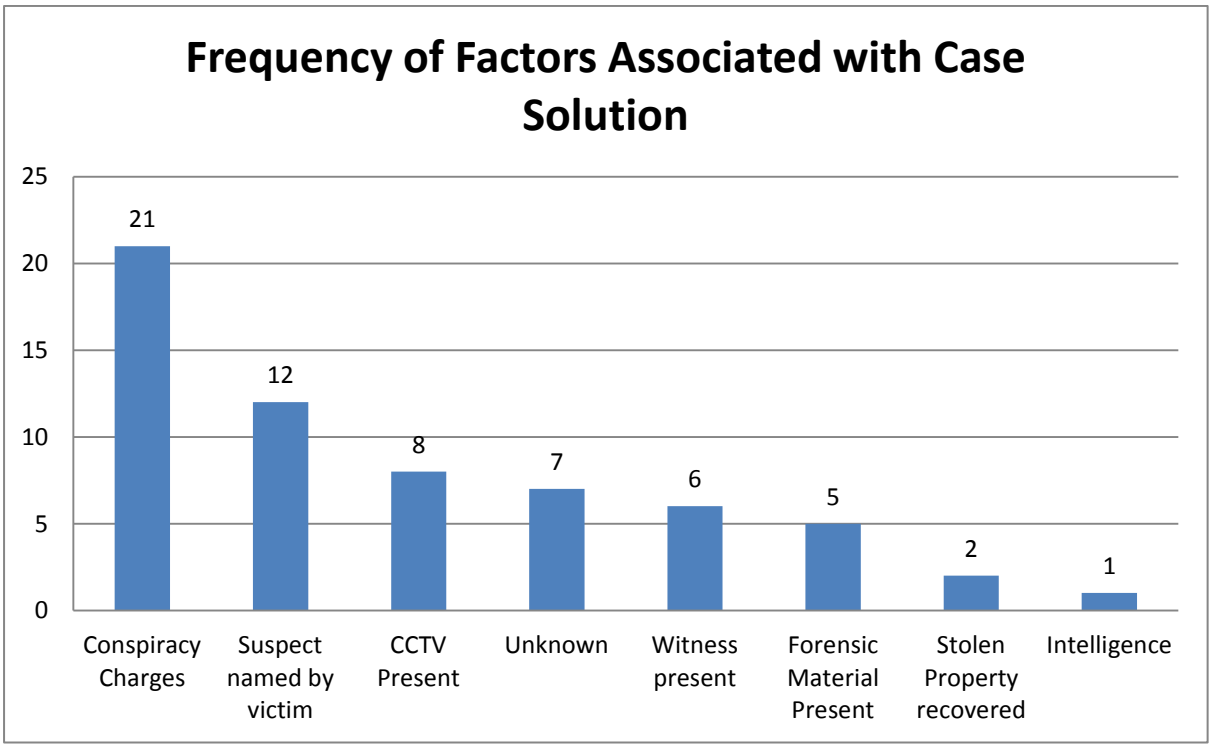
Of the 1401 solved residential burglaries 1029 (73.45%) had 1 or more solvability factors present. 372 (26.55%) solved residential burglaries had no solvability factors present. Of these 372 a random sample of 62 was selected and the records reviewed to determine the factor most strongly associated with case solution.

The suspect being charged with conspiracy to burgle was the most common, occurring 21 times. The next most common was the suspect being named by the victim which occurred 12 times. The presence of a witness or the recovery of stolen property are both identified solvability factors, but were not identified as such within the crime report. In 7 of the cases it was not possible from the crime report or investigation management module to determine the factor most strongly correlated with case solution.

Table 24: Frequency of Factors Associated with Solved Burglaries where no Solvability Factors Present

Frequency of factors associated with case solution in random sample of 62 solved burglaries with no solvability factors present.		
CCTV Present	8	12.90
Forensic material present	5	8.06
Intelligence	1	1.61
Stolen property recovered	2	3.23
Conspiracy Charges	21	33.87
Suspect named by victim	12	19.35
Witness present	6	9.68
Unknown	7	11.29
Total	62	

Figure 28: Frequency of Factors Associated with Case Solution where no Solvability Factors Present



Geographic Distribution of Solvability Factors

The distribution of solvability factors across policing areas is not uniform; burglaries in some policing areas have a higher rate of solvability factors than in others. The area with the highest rate of solvability factors was Windsor and Maidenhead (65.60%) and the area with the lowest rate of solvability factors was Wycombe (50.16%).

There is no clear correlation between the rate of solvability factors and the actual detection rate by LPA. This would indicate that factors other than just solvability factors are at work in the detection of burglary. Factors such as available investigative resources, workloads, working practices, supervision and investigator motivation might all play a part.

Table 25: Rate of burglaries with at least one solvability factor by LPA

Burglaries with one or more solvability factors present					
Local Police Area (LPA)	Number of burglaries with one or more solvability factors present	Number of burglaries with no solvability factors present	Total Number of burglaries	Percentage of burglaries with one or more solvability factors present	Percentage of burglaries solved. (Detection rate).
Aylesbury Vale	345	283	628	54.94	11.00
Bracknell Forest	236	125	361	65.37	12.12
Cherwell	218	165	383	56.92	11.46
Chiltern and South Bucks	636	478	1114	57.09	7.04
Milton Keynes	820	675	1495	54.85	13.10
Oxford	561	482	1043	53.79	10.51
Reading	1325	1080	2405	55.09	7.15

Slough	885	863	1748	50.63	6.70
South and Vale	396	356	752	52.66	24.73
West Berkshire	489	394	883	55.38	8.88
West Oxfordshire	141	98	239	59.00	8.37
Windsor and Maidenhead	858	450	1308	65.60	8.69
Wokingham	420	298	718	58.50	10.46
Wycombe	616	612	1228	50.16	8.12
All LPAs	7946	6360	14306	55.54	9.79

Figure 29: Percent of all burglaries with at least one solvability factor by LPA

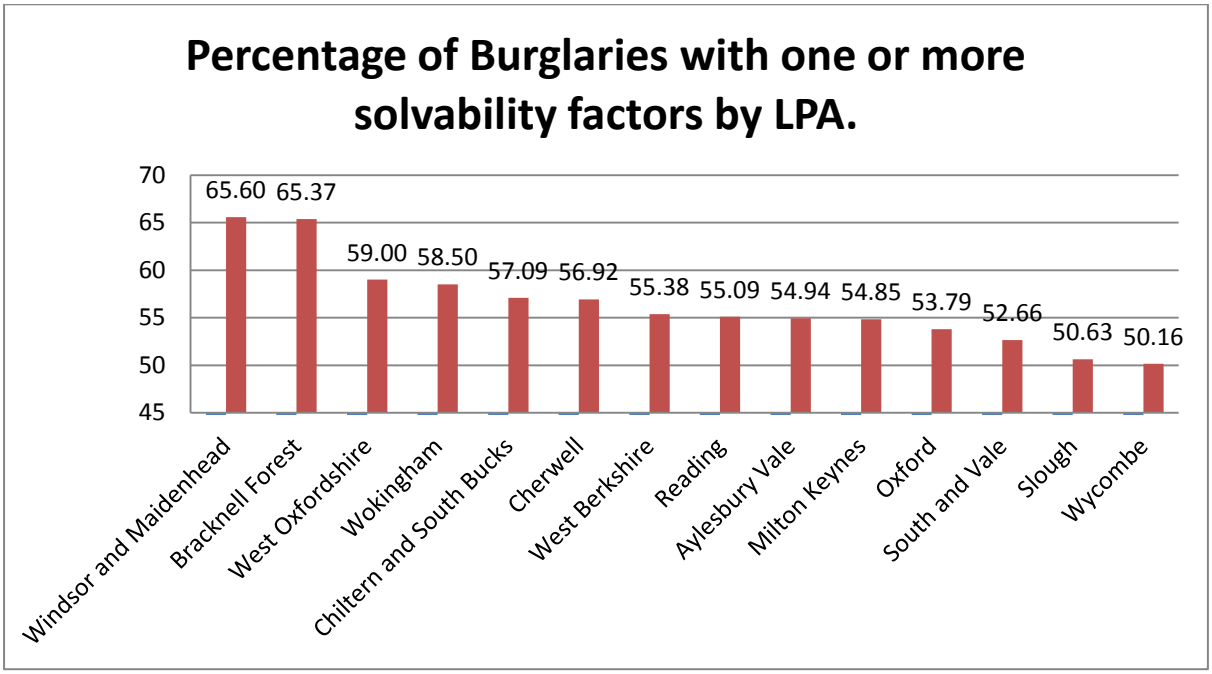
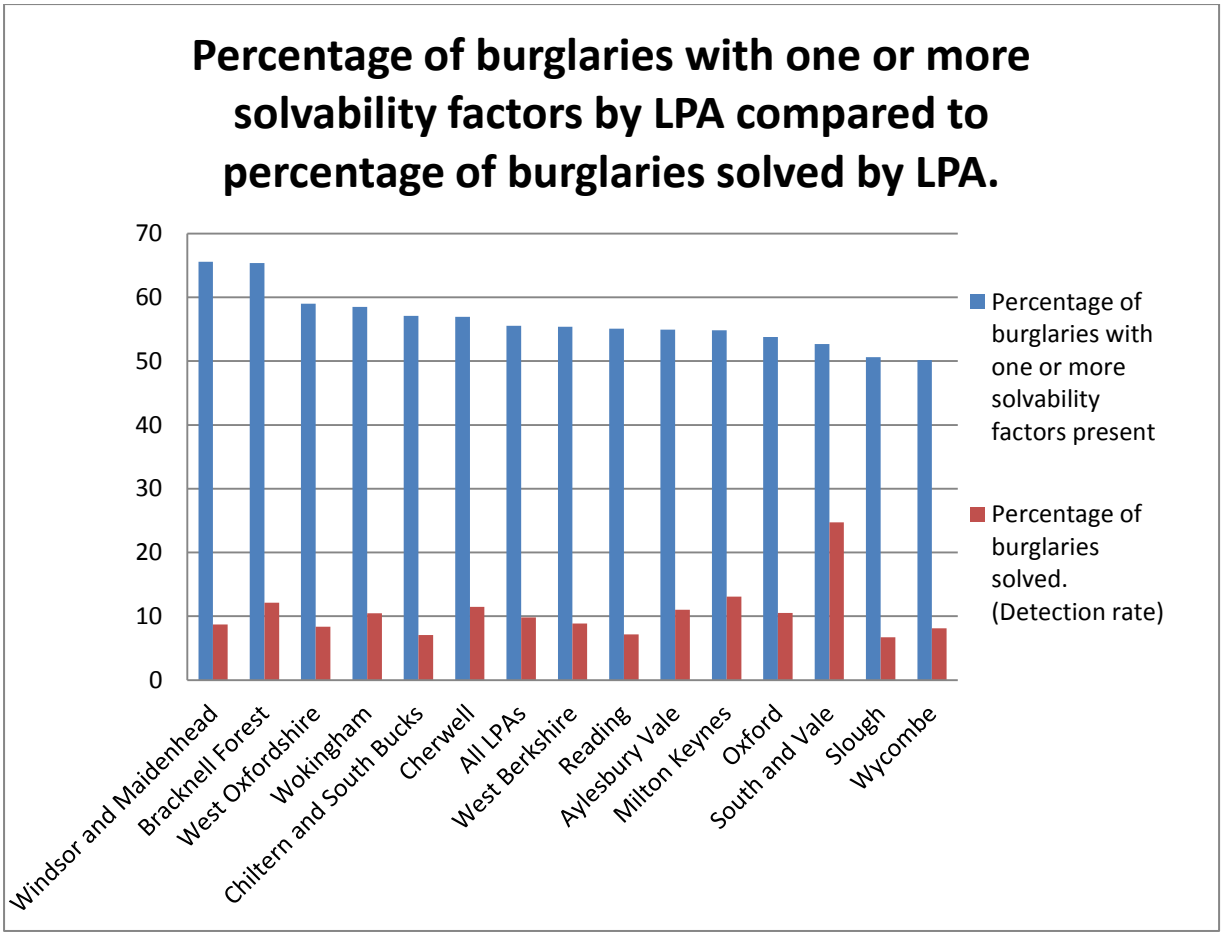


Figure 30: Percentage of burglaries with one or more solvability factors by LPA compared to percentage of burglaries solved by LPA



Summary

The solvability factors, identified by reference to their effect sizes, were then tested against the full sample of completed residential burglaries to determine their predictive accuracy. All the solvability factors, except whether the premises were occupied, had a total predictive accuracy in excess of 80%. As the number of solvability factors per case increases the total predictive accuracy increases and the total number of wasted investigations falls. However, as the number of solvability factors per case rises the number of lost detections rises.

Most burglaries have no solvability factors present. However, some burglaries are solved in the absence of solvability factors. A small sample of these were reviewed and the use of conspiracy charges and the suspect being named are the two main reasons for case solution in the absence of solvability factors.

The geographical distribution of solvability factors is uneven and is not clearly correlated with the actual detection rates of those police areas which might indicate that factors other than just solvability factors are involved in determining the actual detection rate.

Discussion

Many of the results from this study were unsurprising, expected and in line with existing research to date. However, other results were unexpected and the implications are far reaching.

The study design has been unable to test whether the presence of a particular variable provided the first links between the crime and the suspect or whether it was definitive in securing the evidence to charge in contrast to previous studies (Burrows et al 2005). Nor has this study been able to demonstrate any causative link between the solvability factors and the case outcomes. However, this study has been able to demonstrate that a number of factors are strongly correlated with case outcome. There are some notable similarities and differences in these factors from Greenberg's (1973) original work.

Solvability Factors

Greenberg identified the recovery of usable fingerprints as a solvability factor. Others have identified that the recovery of DNA is an equally powerful solvability factor (Burrows et al 2005, Robinson and Tilley 2009, Donnellan 2010). Indeed, there has been a substantial investment in improving the capability of forensic investigation in the UK through the development of the National Automated Fingerprint Identification system (NAFIS) and the National DNA Database (NDNAD). It is therefore no surprise to identify the extent of the effect size for these elements. What is unexpected, however, is the new finding that the recovery of footwear marks has such a great effect size. It is peculiar that a footwear mark, which does not definitively link a suspect to a scene, should have such a correlation. This is in

contrast to Greenberg who found that “of the three major categories of physical evidence that generally would be collected at the crime scene of burglaries – fingerprints, toolmarks and footprints – only fingerprints appeared to have been useful” (1973, p25). The increasing importance of footwear marks could perhaps be explained by the presence of a dedicated footwear unit within Thames Valley Police that process and match footwear marks at crime scenes and the footwear of burglars at the point of arrest. It would seem that Sherlock Holmes rightly noted that “There is no branch of detective science which is so important and so much neglected as the art of tracing footsteps” (Doyle 1887, p57).

The role of witnesses in solving burglary is unsurprisingly of critical importance. Greenberg assigned the same weighting to the presence of a witness as to the recovery of usable fingerprints. This research confirms the importance of witnesses to burglary case solution, but the effect size is substantially smaller than that of recovered fingerprints. This finding may be consistent, not with a diminishing role for witnesses, but with the importance of forensic evidence in investigation.

Hogan Howe (2012) identified that there are 3 ways of solving crime; catching the offender in the act, forensics and someone says who did it. Indeed, Coupe and Blake (2005) identified that arresting offenders at or near the crime scene makes a remarkably large contribution to the overall detection rates. Robinson and Tilley (2009) confirmed that catching offenders at, or near, the scene is the single factor likely to have the greatest impact of subsequent case detection. The relative importance of burglaries reported whilst in progress has been again confirmed by this study for both completed and attempted burglaries, although in contrast to Robinson and Tilley (2009) it is not the most important factor in case solution. This could perhaps be owing to the relative priority that TVP has assigned to these

emergencies against the importance of forensic recovery after the event. It is most interesting to note that the effect size for burglaries in progress is much greater for attempted offences than completed offences. This could perhaps be explained by the increased rate at which these offences, by their very nature, are witnessed and disturbed.

Greenberg (1973) identified offence duration as of particular importance assigning a substantial weighting to offences of less than an hour's duration. This research has confirmed the correlation between shorter offence durations and positive case outcomes, however the effect size is substantially smaller than expected for both attempted and completed burglaries and hence, it has not been selected as a solvability factor.

The time to attendance of the first officer was not identified as a solvability factor by Greenberg, but was identified as such by Eck. The correlation between attendance time and case solution is not unexpected owing to the well known correlation between response times and the likelihood of catching burglars red handed. What is unexpected, however, is that even when burglaries in progress are removed from the data there remains a statistically significant correlation between attendance time and solved cases, although the effect size is small for both attempted and completed burglaries. Further research could identify whether this correlation relies on increasing the likelihood of other more fundamental solvability factors, such as identifying witnesses before they leave the scene or obtaining forensic evidence before it is destroyed by the elements. However, the overall effect size of the correlation between attendance times and case outcome was not great enough for it to become a solvability factor.

Furthermore, whether the offender left anything at the scene, such as a tool or gloves, is a newly discovered solvability factor with a not insignificant effect size. This study has been unable to analyse whether the nature of the item left behind has any greater impact on effect size. Further research may also be able to analyse whether the correlation to solved cases derives from the object itself, such as a dropped driving licence, or from a more basic solvability factor, such as a fingerprint recovered from the item.

The recovery of stolen property is also a newly discovered solvability factor. Unfortunately, the way this data is stored prevented an analysis to determine whether or not the property is discovered before or after the identification of the suspect. Nevertheless it is interesting to note the effect size for this solvability factor is much greater for the completed offence than the attempted offence.

The finding that house to house enquiries are correlated with unsolved cases is an unexpected finding requiring explanation. The purpose of house to house enquiries is to identify witnesses to the offence or to other suspicious activity that may be associated with the burglary. It would be expected that house to house enquiries would be completed in all burglaries and indeed an 88% frequency of completion suggests a high degree of compliance. However, it is surprising to find that there are fewer recorded witnesses in cases where house to house enquiries are completed than in cases where these enquiries are not completed. I am unable to speculate as to how completing these enquiries could produce fewer witnesses. Therefore, I would suggest it more likely that this finding relates more to the recording of these enquiries than their actual completion. It is possible to speculate that in cases that are quickly solved the investigator feels under a reduced obligation to record these enquiries than in cases that cannot be solved.

The recent proliferation of CCTV, not only in town centres but also in residential settings, has resulted in much more criminal activity being caught on camera. It was therefore expected that preserving CCTV would be strongly correlated with solved burglaries, but this is not the case. However, it is perhaps less surprising when it is considered that this study only obtained data on whether CCTV was *preserved*, not whether it was viewed or whether it formed an active part of the investigation. It is not unreasonable to suppose that CCTV is frequently preserved 'just in case' it may be of investigative value. Unfortunately it was not possible to extract any other variables in relation to CCTV such as whether it was viewed or whether an image of a suspicious person was captured. It is reasonable to suppose that such variables *would* be more strongly correlated with solved cases.

It is unfortunate that this research has been unable to study the effect of the suspect named variable of the Greenberg research and therefore a full replication of his weighted model was not possible. However, the study of those solved cases in the absence of solvability factors identified that the suspect being named by the victim occurs with some frequency. It would not be unreasonable to suppose that if the data were available in a format accessible to this study that suspect named would also have been identified as a solvability factor.

Attempted Burglary

One of the more significant findings is that the detection rate for attempted burglary is substantially below that for the completed offence. This is most surprising as an attempted burglary is no different in kind from the completed offence; rather it differs in that the offence fails before the act of theft is complete. As such it would not be unreasonable to suppose that the offenders for attempted burglary differ from

those for the completed offence in terms of their capability. If those offenders who commit attempted burglary are less capable than those who succeed in committing the completed offence then it might be expected that they would be more likely to leave evidence at the scene and that therefore the detection rate for attempted burglary would be higher than for the completed offence. The fact that this is not the case requires explanation.

The effect size analysis identified that for both the completed and attempted burglaries the forensic variables had a very substantial effect size indeed, greater even than the offender being seen or a witness being available. It follows that the correlation of the recovery of forensic material with subsequent detection cannot be overstated. The analysis of the frequency of variables for attempted burglary indicated that the forensic variables occur far less frequently than for the completed offence. Although the numbers are very small the effect size is great. It is possible to speculate that the reasons for the lower rate of forensic recovery might be owing to the relative lack of physical contact with the point of entry that occurs during an attempted offence compared to the completed offence. Indeed, even when forensic recovery takes place at the scene of an attempted burglary it is more likely to be outside the property and it may be insufficient without corroborative evidence to provide the evidence required to charge. Further research would be required to identify the differing roles of forensic evidence in attempted and completed burglaries.

A second difference is the much higher rate at which attempted burglaries are disturbed, witnessed and therefore produce emergency in progress reports. This perhaps follows from the fact that attempted burglary fails before the completed offence is complete. Further research could identify whether this failure occurs when

the offender is disturbed in the act and whether this is the cause of the higher rate of reports of burglary in progress for attempted offences. It might be considered that this would result in a higher detection rate for attempted offences, but the effect size for the offence being witnessed is dwarfed by the effect sizes for the forensic variables.

Of course the differences in the effect sizes of the variables could reflect nuances in Thames Valley Police's investigative practice. For example, it might be that the focus on forensic investigation is greater than the focus on responding effectively to reports of burglaries in progress. Such differences could affect the discovered correlations and further research could test whether these correlations also hold in other UK forces.

Predictive Accuracy

This study has demonstrated that it is possible to predict, using the 12 identified solvability factors, case outcomes with a high degree of accuracy. The total predictive accuracy of 62.68% when one factor is present and of 80.71% when two factors are present compares reasonably to Greenberg's (1973) model which was able to predict with 67% to 92% accuracy depending on the police department. This research is also comparable to Eck's (1979) replication which was able to predict with 85% accuracy. These studies assigned differing weights to each of their identified 6 variables. It might be that with further statistical work weights could be assigned to each of the identified solvability factors of the present research which could perhaps further increase the predictive accuracy of the model.

The predictive accuracy of this model is almost certainly as good as that of Greenberg or Eck in view of the fact that it adopts a much higher standard of case

solution. The choice to use sanction detections rather than case clearances or arrests will have adversely affected the predictive accuracy. However, once the suspect named variable is added and further statistical work is done to weight the 12 variables it is likely that this model will show further increases in predictive accuracy.

Donnellan (2010) identified that one solvability model will not fit both residential burglaries and residential burglaries involving violence against the occupier. This research has found that the effect sizes for the key variables for completed burglaries and attempted burglaries are very similar. Although resources have not permitted the development of a solvability model for attempted burglaries it is likely that any such model would be very similar in many respects to the full burglary model.

As the model stands it provides the information required by police leaders to make judgements as to whether to set a cut-point and save resources. The model identified could be further developed to attach cash savings to each cut-point based on the fact that each burglary investigation takes 3.7 hours on average (Mawby 2001) and the cost per officer hour. Whilst the popular press might urge that it is never acceptable to screen out a burglary case, such arguments might be tempered by a demonstration of the cash benefits to tax payers of doing so. The resource savings of adopting a cut-point are very substantial indeed given that this model would screen out at least 67.69% of cases. This compares to Greenberg's (1973) model which screened out a massive 86.7% of investigations and to the Rochester model which screened out 32% of cases (Bloch and Bell 1976).

The concerns of the media may be reduced if the level of lost detections never rises as high as the model predicts. There is some reason for supposing this may be the case as greater investigative effort can be spent on the remaining

investigations. The Rochester system found that "because the team closed their cases early they were able to concentrate on those that remained open". (Bloch and Bell 1976, p45). Indeed, “officer workload is a much more important factor than mere police presence in determining the clear up rate” (Burrows 1982, p9). This research has identified that very substantial numbers of cases have solvability factors present, but do not result in detection. It could be that if more investigator time were available for these cases that the level of lost detections would be much lower or perhaps non-existent. Perhaps therefore the argument about case screening could be reframed in terms of allowing investigators the time to focus on the most promising cases rather than chasing those without hope of result.

The foundation is now laid for a randomised controlled trial to test this statistically based case screening model against both the existing clinically based case screening practices of most police areas and against the practice of thoroughly investigating every case. Through the adoption of a full experimental design it will be possible to determine the causal impact of adopting such a screening process. A proposed case screening form for use by officers can be found in table 33.

Geographic Variances in Detection Rates

This research has identified that the geographical distribution of solvability factors is not uniform. Burglary solvability factors appear to be unevenly distributed between the Thames Valley LPAs. These differences are not easily explicable in terms of rural/urban divide or the presence of major roads. There are substantial differences in detection rates between different LPAs. These differences do not readily correspond to the ratio of solvability factors in each LPA. This finding might be explicable in terms of differing investigative practice or investigator effort between LPAs. Further research should seek to address the interesting question of why such differences arise. Focussing further research onto those police areas with the lowest ratio of solvability factors per burglary, but with the highest detection rates is likely to yield the most interesting results in terms of identifying investigative best practice.

The uneven geographical distribution of solvability factors leads naturally to the question of whether forces should consider the introduction of differential targets which recognise the varying difficulties of solving burglaries in different areas. Differential targets are not widely embraced by the service as they are difficult to set, difficult to communicate and open to misinterpretation. Despite these practical difficulties this research would support consideration of whether such targets would offer a fairer mechanism for judging the effectiveness of a police area in solving burglary.

It is well understood that the role of the initially attending patrol officers is critical. What is now clearer than before is that their role is effectively a hunt for solvability factors. Where such factors are not present officers should still be considering the presence of other circumstantial evidence that may help solve the case through the subsequent application of conspiracy charges. These charges, like

secondary detections, can often follow substantial investigations, but may have little in the way of direct evidence linking the suspect to that particular crime. As such it could be argued that these should have been excluded from the definition of solved cases. To do so would have further enhanced the predictive accuracy of this model.

Conclusions

The detection of crime, and in particular the detection of burglary, is central to the policing mission. Stubbornly low national detection rates and an era of austerity must focus activity on what can be done to bring more offenders to justice whilst conserving valuable resources.

Existing research has identified that certain variables are powerfully correlated to solved burglaries and this study is no exception (Greenberg et al 1973, Eck 1979, Coupe and Griffiths 1996, Robinson and Tilley 2009). However, this study of 14306 residential burglaries *has* identified new solvability factors which were: the recovery of footwear impressions, the recovery of stolen property, whether anything was left at scene by the offender and the theft of a vehicle in the course of the crime. This study has also confirmed and built upon previous studies that identified the importance of reports of the crime in progress (Coupe and Griffiths 1996, Robinson and Tilley 2009), witnesses to the offence (Greenberg et al. 1973, Eck 1979) and the recovery of forensic evidence (Donnellan 2010). However, in contrast to the existing body of research this study has identified the pre-eminence of forensic recovery at the scene in subsequent case solution.

The effect size analysis of the variables led to the identification of 12 solvability factors that are able to predict case outcomes with a surprisingly high degree of accuracy. In a replication of previous research this study produced a screening model that would enable police leaders to set a solvability threshold to determine a desired balance between allocated cases and lost detections. The resource savings of this model may prove attractive in the current financial climate. Given that 38.59% of burglaries with solvability factors present go unsolved it may

follow that more of these would be solved if investigators were able to devote more time to these cases. The next steps would be to conduct an experiment to determine the extent to which the adoption of this model would produce lost detections whilst saving investigative resources.

This study identified that the geographic distribution of burglary solvability factors was not uniform across LPAs. It also found that this distribution was not consistent with the detection rates of those LPAs, which would indicate differing levels of investigative performance. Together these findings suggest that it may be possible to use such techniques to fairly identify differential targets for different police areas.

Like those before it this study did not identify any “silver bullet” (Robinson and Tilley 2009, p 14) with which to slay the burglary werewolf. However, it has identified 12 important solvability factors and from these developed policy implications around case screening and differential targets that police leaders may find increasingly attractive in an era of austerity.

Appendices

Table 268 : Missing Data

	Solved cases: Percent data missing	Unsolved cases: Percentage of data missing
Time to attend:	16.38822593	40.26826
Offence Duration:	12.01272872	12.72831
Witness report of offence	0	0
Suspect named	0	0
Suspect description recorded	0	0
Offender disturbed	21.79793158	19.57763
Offender seen	21.79793158	19.57763
Offenders vehicle sighted.	71.59904535	76.99772
Description of offenders vehicle recorded	0	0
CCTV Preserved	0	0

Media appeal completed	0	0
House to house completed	0	0
Reported as burglary in progress	16.38822593	6.525875
Any stolen property recovered.	0	0
Fingerprints recovered	0	0
DNA recovered	0	0
Footwear marks recovered	0	0
Vehicle stolen in crime	21.79793158	19.57763
Property stolen	0	0
Anything left at scene by the offender.	37.94749403	39.44064
Premises was subject to a previous burglary	44.86873508	40.06849
Offender MO: Tidy search	29.67382657	31.38318

Offender MO: Untidy search	29.67382657	31.38318
Offender MO: Thorough search	29.67382657	31.38318
Offender MO; Search whole house	29.67382657	31.38318
Antiques Stolen	0	0
Camcorda / camera stolen	0	0
Cash stolen	0	0
Cheque book / credit cards stolen	0	0
Clothing stolen	0	0
Computer stolen	0	0
Household electrical stolen	0	0
Jewelry stolen	0	0
Power tools stolen	0	0
Committed during darkness	37.23150358	47.47907

Committed during daylight	37.23150358	47.47907
Premises were occupied	16.54733492	15.24924
Premises were unoccupied.	16.54733492	15.24924
Dwelling type: Bungalow	25.21877486	22.63128
Dwelling type: Caravan	25.21877486	22.63128
Dwelling type: detatched house	25.21877486	22.63128
Dwelling type: Farmhouse	25.21877486	22.63128
Dwelling type: Ground floor flat	25.21877486	22.63128
Dwelling type: Flat other	25.21877486	22.63128
Dwelling type: multi-occupancy dwelling	25.21877486	22.63128
Dwelling type: semi-	25.21877486	22.63128

detatched		
Dwelling type: terraced house	25.21877486	22.63128
Location type: Rural	25.29832936	22.73592
Location type: Town	25.29832936	22.73592
Location type: Village	25.29832936	22.73592

Table 27 : Temporal Distribution of Solvability Factors

Temporal distribution of burglaries with one or more solvability factors by hour of the day				
Hour of day	No solvability Factors	One or more solvability factors	Total	Percent of burglaries with one or more solvability factors present
00:00 - 00:59	216	501	717	69.87
01:00 - 01:59	37	360	361	89.75
02:00 - 02:59	28	315	315	91.11
03:00 - 03:59	26	252	253	89.72
04:00 - 04:59	14	183	184	92.39
05:00 - 05:59	33	129	129	74.42
06:00 -	86	151	151	43.05

06:59				
07:00 - 07:59	98	161	161	39.13
09:00 - 09:59	345	550	550	37.27
10:00 - 10:59	203	343	343	40.82
11:00 - 11:59	260	476	476	45.38
12:00 - 12:59	98	211	212	53.77
13:00 - 13:59	267	505	505	47.13
14:00 - 14:59	313	567	569	44.99
15:00 - 15:59	228	456	456	50.00
16:00 - 16:59	259	493	493	47.46
17:00 - 17:59	205	412	413	50.36

18:00 - 18:59	265	512	512	48.24
19:00 - 19:59	267	506	507	47.34
20:00 - 20:59	165	418	418	60.53
21:00 - 21:59	133	430	431	69.14
22:00 - 22:59	131	644	644	79.66
23:00 - 23:59	98	672	673	85.44
Grand Total	3775	9462	9473	60.15

Table 289: Variables Analysed

Variables Captured for Sample of Residential Burglary in Thames Valley from 01/03/10 to 31/10/11					
	Variable Name		Variable Name		Variable Name
1	Crime Report Number	2	Input Date	3	Offence from date
4	Offence from time	5	Offence to date	6	Offence to time
7	Offence time period in minute	8	Offence time period in hours	9	Offence time period by catagory
10	The date reported	11	The time reported	12	The date first attended
13	The time first attended	14	The offence disposal code	15	Detected
16	Crime classification	17	Crime qualified	18	Major premise type
19	Minor premise type	20	Premise type other	21	Unique Reference Number (URN
22	URN date	23	Offender disturbed	24	Offender seen
25	Type of offence	26	Nature of premises attached	27	Premises occupied
28	Premises type	29	Committed during	30	Location type

			darkness / daylight		
31	Estate type	32	Alcohol ignored	33	Alcohol stolen
34	Antique ignored	35	Antique stolen	36	Camera ignored
37	Camera stolen	38	Cash stolen	39	Cash cards ignored
40	Cash cards stolen	41	Clothing ignored	42	Clothing stolen
43	Computer ignored	44	Computer stolen	45	Fax ignored
46	Fax stolen	47	Games machine ignored	48	Games machine stolen
49	Tools ignored	50	Tools stolen	51	Electrical ignored
52	Electrical stolen	53	ID papers ignored	54	ID papers stolen
55	Jewellery ignored	56	Jewellery stolen	57	Office equipment ignored
58	Office equipement stolen	59	Other property ignored	60	Other property stolen
61	Other property text	62	Power tools ignored	63	Power tools stolen
64	CDs ignored	65	CDs stolen	66	Quality jewelltry ignored
67	Quality jewellery stolen	68	Silver ignored	69	Silver stolen

70	Silver plate ignored	71	Silver plate stolen	72	TV/video ignored
73	TV / video stolen	74	Removal of property in bin liner	75	Removal of property in duvet
76	Removal of property other	77	Removal of property other text	78	Removal of property pillowcase
79	Removal of property suitcase	80	Search childs bedroom	81	Search of ground floor
82	Search of kitchen	83	Search of living and dining room	84	Search of master bedroom
85	Search of office	86	Search other	87	Other text
88	Safe attacked	89	Search single office	90	Search storeroom
91	Search upper floor	92	Search whole house	93	Search bottom draw up
94	Thorough search	95	Tidy search	96	Untidy search
97	Premises subject to previous burglary	98	Vehicle used in crime	99	Vehicle stolen
100	Vehicle sighted	101	Anything left at scene by offender	102	Left at scene text

103	Arrest made	104	Stolen	105	House to house completed
106	Media appeal	107	CCTV preserved	108	Forensic ident package
109	Record suspect vehicle details	110	Record suspect description	111	Vehicle role
112	Vehicle found	113	Witness recorded	114	Suspect recorded
115	Number of supervisory reviews	116	Property recovered	117	Ident
118	Ident type	119	Opening classification	120	Date
121	Time	122	URN A	123	Closing level 2
124	Closing level 3	125	Response grading	126	Time to attend
127	Time to at scene in seconds	128	Time to at scene in minutes		

Table 29: All variables burglary detected and undetected cases

	Burglary Dwelling Solvability Factors (completed offence)							
		Solved Cases			Unsolved Cases			T-test
	Variable Name	Mean	SD	n	Mean	SD	N	
	Time to attend	132.26	532.75	1051	171.26	492.97	9826	-2.418*
	Offence Duration	13.14	60.93	1106	20.08	104.42	9174	-2.164*
	Number of supervisory reviews	2.62	2.72	1257	2.69	1.89	10512	-1.251
				Solved Cases		Unsolved Cases		Chi-Square
				n	N	N	N	
Investigative	Witness report of offence			279	1257	963	10512	202.087***
	Suspect named			1257	1257	1843	10512	
	Suspect description recorded			20	1257	87	10512	7.264**

	Offender disturbed	227	1257	1045	10512	112.522***
	Offender seen	277	1257	904	10512	270.795***
	Offenders vehicle sighted.	51	1257	206	10512	48.995***
	Description of offenders vehicle recorded	11	1257	69	10512	.795
	CCTV Preserved	412	1257	3476	10512	.043
	Media appeal completed	71	1257	404	10512	9.446**
	House to house completed	945	1257	9519	10512	277.057***
	Reported as burglary in progress	106	1257	406	10512	224.522***
	Any stolen property recovered.	248	1257	1145	10512	13.728**
Forensic	Fingerprints recovered	267	1257	388	10512	657.967***
	DNA recovered	167	1257	95	10512	790.805***
	Footwear marks recovered	62	1257	29	10512	317.300***
Offender MO	Vehicle stolen in crime	100	1257	502	10512	29.403***
	Property stolen	956	1257	7894	10512	13.728**
	Anything left at scene by the offender.	165	1257	811	10512	79.103***

	Premises was subject to a previous burglary	173	1257	1550	10512	36.574***
	Offender MO: Tidy search	569	1257	4821	10512	4.281*
	Offender MO: Untidy search	305	1257	3274	10512	13.204***
	Offender MO: Thorough search	80	1257	702	10512	.058
	Offender MO; Search whole house	357	1257	3649	10512	8.506**
	Antiques Stolen	2	1257	45	10512	1.731
	Camcorda / camera stolen	81	1257	757	10512	.112
	Cash stolen	40	1257	291	10512	1.676
	Cheque book / credit cards stolen	70	1257	569	10512	.711
	Clothing stolen	18	1257	114	10512	1.979
	Computer stolen	298	1257	2530	10512	1.418
	Household electrical stolen	39	1257	341	10512	.032
	Jewellery stolen	155	1257	1866	10512	18.695***
	Power tools stolen	11	1257	118	10512	.313
	Committed during darkness	454	1257	3447	10512	7.874*

	Committed during daylight	384	1257	3151	10512	3.498
	Premises were occupied	474	1257	3178	10512	32.958***
	Premises were unoccupied.	592	1257	6163	10512	53.253***
Property	Dwelling type: Bungalow	19	1257	239	10512	1.810
	Dwelling type: Caravan	2	1257	22	10512	.063
	Dwelling type: detached house	162	1257	1298	10512	3.465
	Dwelling type: Farmhouse	1	1257	15	10512	.231
	Dwelling type: Ground floor flat	46	1257	451	10512	.276
	Dwelling type: Flat other	59	1257	379	10512	7.417*
	Dwelling type: multi-occupancy dwelling	31	1257	310	10512	.268
	Dwelling type: semi-detached	150	1257	1337	10512	.680
	Dwelling type: terraced house	94	1257	897	10512	.337
	Location type: Rural	86	1257	698	10512	.460
	Location type: Town	753	1257	6951	10512	21.578***

	Location type: Village	141	1257	1081	10512	1.448

Table 30: All variables attempted burglary detected and undetected cases

	Attempted Burglary Dwelling Solvability Factors							
		Solved Cases			Unsolved Cases			T-test
	Variable Name	Mean	SD	n	Mean	SD	N	
	Time to attend	86.95	189.47	104	243.95	539.80	2104	-2.957**
	Offence Duration	6.26	22.53	128	37.62	354.22	1927	-1.001
	Number of supervisory reviews	1.99	2.17	144	2.24	1.65	2393	-1.774
				Solved Cases		Unsolved Cases		Chi-Square
				n	N	n	N	
Investigative	Witness report of offence			44	144	237	2393	58.815***

	Suspect named	144	144	226	2393	
	Suspect description recorded	1	144	43	2393	.969
	Offender disturbed	61	144	537	2393	37.459***
	Offender seen	56	144	378	2393	58.834***
	Offenders vehicle sighted.	9	144	58	2393	8.734*
	Description of offenders vehicle recorded	3	144	11	2393	6.525*
	CCTV Preserved	40	144	694	2393	.099
	Media appeal completed	3	144	58	2393	.067
	House to house completed	96	144	2091	2393	49.001***
	Reported as burglary in progress	28	144	143	2393	76.770***
	Any stolen property recovered.	6	144	70	2393	.720
Forensic	Fingerprints recovered	20	144	24	2393	745.583***
	DNA recovered	14	144	24	2393	879.481***
	Footwear marks recovered	2	144	3	2393	352.954***
Offender MO	Vehicle stolen in crime	0	144	3	2393	.174

	Property stolen	6	144	101	2393	4.113
	Anything left at scene by the offender.	16	144	168	2393	5.670
	Premises was subject to a previous burglary	14	144	357	2393	14.538**
	Offender MO: Tidy search	2	144	43	2393	.000
	Offender MO: Untidy search	0	144	19	2393	.915
	Offender MO: Thorough search	1	144	6	2393	1.608
	Offender MO; Search whole house	2	144	20	2393	1.152
	Antiques Stolen	0	144	1	2393	.032
	Camcorda / camera stolen	0	144	0	2393	.
	Cash stolen	0	144	1	2393	.032
	Cheque book / credit cards stolen	0	144	1	2393	.032
	Clothing stolen	1	144	0	2393	31.065***
	Computer stolen	0	144	6	2393	.196
	Household electrical stolen	0	144	1	2393	.032

	Jewellery stolen	1	144	4	2393	4.753*
	Power tools stolen	0	144	3	2393	.097
	Committed during darkness	51	144	773	2393	21.794***
	Committed during daylight	44	144	543	2393	7.067*
	Premises were occupied	65	144	837	2393	57.386***
	Premises were unoccupied.	45	144	979	2393	18.029***
Property	Dwelling type: Bungalow	1	144	57	2393	1.810
	Dwelling type: Caravan	0	144	2	2393	.063
	Dwelling type: detached house	23	144	278	2393	3.465
	Dwelling type: Farmhouse	0	144	2	2393	.231
	Dwelling type: Ground floor flat	6	144	93	2393	.276
	Dwelling type: Flat other	2	144	98	2393	7.417*
	Dwelling type: multi-occupancy dwelling	0	144	20	2393	.268
	Dwelling type: semi-detached	21	144	298	2393	.561
	Dwelling type: terraced	22	144	364	2393	.337

	house					
	Location type: Rural	8	144	123	2393	.048
	Location type: Town	78	144	1404	2393	1.135
	Location type: Village	17	144	258	2393	.147

Table 101: Proposed Burglary Case Screening Decision Model

Burglary Decision Model	
When the number of factors present below exceeds ..... then allocate cases for investigation, otherwise notify victim and file.*	
Solvability Factor Footwear marks recovered DNA recovered Fingerprints recovered Offender Seen Offence witnessed Reported as a burglary in progress Offenders vehicle sighted Stolen property recovered Offender disturbed Suspect description recorded Anything left at scene by offender Vehicle stolen in the crime Premises were occupied	Mark if present
Instructions Mark each of the solvability factors present If the number of solvability factors equals or is greater than the	

number specified above then investigate the case, otherwise file.	

*Police leader to determine appropriate cut-point by number of solvability factors desired.

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