**Title page**

**Title: Predicting the Criminal Record of Hungarian Homicide Offenders from Crime Scene** **Behaviours**

**Authors:** Krisztián Ivaskevics1, Louise Almond2

**Author address**:

1 National University of Public Service, Faculty of Law Enforcement, Department of Criminal Psychology, Hungary

2 University of Liverpool, School of Psychology, UK

**Corresponding Author**: Krisztián Ivaskevicsemail: Ivaskevics.Krisztian@uni-nke.hu

**Running head**: Crime Scene Behaviours and Criminal History

**Abstract**

The present study explored the relationship between crime scene behaviour and criminal history in a sample of Hungarian homicide offenders. While there is a multitude of studies examining the relationship between individual crime scene behaviours and offender characteristics, this is the first study that utilised a Hungarian sample for this purpose. Data were obtained from an official Hungarian police database and contained 355 solved stranger homicide cases. Chi-square analyses were conducted to analyze the bivariate relationship between 40 crime scene behaviours and 8 previous conviction variables. Results indicated that the different killing methods and the type of injuries inflicted were amongst the most important predictors, with four killing behaviours and three injury types found to be related to six different preconviction types. Significant associations revealed by the initial analyses were then subsequently entered into binary logistic regression models. All models except for one were significant, which confirms prior studies suggesting that crime scene behaviours can be used to predict offender characteristics in homicide offences. However, inconsistencies with earlier studies suggest that the behaviour of Hungarian homicide offenders is somewhat different from that observed in other countries, which warrants cross-cultural comparisons in this area.

**Key words: Homicide, Offender profiling, Crime scene behaviours, Cross cultural, Previous convictions**

**Introduction**

The homicide rate in Hungary has shown a fluctuating trend over the past few years. According to EUROSTAT (2018) data, the homicide rate per 100.000 inhabitants increased from 1.31 to 2.05 between 2014 and 2015, it declined to 1.91 in 2016. The investigation of homicide offences consumes considerable amount of police resources, it is perceived as one of the most severe crimes, and it also imposes significant economic costs (DeLisi et al., 2010; Innes, 1999; Liska, Sanchirico & Reed, 1988). Criminal investigators frequently utilise the assistance provided by offender profilers or behavioural investigative advisors (Alison, 2005), who’s support involve the inference of offender characteristics from crime scene behaviour. Although a variety of different approaches exist with regards to the background and perspective of the expert employed (Goodwill, Alison & Beech, 2009; Muller, 2000), it is essential that any behavioural advice provided to investigations must be based on empirically grounded research (Alison, West & Goodwill, 2004; Almond, Alison & Porter, 2011). Numerous studies were carried out contributing to this endeavor, for a variety of crime types including homicide (Häkkänen & Laajasalo, 2006; Salfati & Bateman, 2005), sexual crimes (Almond, Canter & Salfati, 2006; Canter & Heritage, 1990; Canter, Bennell, Alison & Reddy, 2003), arson (Almond, Duggan, Shine & Canter, 2005; Canter & Fritzon, 1998; Häkkänen, Puolakka & Santtila, 2004), burglary (Santtila, Ritvanen & Mokros, 2004) and robbery (Goodwill et al., 2013).

The core assumption behind profiling, assumes a relationship between the behaviours exhibited by offenders at the crime scene, and their background characteristics (Mokros & Alison, 2002). This assumption is often specified in the form of the so called A-C equation (Canter, 2000; Canter et al., 2003), which posits that inferences can be derived from actions (A) in an offence about the background characteristics (C) of an offender (Canter, 2011). Such inferences can have practical value for criminal investigators, as they can be utilised to narrow suspect pools and prioritize investigative resources (Crabbé, Decoene & Vertommen, 2008; Ter Beek, Van Den Eshof & Mali, 2010; Trojan & Salfati, 2011). From an investigative perspective, one of the most useful offender characteristics on which inferences can be made is criminal history. Several studies showed that the majority of homicide offenders do have a recorded offence prior to their homicide (Broidy, Daday, Crandall, Sklar & Jost, 2006; DeLisi & Scherer, 2006), and these records are available for investigators in police databases.

Previous studies looking at the relationship between crime scene behaviour and criminal history mainly used two different approaches. The majority of studies applied multidimensional scaling techniques (e.g. smallest space analysis) to thematically differentiate crime scene behavioural patterns, and then examined how these relate to offender background themes (e.g. Häkkänen et al., 2004; Horning, Salfati & Crawford, 2010; Trojan & Salfati, 2011). However, it has been argued that instead of grouping offender behaviours into typologies, the examination of how individual behaviours can predict offender characteristics might be more appropriate and practical for criminal investigations (Almond et al., 2018; Fujita et al., 2013). One of the first study that examined the relationship between individual crime scene behaviours and criminal history was carried out by Davies, Wittebrood and Jackson (1997), on a sample of 210 stranger rape cases. They found that offenders who took fingerprint precautions were 4 times more likely to have a previous conviction for burglary, 2 times more likely to have previous conviction for robbery, and nearly 3 times more likely to have previous conviction for sexual offences. In their contemporary replication of the previously outlined study, Almond et al. (2018) also found positive relationship between different types of precautions taken by the offenders and previous robbery, burglary and criminal damage convictions.

In relation to homicide offenders Cole and Brown (2014), investigated the relationship between crime scene behaviours and offender characteristics by studying 312 homicides. They found that offenders were over 2 times likely to have a previous conviction for sexual offences if their victim was a sex worker, or if the offender took clothing from the victim. In addition, offenders were twice as likely to have previous convictions for violence if they were under the influence of alcohol or drugs during the index offence. Fujita et al. (2013) conducted a similar analysis based on data from 839 Japanese homicide cases. They found that offenders who shot their victims using firearms were 7 times more likely to have a criminal record. Behaviours such as striking by weapon, setting fire after the killing, and body hidden were also positively associated with the offender having a previous criminal record.

Studies outlined above successfully demonstrated the usefulness of examining the bivariate relationships between crime scene behaviours and criminal history. These findings are also being practically used by offender profiling practitioners to provide evidence based support to criminal investigations. In Hungary however, while offender profiling in a practical sense has been employed since 1996 (Nagy & Elekesné, 2004), no studies have been performed to examine the behavioural patterns specifically of Hungarian homicide offenders. The aim of the present study is therefore twofold. First, it attempts to provide the first step towards establishing empirically based offender profiling in Hungary by investigating the relationship between crime scene behaviours and criminal history of Hungarian homicide offenders, by using the method proposed by Davies et al. (1997) and Almond et al. (2018). Second, as suggested by Cole and Brown (2014), the present study also attempts to validate earlier findings using a culturally different sample.

**Methods**

***Sample***

The data sample consisted of 355 completed stranger homicide cases, which were obtained from the Crime Analysis and Evaluation Department of the Hungarian Police. The database contains nationwide police data of solved homicide offences. The data is based on a questionnaire that investigators need to complete after closing a homicide case, containing 254 questions on (1) the demographic details of both the offender and the victim, (2) modus operandi of the offender, (3) forensic details, and (4) behavioural aspects of the crime. The data included cases with both single and multiple offenders. In cases involving multiple offenders it is not known which offender displayed which crime scene behavior, therefore the crime scene behaviours are coded in the database as present or absent for that case, not per offender. Therefore for these cases, the presence of the multiple offenders preconvictions were also combined. In the cases of serial offenders, only their first detected offence was included in the sample to avoid biases stemming from the potential overrepresentation of their crime scene behaviours (Almond et al., 2018; Canter et al., 2003). All offences were committed between 1975 and 2017. The average age of the offenders was 27.78 years (SD = 9.81), whereas the average age of the victims was 46.36 (SD = 19.27). 70.1% of the victims were males (n = 249), and 29.9% were females (n = 106). Although the data was not originally collected for research purposes, data entry was carried out by trained and experienced crime analysts. Independent variables consisted of 40 crime scene behaviours, which were selected based on various research on homicide offences (Cole & Brown, 2014) and can be categorized into the following types: violent behaviours, weapon use, method of killing, sexual behaviours, body disposal and other behaviours. Although the crime scene variable overkill was not directly available in the present sample, it was inferred from other variables indicating the number of injuries the victim had sustained, based on the definition of overkill by Tamsen, Logan and Thiblin (2015). Dependent variables consisted of 8 previous conviction types: *criminal record, sex, violence, theft*, *burglary*, *fraud* and *robbery*. For the full list of crime scene and pre-conviction variables used in the analyses along with their respective frequencies, see Appendix A. Although some of the variables were originally coded as multi-categorical, all variables were dichotomized (present = “1’, absent = “0”), which is generally considered the most reliable method when dealing with data not intended for research purposes (Almond et al., 2018; Almond, McManus, Giles & Houston, 2017; Fujita et al., 2013).

Chi-square test of independence was carried out on the offenders previous convictions to explore differences between homicide cases committed by single and multiple offenders. No significant differences were found between the two samples on any of the preconviction variables. Additional independence tests were implemented on the outcome variables between offenders who targeted male and female victims with again, no significant comparisons identified. As such, subsequent analyses were conducted on the entire sample.

***Procedure***

The procedure was similar to that employed by Almond et al. (2018). In the first step, chi-square analyses were employed to explore significant associations between crime scene behaviours and conviction variables. Odds ratios of any significant associations were also calculated, to indicate the statistical probability of an offender having a certain type of previous conviction (Almond et al., 2018; Goodwill et al., 2009).

In the next step, significant associations were studied by binary logistic regression analyses, to evaluate the extent to which crime scene variables are able to predict previous convictions (Chan, 2012).

**Results**

***Exploring Homicidal Behaviours and Conviction History***

Chi-square analyses were conducted to explore significant associations between individual behaviours and previous conviction types. In cross-tabulations where any of the cells had expected values lower than 5, Fisher’s Exact Test was employed. Table 1 summarises the results showing the odds ratios and their associated 95% confidence intervals between homicidal crime scene behaviours and previous criminal histories. The main associations observed were as follows:

**Method of killing.** Methods of killing were associated with the most number of preconvictions withfour behaviours in this category showing significant relationships. Offenders who caused their victim’s death by *shooting* were 5½ times as likely to have previous conviction for *fraud* χ2(1) = 7.386, Fisher’s Exact Test (FET) = .033, and were 3 times as likely to have previous conviction for *other* crimes χ2(1) = 6.282, p < .05. Offenders who had *beaten* their victim to death were over 1½ times as likely to have a *criminal record* χ2(1) = 4.785, p < .05, and nearly 2 times as likely to have a *theft* preconviction χ2(1) = 6.908, p < .05. S*trangulation*, as a method of killing was associated increased likelihood of previous *sex* conviction χ2(1) = 20.539, FET = .000, with an odds ratio of over 6. Finally, the use of a *sharp* *instrument* for killing showed an inverse relationship with *criminal record*, indicating that offenders presenting this behaviour were ½ times less likely to have this type of preconviction χ2(1) = 5.711, p < .05.

**Sexual behaviours.** Three sexual crime scene behaviours were associated with prior convictions. Homicide offenders who inflicted *injury* to their victim’s *genital* area were 4 times as likely to have previous *sex* convictionχ2(1) = 6.009, FET = .036 and over 2½ as likely to have previous conviction for *other* crimes χ2(1) = 4.945, p < .05. Furthermore, offenders who *partially* *disrobed* their victims were over 4 ½ times as likely to have a previous *sex* conviction χ2(1) = 10.591, FET = .007. Finally, homicide offenders who inflicted *injury* to their victim’s *anus* were nearly 15 times as likely to have previous conviction for *theft* χ2(1) = 6.518, FET = .021.

**Other behaviours.** A total of five crime scene behaviours in this category were related to previous convictions. Homicide offenders who took *forensic precautions* to avoid detection were over 3½ times as likely to have previous conviction for *fraud* χ2(1) = 5.883, FET = .028, and over 1½ times as likely to have previous conviction for *theft* χ2(1) = 6.846, p < .05. Furthermore, homicide offenders who exhibited the behaviour *theft from victim* were over 3 times as likely to have previous *sex* conviction χ2(1) = 7.182, p < .05. Homicide offenders whose *victim was* *alcohol abuser* were over 5 times as likely to have previous *violence* conviction χ2(1) = 6.324, FET = .031. The behaviour *binding* was related to two preconviction types. Offenders presenting this behaviour were over 6½ times as likely to have a previous conviction for *fraud* χ2(1) = 9.499, FET = .021, and were nearly 5 times as likely to have previous conviction for *sex* crimes χ2(1) = 7.945, FET = .021.

**Violent behaviours.** Only one behaviour in this category was related to previous convictions. Homicide offenders who inflicted *injury* to their victim’s *torso* were over 1½ times as likely to have previous conviction for *violence* χ2(1) = 7.386, FET = .031.

**Body disposal behaviours.** Only one behaviour in this category was related to previous convictions. Homicide offenders who *disposed* of their victim’s body at an *inside* location were over 1½ times likely to have previous conviction for *theft* χ2(1) = 6.595, p < .05.

[Table 1 near here]

***Logistic Regression Models***

In the next section, significant associations revealed by the chi-square analyses were entered into binary logistic regressions using the specific offence types (see Table 2).

**Criminal record** – Chi-square analysis revealed two behaviours significantly associated with previous *criminal record*: method of *killing – beating* and *method of killing – sharp instrument*. Binary logistic regression containing these two behaviours was statistically significant, χ2(2) = 8.348, p < .05. However, according to Wald’s criterion, none of the behaviours contributed significantly to the final model. The model explained between 2.3% (Cox and Snell R2) to 3.2% (Nagelkerke R2) of the variance in previous *criminal record* status, and correctly classified 64.8% of the cases.

**Previous fraud** – Chi-square analysis identified three behaviours significantly associated with previous *fraud* conviction. When these three behaviours were entered into a binary logistic regression, the resulting model was significant χ2(3) = 11.302, p = .01. However, only the behaviour *method of killing – shooting* contributed significantly to the final model, the other two behaviours (*forensic precautions*; *binding*) were both non-significant. The model explained between 3.2% (Cox and Snell R2) and 11.7% (Nagelkerke R2) of the variance in previous *fraud* conviction status, and correctly classified 96.2% of the cases.

**Previous violence** – The initial chi-square analysis identified two crime scene behaviours significantly associated with previous *violence* convictions. Binary logistic regression containing these two behaviours was not significant χ2(2) = 4.765, p > .05.

**Previous theft** - Chi-square analysis revealed four crime scene behaviours significantly associated with previous conviction for *theft*. These behaviours were entered into a binary logistic regression, which resulted in a significant model χ2(4) = 18.293, p = .001. However, only the behaviour *method of killing – beating* contributed significantly to the final model, the other three behaviours (*forensic precautions; injury to anus; inside body disposal site)* were non-significant. The model explained between 6.1% (Cox and Snell R2) to 8.3% (Nagelkerke R2) of the variance of *theft* conviction status, and correctly classified 65.1% of the cases.

**Previous sex** - Chi-square analysis revealed five behaviours significantly associated with previous conviction for *sex* offences. Logistic regression model containing all predictors was statistically significantχ2(5) = 15.391, p < .01, indicating that the model was able to distinguish between offenders with and without *sex* preconvictions. However, only the behaviour *method of killing – strangulation* (p = .006) made a significant contribution to the prediction of prior *sex* offences. The model as a whole explained between 5.5% (Cox and Snell R2) and 14.2% (Nagelkerke R2) of the variance of *sex* preconviction status, and correctly classified 93.8% of the cases.

**Previous other convictions** - Chi-square analysis revealed two behaviours significantly associated with previous conviction for *other* offences. These behaviours were entered into a binary logistic regression, which resulted in a significant model χ2(2) = 8.807, p < .05. Both the behaviours *method of killing – shooting* (p = .021)and *genital injury* (p = .039) made a significant contribution to the final model, which explained between 3.0% (Cox and Snell R2) and 4.2% (Nagelkerke R2) of the variance of previous *other* conviction status and correctly classified 68.5% of the cases.

[Table 2 near here]

**Discussion**

The main purpose of the present study was to explore the relationship between crime scene behaviours and criminal history of homicide offenders. With being the first study to use a Hungarian sample, the findings presented here represent the first step towards providing empirical support for the development of evidence-based profiling in Hungary. This study found that approximately two thirds of homicide offenders had previous convictions and were therefore known to the police. The exploration of bivariate relationships between crime scene behaviours and previous convictions revealed several significant findings. Results indicated that the different killing methods were amongst the most important predictors, with four killing behaviours found to be related to five different previous conviction types. The infliction of injuries was also highly indicative of previous convictions with *genital injury* related to *sexual*, *anus* *injury* to *theft* and *torso* injury to *violence* preconvictions. These findings can be of increased utility, since while many of the offence behaviours suffer from low base rate occurrence, the victim’s cause of death and the injuries sustained are both the types of information that are available in almost every homicide investigation.

Chi-square analyses revealed several significant associations that are consistent with other studies. The behaviour *forensic precautions*, was related to previous *theft* conviction and conviction for *other* offences. This is in line with findings indicating that stranger offenders who take precautions are more likely to have a criminal record (Almond et al., 2018; Davies et al., 1997). Previous conviction for *sex* offences was associated – among others – with the behaviours *victim partially undressed* and *injury to genitals*. This is also in line with prior research suggesting sexual crime scene behaviours are related to previous sexual offence convictions (Davies et al., 1997). Finally, the behaviour *victim alcohol abuser* showed a positive relationship with *violence* preconviction, which also supports the previous findings of Cole and Brown (2014) who revealed the same connection with slightly smaller odds ratios.

Other associations were inconsistent with previous findings. The behaviour *theft from victim* was associated with previous *sex*, but not with previous *theft*, *robbery* or *burglary* convictions. This contradicts research indicating that this behaviour is generally related to prior acquisitive crimes (Almond et al., 2018). Furthermore, while there were four behaviours significantly associated with *theft* preconvictions, none were related to previous *robbery*, or *burglary* convictions. This is also inconsistent with studies revealing several crime scene behaviours associated with these instrumental type criminal histories in samples of rapists (Almond et al., 2018; Davies et al., 1997). In addition, while the study carried out by Fujita et al. (2013) found four different behaviours positively associated with previous *criminal record*, the present study only revealed one such behaviour. Finally, Cole and Brown (2014) revealed a positive association with the selection of *prostitute victims* and previous *sex* offences, whereas the current study failed to identify this connection.

Some associations revealed in the current study did not appear in prior research. Previous *fraud* convictionfor example, was positively associated with the behaviours *forensic precautions, method of killing – shooting* and *binding.* This finding suggests that crime scene behaviours of homicide offences are not only related to previous interpersonal crimes, but also show links to prior white-collar offences. Future studies are therefore recommended to further investigate the relationship between interpersonal crime-scene behaviours and non-interpersonal previous offences.

In addition to the exploration of bivariate relationships, the study also applied logistic regressions to predict different pre-conviction types from the significant behaviours revealed by the chi-square analyses. All models except for one were significant, which confirms previous findings that crime scene behaviours can be used to predict offender characteristics in homicide offences (Baumgartner, Ferrari & Palermo, 2008; Cole & Brown, 2014; Fujita et al., 2013). With regards to the accuracy of the models, classification performance was fairly high for predicting previous *sex and fraud* convictions, and every model predicted better, than chance.

**Limitations**

The most important limitation of this study that needs to be addressed is the use of secondary data, which was originally collected for investigative and not for research purposes. Although every precautionary measure was taken to ensure the reliability of the data, potentially inaccurate reports in the original case files could not be controlled, which may lead to biases and diminished reliability (Ter Beek et al., 2010). On the other hand, one can argue that the use of real life police data increases the ecological validity of the findings (Almond et al., 2018).

Another arguable source of limitation lies in the selection of cases included in the analysis. As offender profiling is typically employed by the police in more challenging investigations (Cole & Brown, 2014; Innes, 2003), it would have been advantageous to only include cases in which arrests had not been made within a certain timeframe. However, the dataset did not allow for filtering such difficult-to-solve cases, which makes the generalizability of the findings somewhat limited.

**Conclusion**

The present study was the first to utilise a Hungarian sample for examining the relationship between crime scene variables and criminal history. Many associations were similar to those evidenced earlier. However, there were a few associations, which were either novel, or were inconsistent with other studies. The findings presented here also bear potential practical value in terms of laying down the foundations for empirically based offender profiling in Hungary. Practitioners might utilise these findings to inform investigators on offenders’ likely criminal history based on specific crime scene behaviours in homicide cases. This could contribute to more effective suspect prioritization and in turn more effective resource allocation. Future research should also consider applying similar methodology to high volume crimes (e.g.: robbery) and to include additional offender characteristics (e.g.: age, marital status, employment) to increase the range of practical utility. Overall, our findings suggest that while the existence of bivariate relationships between homicidal crime scene behaviours and criminal history is evident regardless of culture, the patterns of such relationships might differ across countries. As such, future studies should also employ direct cross-cultural comparisons to confirm this assumption.

**Table 1.** Odds Ratios (OR) and Associated 95% Confidence Intervals (95% CI) Showing the Relationship Between Offender Crime Scene Behaviours and Previous Convictions

|  |  |  |  |
| --- | --- | --- | --- |
| Crime Scene Behaviours | Criminal record | Violence | Fraud |
|  | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Method of killing – shooting |  |  |  |  | 5.56 | 1.40–22.08 |
| Method of killing – hitting | 1.88 | 1.06–3.33 |  |  |  |  |
| Method of killing – sharp instrument | .53 | .31–.90 |  |   |  |  |
| Forensic precautions |  |  |  |  | 3.77 | 1.20–11.80 |
| Binding |  |  |  |  | 6.81 | 1.69–27.55 |
| Torso injury |  |  | 1.88 | 1.13–3.12 |  |  |
| Victim alcohol abuser |  |  | 5.23 | 1.28–21.37 |  |  |
| Crime Scene Behaviours | Sex | Theft | Other |
|  | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Method of killing–beating |  |  | 1.99 | 1.19–3.33 |  |  |
| Method of killing–strangulation | 6.26 | 2.59–15.11  |  |  |  |  |
| Method of killing – shooting  |  |  |  |  | 3.07 | 1.23–7.66 |
| Binding | 4.92 | 1.46–16.58 |  |  |  |  |
| Forensic precautions |  |  | 1.85 | 1.16–2.93 |  |  |
| Victim partially undressed | 4.77 | 1.71–13.27 |  |  |  |  |
| Body disposed outside |  |  | 1.80 | 1.15–2.83 |  |  |
| Anus injury |  |  | 14.97\* | 0.79–280.79 |  |  |
| Genital injury | 4.08 | 1.22–13.62 |  |  | 2.74 | 1.09–6.86 |
| Theft from victim | 3.24 | 1.32–7.99 |  |  |  |  |

*\*Odds ratio for this contingency table was calculated with Haldane’s correction, as one of the cells contained zero.*

**Table 2**. Logistic Regression Results for Crime Scene Behaviours Which Differentiate Offenders With and Without Previous Convictions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Offence Behaviour Variables | No criminal record% | Criminal record% | Z | OR | 95% CI | Sig. |
| Method of killing – sharp instrument | 27.2 | 16.5 | - 1.83 | .60 | .35 | 1.03 | — |
| Method of killing – beating | 15.2 | 25.2 | 1.64 | 1.64 | .91 | 2.96 | — |
|  | No sex conviction% | Sex conviction% |  |  |  |  |  |
| Injury to genitals | 5.8 | 20.0 | 1.87 | 5.95 | .92 | 38.55 | — |
| Theft from victim | 35.0 | 63.6 | 1.38 | 2.11 | .73 | 6.06 | — |
| Method of killing - strangulation | 9.6 | 40.0 | 2.73 | 4.73 | 1.55 | 14.45 | .006 |
| Victim partially undressed | 6.2 | 24.0 | .76 | .44 | .05 | 3.63 | — |
| Binding | 1.1 | 9.5 | .38 | 1.39 | .25 | 7.78 | — |
|  | No fraud conviction% | Fraud conviction% |  |  |  |  |  |
| Method of killing – shooting | 5.1 | 23.1 | 2.04 | 4.61 | 1.06 | 20.05 | .042 |
| Forensic precautions | 28.8 | 61.5 | 1.64 | 2.89 | .81 | 10.17 | — |
| Binding | 4.2 | 23.1 | 1.32 | 2.94 | .59 | 14.49 | — |
|  | No violence conviction% | Violence conviction% |  |  |  |  |  |
| Injury to torso | 58.2 | 72.3 | .74 | 1.38 | .59 | 3.23 | — |
| Victim alcohol abuse | 3.5 | 15.9 | 1.86 | 3.99 | .93 | 17.14 | — |
|  | No theft conviction% | Theft conviction% |  |  |  |  |  |
| Forensic precautions | 26.3 | 39.7 | 1.37 | 1.47 | .85 | 2.57 | — |
| Method of killing - beating | 17.1 | 29.0 | 2.03 | 1.89 | 1.02 | 3.50 | .042 |
| Injury to anus**\*** | 0.0 | 3.6 | .01 | — | — | — | — |
| Body disposed inside | 30.0 | 43.5 | 1.24 | 1.41 | .82 | 2.45 | — |
|  | No other conviction% | Other conviction% |  |  |  |  |  |
| Genital injury | 4.6 | 11.7 | 2.31 | 2.96 | 1.19 | 7.45 | .021 |
| Method of killing – shooting | 3.8 | 10.9 | 2.06 | 2.69 | 1.05 | 6.90 | .039 |

**\*** Odds ratios and confidence intervals could not be calculated in the logistic model for this variable as one of the cells contained zero.

**APPENDIX A**

Frequencies of Crime Scene Behaviours and Previous Convictions

|  |  |
| --- | --- |
| Crime scene behaviours and previous convictions | Frequency (%) |
| Violent behaviours |  |
| Head or face injury | 240 (67.6) |
| Injury to torso | 192 (54.1) |
| Overkill | 46 (13.0) |
| Weapon use |  |
| Any weapon used | 263 (74.1) |
| Weapon used – sharp instrument  | 155 (43.7) |
| Weapon used from crime scene  | 137 (38.6)  |
| Weapon used – blunt instrument | 79 (22.3) |
| Weapon brought by the offender | 66 (18.6) |
| Weapon used – firearm | 29 (8.2) |
| Weapon used – ligature | 24 (6.8) |
| Method of killing |  |
| Method of killing – beating | 77 (21.7) |
| Method of killing – sharp instrument | 72 (20.3) |
| Method of killing – strangulation | 41 (11.5) |
| Method of killing – blunt instrument | 27 (7.6) |
| Method of killing – shooting | 22 (6.2) |
| Method of killing – other | 5 (1.4) |
| Sexual behaviors |  |
| Victim found partially undressed | 26 (7.3) |
| Injury to genitals | 20 (5.6) |
| Victim found undressed | 19 (5.4) |
| Injury to anus | 4 (1.1) |
| Body disposal  |  |
| Body left exposed | 167 (47.0) |
| Body disposed inside | 123 (34.6) |
| Body disposed outside | 119 (33.5) |
| Body moved to recovery site | 42 (11.8) |
| Body concealed | 39 (11.0) |
| Victim’s face covered | 24 (6.8) |
| Victim’s clothing cut | 7 (2.0) |
| Body dismembered | 5 (1.4) |
| Offender burned the scene | 5 (1.4) |
| Body openly displayed | 3 (0.8) |
| Other behaviors |  |
| Theft from victim | 121 (34.1) |
| Forensic precautions | 111 (31.3) |
| Clothing taken from victim | 18 (5.1) |
| Binding | 17 (4.8) |
| Gagging  | 13 (3.7) |
| Victim was an alcohol abuser | 11 (3.1) |
| Victim was a sex worker | 4 (1.1) |
| Blindfolding | 3 (0.8) |
| Victim was a drug addict | 0 (0.0) |
| Previous convictions |  |
| Criminal record | 230 (64.8) |
| Violence | 135 (38.0) |
| Other | 101 (28.5) |
| Theft | 98 (25.9) |
| Burglary | 89 (25.1) |
| Robbery | 47 (13.2) |
| Sex | 25 (7.0) |
| Fraud | 13 (3.7) |

**Acknowledgements**

The authors would like to express their gratitude to the Crime Analysis and Evaluation Department of the Hungarian Police for providing access to the data used in the current study.

**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

**References**

Alison, L., West, A., & Goodwill, A. (2004). The academic and the practitioner: Pragmatists' views of offender profiling. *Psychology, Public Policy, and Law, 10*(1-2), 71.

Alison, L. E. (2005). The forensic psychologist's casebook: Psychological profiling and criminal investigation.

Almond, L., Alison, L., & Porter, L. (2011). An evaluation and comparison of claims made in behavioural investigative advice reports compiled by the National Policing Improvements Agency in the United Kingdom. In R. Lee & A. Laurence (Eds.), *Professionalizing Offender Profiling: Forensic and Investigative Psychology in Practice* (Vol. 1, pp. 250-263). UK: Routledge.

Almond, L., Canter, D., & Salfati, G. C. (2006). Youths who sexually harm: A multivariate model of characteristics. *Journal of Sexual Aggression, 12*(2), 97-114. doi:10.1080/13552600600823605

Almond, L., Duggan, L., Shine, J., & Canter, D. (2005). Test of the arson action system model in an incarcerated population. *Psychology, Crime & Law, 11*(1), 1-15. doi:10.1080/1068316031009634287

Almond, L., McManus, M., Bal, A., O’Brien, F., Rainbow, L., & Webb, M. (2018). Assisting the Investigation of Stranger Rapes: Predicting the Criminal Record of U.K. Stranger Rapists From Their Crime Scene Behaviors. *Journal of Interpersonal Violence, 0*(0), 0886260518756118. doi:10.1177/0886260518756118

Almond, L., McManus, M. A., Giles, S., & Houston, E. (2017). Female sex offenders: an analysis of crime scene behaviors. *Journal of Interpersonal Violence, 32*(24), 3839-3860.

Baumgartner, K., Ferrari, S., & Palermo, G. (2008). Constructing Bayesian networks for criminal profiling from limited data. *Knowledge-Based Systems, 21*(7), 563-572.

Broidy, L. M., Daday, J. K., Crandall, C. S., Sklar, D. P., & Jost, P. F. (2006). Exploring demographic, structural, and behavioral overlap among homicide offenders and victims. *Homicide Studies, 10*(3), 155-180.

Canter, D. (2000). Offender profiling and criminal differentiation. *Legal and Criminological Psychology, 5*(1), 23-46.

Canter, D., & Fritzon, K. (1998). Differentiating arsonists: A model of firesetting actions and characteristics. *Legal and Criminological Psychology, 3*(1), 73-96. doi:10.1111/j.2044-8333.1998.tb00352.x

Canter, D., & Heritage, R. (1990). A multivariate model of sexual offence behaviour: Developments in ‘offender profiling'. I. *The Journal of Forensic Psychiatry, 1*(2), 185-212. doi:10.1080/09585189008408469

Canter, D. V. (2011). Resolving the offender “profiling equations” and the emergence of an investigative psychology. *Current Directions in Psychological Science, 20*(1), 5-10.

Canter, D. V., Bennell, C., Alison, L. J., & Reddy, S. (2003). Differentiating sex offences: A behaviorally based thematic classification of stranger rapes. *Behavioral Sciences & the Law, 21*(2), 157-174.

Cole, T., & Brown, J. (2014). Behavioural Investigative Advice: Assistance to Investigative Decision‐making in Difficult‐to‐detect Murder. *Journal of Investigative Psychology and Offender Profiling, 11*(3), 191-220.

Crabbé, A., Decoene, S., & Vertommen, H. (2008). Profiling homicide offenders: A review of assumptions and theories. *Aggression and Violent Behavior, 13*(2), 88-106.

Davies, A., Wittebrood, K., & Jackson, J. (1997). Predicting the criminal antecedents of a stranger rapist from his offence behaviour. *Science & Justice, 37*(3), 161-170.

DeLisi, M., Kosloski, A., Sween, M., Hachmeister, E., Moore, M., & Drury, A. (2010). Murder by numbers: Monetary costs imposed by a sample of homicide offenders. *The Journal of Forensic Psychiatry & Psychology, 21*(4), 501-513.

DeLisi, M., & Scherer, A. M. (2006). Multiple homicide offenders: Offense characteristics, social correlates, and criminal careers. *Criminal Justice and Behavior, 33*(3), 367-391.

EUROSTAT. (2018). *Recorded offences by offence category - police data*. Retrieved from: <https://ec.europa.eu/eurostat/web/products-datasets/-/crim_off_cat>

Fujita, G., Watanabe, K., Yokota, K., Kuraishi, H., Suzuki, M., Wachi, T., & Otsuka, Y. (2013). Multivariate models for behavioral offender profiling of Japanese homicide. *Criminal Justice and Behavior, 40*(2), 214-227.

Goodwill, A. M., Alison, L. J., & Beech, A. R. (2009). What works in offender profiling? A comparison of typological, thematic, and multivariate models. *Behavioral Sciences & the Law, 27*(4), 507-529.

Goodwill, A. M., Stephens, S., Oziel, S., Sharma, S., Allen, J. C., Bowes, N., & Lehmann, R. (2013). Advancement of Criminal Profiling Methods in Faceted Multidimensional Analysis. *Journal of Investigative Psychology and Offender Profiling, 10*(1), 71-95. doi:doi:10.1002/jip.1388

Häkkänen, H., & Laajasalo, T. (2006). Homicide Crime Scene Behaviors in a Finnish Sample of Mentally Ill Offenders. *Homicide Studies, 10*(1), 33-54. doi:10.1177/1088767905283544

Häkkänen, H., Puolakka, P., & Santtila, P. (2004). Crime scene actions and offender characteristics in arsons. *Legal and Criminological Psychology, 9*(2), 197-214. doi:doi:10.1348/1355325041719392

Horning, A. M., Salfati, C. G., & Crawford, K. (2010). Prior crime specialization and its relationship to homicide crime scene behavior type. *Homicide Studies, 14*(4), 377-399.

Innes, M. (1999). The media as an investigative resource in murder enquiries. *British Journal of Criminology, 39*(2), 269-286.

Innes, M. (2003). *Investigating murder: Detective work and the police response to criminal homicide*. Oxford, UK: Oxford University Press.

Liska, A. E., Sanchirico, A., & Reed, M. D. (1988). Fear of crime and constrained behavior specifying and estimating a reciprocal effects model. *Social Forces, 66*(3), 827-837.

Mokros, A., & Alison, L. J. (2002). Is offender profiling possible? Testing the predicted homology of crime scene actions and background characteristics in a sample of rapists. *Legal and Criminological Psychology, 7*(1), 25-43. doi:doi:10.1348/135532502168360

Muller, D. A. (2000). Criminal Profiling : Real Science or Just Wishful Thinking? *Homicide Studies, 4*(3), 234-264. doi:10.1177/1088767900004003003

Nagy, E., & Elekesné, L. Z. (2004). A specifikus elkövetői profilalkotás elmélete és gyakorlata. *Belügyi Szemle, 29*(2), 306-344.

Salfati, C. G., & Bateman, A. L. (2005). Serial homicide: an investigation of behavioural consistency. *Journal of Investigative Psychology and Offender Profiling, 2*(2), 121-144. doi:doi:10.1002/jip.27

Santtila, P., Ritvanen, A., & Mokros, A. (2004). Predicting Burglar Characteristics from Crime Scene Behaviour. *International Journal of Police Science & Management, 6*(3), 136-154. doi:10.1350/ijps.6.3.136.39127

Tamsen, F., Logan, F. K., & Thiblin, I. (2015). Homicide Injury Quantification: Correlations and Reliability of Injury Severity Scores Applied to Homicide Victims. *Homicide Studies, 19*(1), 88-100.

Ter Beek, M., Van Den Eshof, P., & Mali, B. (2010). Statistical modelling in the investigation of stranger rape. *Journal of Investigative Psychology and Offender Profiling, 7*(1), 31-47.

Trojan, C., & Salfati, C. G. (2011). Linking Criminal History to Crime Scene Behavior in Single-Victim and Serial Homicide: Implications for Offender Profiling Research. *Homicide Studies, 15*(1), 3-31. doi:10.1177/1088767910397281