

**THE PRACTICE OF CRIME LINKAGE**

**by**

**Kari Davies**

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## ABSTRACT

Thesis title: *The practice of crime linkage*

Author: *Kari Davies*

The aim of this thesis was to conduct research into the area of the practice of crime linkage. Chapter 1 was a literature review on the subject, finding that the process of crime linkage has started to be explored, although there is scope for much more research in this area. Similarly, while work has been started into crime linkage efficacy and the effect of computerised tools on the process, there is also a large amount of research in this area yet to be conducted. Chapter 2 was a response to an evaluation written in 2009 by Professor Margot of the University of Lausanne about the use of the Violent Crime Linkage Analysis System (ViCLAS). It highlighted a number of issues with the evaluation, but also noted that evaluation of ViCLAS is necessary, and that there is work to be done in this area. Chapter 3 started to address some of the research gaps highlighted in Chapter 1 by exploring the process of comparative case analysis (CCA), conducted by analysts at the Serious Crime Analysis Section (SCAS). The process was mapped, and the analysts' decision making processes were discussed in detail, including the behaviours they found useful when linking crimes, the types of searches they conducted using ViCLAS, how they decided whether or not cases were linked, and whether there was any academic research which informed their decision making. Finally, Chapter 4 aimed to fill some of the research gaps identified in both Chapters 1 and 2 by investigating the interrater reliability coding of ViCLAS in Belgium. Despite improvements to coding uniformity compared to previous research, there is still room for improvement, and the reasons for the associated difficulties of coding was discussed.

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## STATEMENT OF AUTHORSHIP

The four chapters that form this thesis have all been submitted either for publication or as official reports for organisations employing practitioners of crime linkage. The details of the submissions are as follows:

- Chapter 1: Davies, K. & Woodhams, J. (2018). *A review of the literature concerning the practice of crime linkage*. Manuscript submitted for publication.
- Chapter 2: Davies, K., Imre, H., & Woodhams, J. (2018a). *A response to Professor Margot's 2009 assessment of the Violent Crime Linkage Analysis System (ViCLAS): An evaluation into the validity of conclusions drawn*. Manuscript submitted for publication.
- Chapter 3: Davies, K., Alrajeh, D., & Woodhams, J. (2018). *An investigation into the process of comparative case analysis conducted by analysts working in the Serious Crime Analysis Section in the United Kingdom*. Submitted to the Serious Crime Analysis Section as an official report.
- Chapter 4: Davies, K., Imre, H., & Woodhams, J. (2018b). *A test of the interrater reliability of the Violent Crime Linkage Analysis System (ViCLAS) coding in Belgium*. Manuscript submitted for publication.

Because each chapter has been included here as they were submitted to journals or law enforcement organisations, all have individual title pages, abstracts, introductions, and conclusions. As a consequence, there may be some overlap in some of the background information included. All chapters, however, have been reformatted to ensure consistency throughout the thesis, including listing the references and appendices at the end of the thesis as opposed to at the end of each chapter. Preceding each chapter is an introductory page which links the thesis together.

At the point of their submission all of the chapters were credited to several authors. For clarity, I am the primary author of all four chapters, having obtained and analysed all data (where relevant). The other authors have provided professional insight, supervision, and feedback on the work.

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## INTRODUCTION

### The concept of crime linkage

Crime linkage is the concept that two or more crimes can be linked together using behavioural, rather than physical, evidence (Woodhams & Bennell, 2014). Crime linkage is based upon two fundamental principles, that of behavioural consistency and behavioural distinctiveness (Bennell & Canter, 2002). An offender's behaviour must be consistent enough across their crime series that a behavioural pattern can be recognised, but in order for this pattern to be recognised and attributed to one offender, it must also be distinctive from other offenders' behaviour. An offender needs to use, for instance, one type of weapon consistently across their crime series, and in contrast to other offenders who choose different types of weapons, in order for this particular behaviour to be useful in linking crime series together.

These two principles of crime linkage originate in personality psychology theory and research. For example, the cognitive affective personality system (CAPS; Mischel & Shoda, 1995) is a theoretical model that accounts for both behavioural consistency as well as behavioural distinctiveness. It explains that when faced with similar situations our behaviours should be similar, due to the activation of similar personality to behaviour pathways triggered by the same situational features. Conversely, different situational characteristics would produce different behaviour. The CAPS model is also split into a 'hot' emotional system, governing our impulsive and automatic behaviours, and a 'cool' cognitive system, concerned with our behaviour subject to more cognitive control (Woodhams & Bennell, 2014). Behaviour stemming from the 'hot' system will be more consistent given its automatic

nature, whereas behaviour from the 'cool' system, with its increased cognition, is proposed to be more subject to change.

That some behaviour might be more resistant to situational influence has been noted in the past (e.g. Goodwill & Alison, 2006), and suggests that the assumptions underpinning crime linkage may not hold true to the same extent for all behaviours. Behaviour elicited in response to others, for example, is likely to be more variable, given its dependence on the situation and the other person's behaviour (Woodhams, Hollin, & Bull, 2007). In contrast, our daily routine may be less subject to change because it is so highly practised. Other factors may also affect our behaviour; behaviour demonstrated closer together in time, for example, may be more similar, because our personality systems have not had sufficient time to evolve (Pervin, 2002).

There is a large body of work on the principles underpinning crime linkage of behavioural consistency and distinctiveness. Evidence for both has been found with a range of different crime types, including rape (Slater, Woodhams, & Hamilton-Giachritsis, 2015), murder (Santtila et al., 2008), car theft (Tonkin, Grant, & Bond, 2008), burglary (Bennell & Canter, 2002), robbery (Woodhams & Toye, 2007), and arson (Santtila, Fritzon, & Tamelander, 2007), as well as with versatile offenders who offend across crime types (Tonkin, Woodhams, Bull, Bond, & Palmer, 2011). Samples utilised in crime linkage research have included series and one-off offences (Tonkin, Santtila, & Bull, 2012), and solved and unsolved offences (Woodhams & Labuschagne, 2012), and research has also tested these principles using a number of different methodologies (Tonkin et al., 2017; Tonkin, Woodhams, Bull, Bond, & Santtila, 2012). While the findings have been supportive of the two underlying principles, as would be predicted from personality psychology theory,

there is behavioural variation within series, and individual differences between offenders in the degree of consistency and distinctiveness they display. Further, some behaviours have demonstrated greater potential for use in crime linkage than others; for example, intercrime distance, temporal proximity, as well as behaviours under an offender's control such as, for instance, the type of approach used (e.g. Goodwill & Alison, 2006; Grubin, Kelly, & Brunson, 2001). Theoretical research has also investigated both the effects of time elapsed between crimes in the same series and offender expertise, although results in both areas have been inconclusive (Davies, Tonkin, Bull, & Bond, 2012; Markson, Woodhams, & Bond, 2010).

#### Crime linkage in practice – an outline of the thesis

The theory of crime linkage has obvious implications for the success of conducting crime linkage in practice, as if it does not hold true, then using the concepts of behavioural consistency and distinctiveness to attempt to find links between offences on the basis of behaviour will not work. The fact that support has been found for these assumptions in a range of circumstances, therefore, should be of some encouragement to practitioners of crime linkage. There are, however, more than just the theoretical assumptions that require consideration when looking at the practice of crime linkage. While the principles behind crime linkage have been well established, there is less research that aims to address questions specifically related to the practice of crime linkage and, to date, there has been no review drawing together the available research on crime linkage practice. Chapter 1 aimed to draw together what is currently known about the practice of crime linkage in the form of a

comprehensive search of the literature, looking at both relevant academic and publicly available practitioner documents.

In terms of the practice of crime linkage, variations in its practice may affect how it is conducted and its subsequent success. There are several different factors to consider, including whether crime type, type of law enforcement personnel, cultural differences, and resources available could affect the linkage process. Most important is the human element involved in linking; the decisions made by practitioners in order to successfully link crimes. Using behavioural information to link crimes is not an automated process, rather, it requires human processing of the information, usually by a law enforcement analyst or officer. The process of human decision making has historically been formalised into the concept of heuristics that are used to maximise the efficacy with which decisions are made by simplifying the amount of information processed (Gigerenzer & Gaissmaier, 2011). These heuristics have been proposed to comprise of three building blocks; search rules and stopping rules dictate the scope of the search undertaken, and decision rules specify how a decision is reached (Gigerenzer & Todd, 1999). Heuristics are said to be useful, both for their ability to take into account aspects of the environment (Gigerenzer & Todd, 1999), and for their ability to save effort on the part of the decision maker (although this can come at the expense of accuracy; Shah & Oppenheimer, 2008).

The heuristics that humans use to make decisions has been well researched in the areas of business, medicine, and some aspects of the legal system (Gigerenzer & Gaissmaier, 2011), however, research into crime linkage practice is limited. It is crucial to understand the decision making processes of practitioners of crime linkage; which behaviours are considered useful, whether and how behavioural consistency and distinctiveness are considered, the

order in which decisions are made, and the threshold at which crimes are considered linked. As noted earlier, there is some indication as to the behaviours that may be useful in linking crimes within the theoretical research, but whether these behaviours are useful in practice requires examination, including how and why analysts identify and use these behaviours to make links between offences. Chapter 3 of this thesis began to unpick the question of how crime linkage is conducted by interviewing analysts working at the Serious Crime Analysis Section (SCAS) in the United Kingdom (UK). SCAS is a department within the National Crime Agency (NCA), whose main remit is to identify at an early stage the emergence of potential serial rapists and sexual murderers, using behavioural crime linkage to suggest offences that may be linked (NCA, n.d.). The aims of Chapter 3 were to map the process of crime linkage as it is conducted by these analysts, learning about the specific decision making processes involved, including the behaviours used to conduct linkage, whether academic research informs decision making, and how analysts use the Violent Crime Linkage Analysis System (ViCLAS; Collins, Johnson, Choy, Davidson, & MacKay, 1998) to assist them with their work.

Given the large amounts of data increasingly being held in computerised databases by law enforcement worldwide (Babuta, 2017), there is a strong likelihood that crime linkage practitioners will have to interact with computerised data. The effects of this human-computer interaction on the process of linkage and of linkage efficacy is an area yet to receive widespread attention. As mentioned above, ViCLAS is an example of a database specifically designed to hold the large amounts of data associated with the linkage process (Collins et al., 1998). The use of ViCLAS and other databases that practitioners of crime linkage may use as part of the process will necessarily impact upon the manner in which linkage is conducted. How these systems work, what data they hold, and their strengths and

weaknesses all need to be assessed in order to understand how the process of crime linkage is both aided by these databases, and also potentially hindered. While Bennell, Snook, MacDonald, House, and Taylor (2012) outlined several aspects of the computerised systems that need to be evaluated – specifically the accuracy of data used and the reliability of their entry – very limited evidence exists (Martineau & Corey, 2008, and Snook, Luther, House, Bennell, & Taylor, 2012, do investigate coding reliability) which answers any of these research questions. Chapter 4 of this thesis aimed to research the reliability with which data are entered into ViCLAS by measuring the interrater reliability of coding between practitioners. While similar studies have been conducted in Canada (Martineau & Corey, 2008; Snook et al., 2012), this was the first study of its kind in Europe, and used samples of Belgian analysts working in the Zeden-Analyse-Moeurs (*ZAM*; translates as *sex offence analysis*) unit, a department comparable to that of SCAS in the UK. This Chapter aimed to identify whether the different manners in which ViCLAS is coded in the different countries that use it have a noticeable impact on the level of interrater reliability. It also aimed to expand on previous research by attempting to understand why some of the coding is reliable and other aspects are not, and what can be done to improve this.

Without an understanding of the processes behind the practice of crime linkage, including both the human and computerised elements of linkage, there exists the potential for misunderstanding and confusion from the research community about just how crime linkage is conducted. ViCLAS is currently relied on all over the world (Wilson & Bruer, n.d.), and as such it is vital that any research written about such systems or the principles underpinning them is accurate. Chapter 2 of this thesis replied to an article written by Professor Margot of the University of Lausanne in 2009, challenging some of the conclusions drawn about both the process of crime linkage and the utility of ViCLAS as a linkage database. In particular, it

addresses the difficulties of conducting evaluations in the field of crime linkage without appropriate reference to relevant research or data.

The aims of this thesis are two-fold. First, and fundamentally, it aims to address the research gaps that exist in the field of the practice of crime linkage. Second, it aims to add to the evidence base that law enforcement can use when conducting crime linkage. With the focus on increasing evidence-based policing (Rainbow, 2008), there is a growing need for this type of research and as such, the research needs to have a practitioner orientated focus, so that it can be of direct use to those conducting crime linkage, as well as being of interest to the academic community. Furthermore, if such research proves to be of benefit to practitioners, it can encourage more academic-practitioner dialogue as to outstanding research needs.

It is hoped that the benefits of increasing the research on the subject of the practice of crime linkage will be manifold. In the current climate of austerity and financial cuts to public services that have required law enforcement to save resources wherever possible (Babuta, 2017; NCA, n.d.), the notion of effective crime linkage being able to more appropriately direct law enforcement resources is particularly important. If more crimes can be attributed to the serial offender responsible then this, in turn, has an impact on victims of crime, providing greater access to justice to those already targeted, and curbing future offending against future potential victims.

**CHAPTER 1:**  
**A REVIEW OF THE LITERATURE CONCERNING THE PRACTICE OF CRIME**  
**LINKAGE**

Chapter 1 has been submitted for publication to the *Journal of Investigative Psychology and Offender Profiling*. The manuscript is authored by Miss Kari Davies (University of Birmingham) and Dr. Jessica Woodhams (University of Birmingham).

Chapter 1 aimed to collate all of the current information on the practice of crime linkage. The review explored documents written by *both* academics and practitioners, ensuring as complete a review as possible. The intention was to collate and assess all information relating to any aspect of the practice of crime linkage, thereby ensuring the empirical research later in the thesis was informed by a thorough understanding of international practice, past and present.

Davies, K.\* & Woodhams, J. (2018). A review of the literature concerning the practice of  
crime linkage

\*All correspondence to be addressed to the first author by email; KAD351@bham.ac.uk; or in writing; Kari Davies, Centre for Forensic and Criminological Psychology, School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

## Abstract

Crime linkage has been the subject of increasing academic attention in recent years. Research has found support for the principles of behavioural consistency and distinctiveness which underpin crime linkage, but this does not provide direct evidence as to whether crime linkage is useful *in practice*. This literature review draws together both academic and practitioner documentation that refers to the practice of crime linkage, from assessing analysts' efficacy, discussing the usage of computerised tools to assist with the linkage process, to providing a comprehensive outline of the process itself. The implications of the amount and type of information currently available are discussed, including the variations in practice and terminology that were explored. Avenues for future investigation and the manner in which future research could be conducted are set out in a research agenda.

This work was supported by the Economic and Social Research Council.

Keywords: crime linkage; linkage analysis; comparative case analysis; signature analysis; behavioural consistency; behavioural distinctiveness

## Introduction

Crime linkage is the process of linking two or more crimes together on the basis of the crime scene behaviour exhibited by an offender (Woodhams & Bennell, 2014). With regards to academic research of this topic, the theory of crime linkage has received an increasing amount of attention in the last decade. This research largely focuses on testing the two fundamental assumptions of crime linkage; behavioural consistency and behavioural distinctiveness (Bennell & Canter, 2002). An offender's behaviour must be similar enough that it can be recognised across a series of offences, and distinctive enough that it can be distinguished from other offenders' behaviour (Woodhams & Bennell, 2014).

Crime linkage is currently used to inform police investigations of a range of crime types, in cases of sexual assault and murder (see the Serious Crime Analysis Section, SCAS; National Crime Agency, n.d.) and in a wider variety of crime types according to police service priority, notably burglary, robbery, and car crime (Burrell & Bull, 2011). In some countries it is also used to support prosecutions in court (Labuschagne, 2006; 2012; Pakkanen, Santtila, & Bosco, 2014). Using offender behaviour to link crimes can be advantageous where more traditional linkage methods are expensive and time consuming (Pakkanen, Zappalà, Grönroos, & Santtila, 2012), or where there is limited or no physical forensic evidence (Grubin, Kelly, & Brunson, 2001; Labuschagne, 2014).

Theoretical research has reflected the broad application of crime linkage, finding support for the principles of behavioural consistency and distinctiveness in burglary (Bennell & Canter, 2002), personal and commercial robbery (Burrell, Bull, & Bond, 2012; Woodhams

& Toye, 2007), sexual assault (Santtila, Junkkila, & Sandnabba, 2005; Woodhams & Labuschagne, 2012), car theft (Davies, Tonkin, Bull, & Bond, 2012; Tonkin, Grant, & Bond, 2008), arson (Santtila, Fritzon, & Tamelander, 2004), and homicide (Salfati & Bateman, 2005; Santtila et al., 2008). Support for these principles has also been found using samples containing several crime types (Tonkin & Woodhams, 2017), both unsolved and solved offences (Woodhams & Labuschagne, 2012), one-off and series of offences (Tonkin, Santtila, & Bull, 2012), and using different methodologies and data from different countries (Tonkin et al., 2017). While these empirical studies have found support for the theories of behavioural consistency and distinctiveness, this is often caveated with the notion that these theories do not hold for all offenders, and within all series, to the same extent (Woodhams & Labuschagne, 2012). Further observations have been made that certain behaviours appear more (statistically) successful at linking crime series together than others. Geographical and temporal information, for example, have often been shown to be effective at linking crimes together (Tonkin, Woodhams, Bull, Bond, & Palmer, 2011), as have behaviours over which offenders are thought to be able to exercise greater control and which are less susceptible to situational influence (Grubin et al., 2001).

These findings from the academic literature have obvious implications for the practice of crime linkage; support for the principles of crime linkage can give credence to the practice of crime linkage in general, and certain research may be able to generate hypotheses about particular behaviours that would be more useful to crime analysts during the crime linkage process than others. Indeed, importantly, not finding support for these principles would suggest that such a practice would be ineffective, so the influence of these positive results cannot be understated.

What this research does not do, however, is assess how these results translate to the *practice* of crime linkage. As noted above, crime linkage can be used in both an investigative and a legal context. In terms of using crime linkage as an investigative tool, the potential ramifications of inefficient or erroneous crime linkage could be severe. This consideration is especially important given that crime linkage is used in this capacity across many different policing contexts and across different continents, including Europe (Rainbow, 2014), North America (Hazelwood & Warren, 2004), and Africa (Labuschagne, 2006). Inaccurate linkage predictions may hinder, rather than help, an investigation, including the inappropriate allocation of law enforcement resources and, in the case of incorrectly identifying several cases as linked, generating unwarranted media interest and unnecessary public anxiety (Grubin et al., 2001). It is of vital importance, therefore, that research focuses on the practice as well as the theory of crime linkage, to ensure its efficacy if used in a police investigation.

In terms of using crime linkage in a legal context, there exist standards of admissibility in some countries that need to be satisfied before crime linkage has the potential to be used as evidence in those countries' courts. The practice of crime linkage, for example, needs to have been subject to peer review and publication, and be generally accepted in the appropriate scientific community (e.g. see *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 1993), and in certain court cases the lack of research in this area has become particularly pertinent. In the case of *the State of New Jersey v. Fortin* (2000), for example, the court ruled Hazelwood's linkage analysis expert testimony as inadmissible on the basis that the technique *'has not attained such a state of the art as to have sufficient scientific reliability'*. More specifically, in a hearing on the admissibility of crime linkage evidence as part of the appeal of *Thomas Ross Young v. Her Majesty's Advocate (HMA)*, the court ruled such evidence was not admissible on the grounds that *'Most studies do not take account of victimology, and*

*the effect of a victim's reaction and behaviour on the behaviour of the offender. Research to date is concerned only with closed, or solved, crimes, and it is not apparent that it can safely be applied to predictions, or unsolved crimes. Inter-rater reliability remains a real issue, and there appears to be no agreed or uniform procedure (either within the UK [United Kingdom] or worldwide) to check and certify this. Indeed, there are no agreed international or national standards in the field of CLA [crime linkage analysis]. Even in the best conditions, with the best researchers using the best practices, there is still a high number of false positives and false negatives and no satisfactory explanation has yet been found for this.'* (Young v. HMA; from the 2013 hearing following an appeal lodged by the defendant in 2008). Evidently, whether crime linkage as a practice meets the admissibility criteria of courts around the world is still under some discussion.

With these considerations in mind, academic research needs to focus, not just on the theoretical underpinnings of crime linkage, but on the practice of crime linkage itself. Despite what are pressing research considerations in this area and the use of crime linkage across the world, there has not, to date, been a review of the literature on the practice of crime linkage. This article, therefore, aimed to draw this literature together. Given the focus of this review, practitioner reports were also considered (rather than being limited to academic publications), as well as any additional source material pertaining to the practice of crime linkage that could be found. In doing so, publicly available information about the practice of crime linkage to date was amassed and analysed, and the consequent remaining gaps in knowledge identified.

## Method

The term ‘crime linkage’ in this article was used as a blanket term for all types of behavioural crime linking, but it must be recognised that variations in the practice of crime linkage are distinguished through the use of distinct terminology in practical settings. In the UK, for example, a distinction has been made between comparative case analysis (CCA) and case linkage analysis (CLA; Rainbow, 2014). This distinction denotes the identification of crimes that share distinctive similarities in behaviour (CCA), as opposed to offering an opinion as to whether a number of offences are, in fact, linked (CLA). The former tends to be conducted by SCAS, whereas the latter is conducted by the UK’s behavioural investigative advisers (BIAs). The practice of crime linkage, rather than being conducted reactively as in these two instances, can also be conducted proactively, searching for links between cases on a database of offences without the need for an index offence/series as a reference point (Woodhams, Bull, & Hollin, 2007). Woodhams, Bull, et al. (2007) call this type of crime linkage proactive CCA. For the sake of clarity, any reference to CCA in this paper refers to reactive CCA unless otherwise specified.

These differences must be borne in mind when considering the practice of crime linkage and, as such, all terminologies used in research and practice were incorporated into the search process. The academic literature discussed in this article was searched using PsycINFO (from 1806 to February 2018) and Westlaw UK (searches run on 05.03.2018; cases and legislation excluded). The following keywords were used in separate searches in order to find relevant material written in English (in several instances, multiple keywords were combined in the same search as indicated below and, due to the volume of Westlaw UK

search results, these queries were further refined using more stringent combinations of keywords):

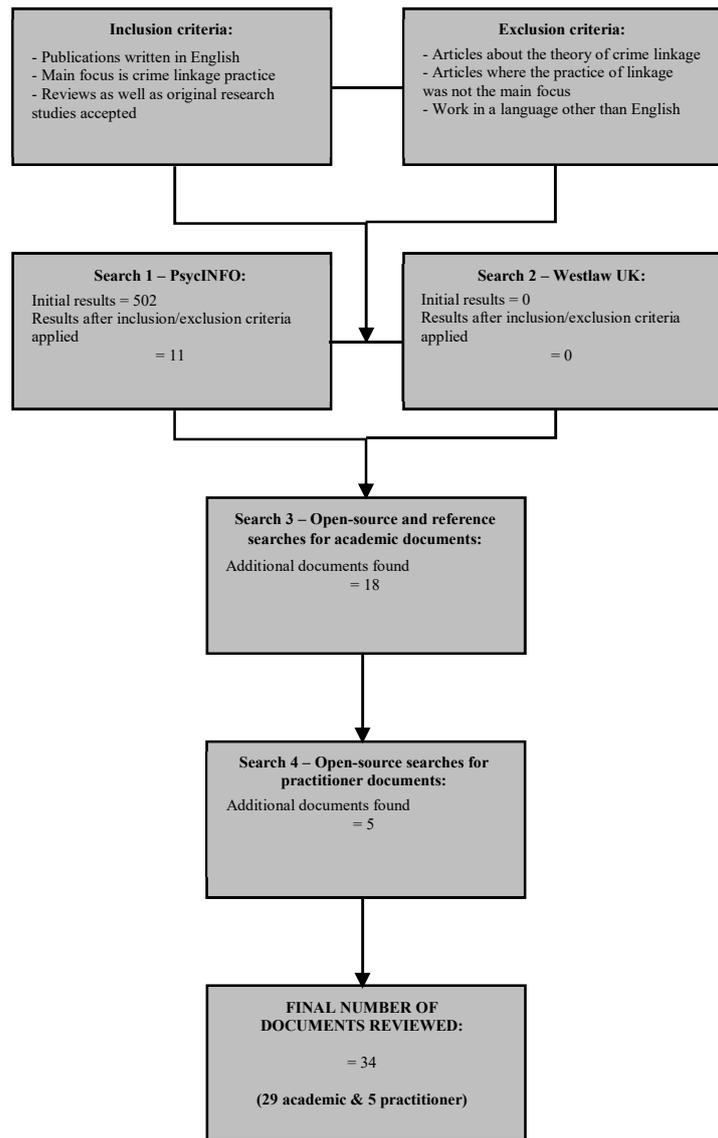
‘crime analyst’; ‘crime linkage’; ‘case linkage’; ‘crime’ & ‘case analysis’; ‘crime’ & ‘linking’; ‘crime’ & ‘linkage analysis’; ‘comparative case analysis’; ‘behavio(u)ral investigative advice’.

Searches were also conducted using Google Scholar, and reference lists of pertinent documents were searched for any further relevant material. Any document was considered relevant if it pertained to behavioural crime linkage (using behaviour demonstrated at a crime scene in order to make inferences about whether or not two or more crimes may have been committed by the same offender) *and* if it referenced the practice of crime linkage (as opposed to evaluating the theoretical underpinnings of crime linkage). Any literature reviews pertaining to the practice of crime linkage were also included. Differences in terminology are returned to in the results section.

All articles were assessed for relevance; only publications where the practice of crime linkage was the main focus were included in this review. The following sorts of documents were not included in the review; studies of the reception of crime linkage evidence by juries (e.g. Charron & Woodhams, 2010; Fawcett & Clark, 2015), investigations of the justification of claims made about links by practitioners (Almond, Alison, & Porter, 2007), descriptions of how the assumptions of crime linkage might be considered by an analyst when conducting linkage, and how they would need to be considered in terms of the benefits and risks of crime linkage (Alison, Goodwill, & Alison, 2005). The reliability of linkage is also questioned in some literature including, as noted above, its lack of acceptability as legal evidence given its

failure to meet the Daubert criteria for admissible expert evidence (Ormerod & Sturman, 2005). Many of these references to the practice of crime linkage are secondary considerations in research concerned with the theoretical principles, as opposed to being considerations in their own right. Where the practice of crime linkage was mentioned in passing or as part of another discussion, articles were excluded.

As well as searching for relevant academic literature, separate UK-focused open source searches using Google were conducted to see if any non-academic documents could be found that pertained to the practice of crime linkage. While it was highly unlikely that these searches would yield an exhaustive list of all practitioner based information that exists, not least because it was anticipated that much of this type of information would not be publicly available due to the subject's sensitive nature, several documents were identified. Inclusion of these papers in this review improves on previous reviews that have focused solely on academic literature (e.g., Bennell, Snook, MacDonald, House, & Taylor, 2012; Woodhams, Hollin, & Bull, 2007).



*Figure 1: The search process*

The search process, including the inclusion and exclusion criteria and the number of results returned at each stage, can be seen in Figure 1 above. At the end of this process, 29 academic documents and five practitioner documents remained, all of which were reviewed (see Table 1 for details of these papers).

*Table 1: Details of the documents included in the review*

<b>Author(s)</b>	<b>Publication date</b>	<b>Publication name</b>	<b>Country of origin</b>	<b>Location of publication</b>
The Association of Police Chief Officers (ACPO)	2005a	Guidance on major incident room standardised administrative procedures (MIRSAP)	UK	Document produced by the National Centre for Policing Excellence (NCPE)
ACPO	2005b	Practice course on core investigative doctrine	UK	Document produced by the NCPE
ACPO	2006	Murder investigation manual	UK	Document produced by the NCPE
Bennell, Bloomfield, Snook, & Taylor	2010	Linkage analysis in cases of serial burglary: Comparing the performance of university students, police professionals, and a logistic regression model	Canada	Journal article in <i>Psychology, Crime &amp; Law</i>
Bennell et al.	2012	Computerized crime linkage systems: A critical review and research agenda	Canada	Journal article in <i>Criminal Justice and Behavior</i>
Burrell & Bull	2011	A preliminary examination of crime analysts' views and experiences of comparative case analysis	UK	Journal article in <i>International Journal of Police Science &amp; Management</i>
Canter et al.	1991	A facet approach to offender profiling	UK	Report produced by the offender profiling research unit: Surrey University
Cole & Brown	2012	When is it best to seek assistance from a behavioural investigative adviser?	UK	Journal article in <i>The Journal of Homicide and Major Incident Investigation</i>

Cole & Brown	2014	Behavioural investigative advice: Assistance to investigative decision-making in difficult-to-detect murder	UK	Journal article in <i>Journal of Investigative Psychology and Offender Profiling</i>
Craik & Patrick	1994	Linking serial offences	UK	Journal article in <i>Policing</i>
Davies, Imre, & Woodhams	2018b	A test of the interrater reliability of the Violent Crime Linkage Analysis System (ViCLAS) coding in Belgium	UK	Submitted for publication
Douglas & Douglas	2006	Modus operandi and the signature aspects of violent crime	United States (US)	Book chapter in the <i>Crime classification manual: A standard system for investigating and classifying violent crimes</i>
Douglas & Munn	1992	Violent crime scene analysis: <i>Modus operandi</i> , signature, and staging	US	Journal article in <i>Law Enforcement Bulletin</i>
Hazelwood & Warren	2004	Linkage analysis: modus operandi, ritual, and signature in serial sexual crime	US	Journal article in <i>Aggression and Violent Behavior</i>
Keppel	1995	Signature murders: A report of several related cases	US	Journal article in <i>Journal of Forensic Sciences</i>
Keppel	2000a	Investigation of the serial offender: Linking cases through <i>modus operandi</i> and signature	US	Book chapter in <i>Serial offenders: Current thought, recent findings</i>
Keppel	2000b	Signature murders: A report of the 1984 Cranbrook, British Columbia cases	US	Journal article in <i>Journal of Forensic Sciences</i>
Keppel & Birnes	2008	Serial violence: Analysis is modus operandi and signature characteristics of killers	US	Book

Keppel, Weis, Brown, & Welch	2005	The Jack the Ripper murders: A <i>modus operandi</i> and signature analysis of the 1888–1891 Whitechapel murders	US	Journal article in <i>Journal of Investigative Psychology and Offender Profiling</i>
Labuschagne	2006	The use of a linkage analysis on the conviction of the Newcastle serial murderer, South Africa	South Africa	Journal article in <i>Journal of Investigative Psychology and Offender Profiling</i>
Labuschagne	2012	The use of a linkage analysis as an investigative tool and evidential material in serial offenses	South Africa	Book chapter in <i>Serial offenders: Theory and Practice</i>
Labuschagne	2014	The use of linkage analysis evidence in serial offense trials	South Africa	Book chapter in <i>Crime linkage: Theory, research, and practice</i>
Martineau & Corey	2008	Investigating the reliability of the Violent Crime Linkage Analysis System (ViCLAS) crime report	Canada	Journal article in <i>Journal of Police and Criminal Psychology</i>
Mugford & Martineau	2014	The ability of human judges to link crimes using behavioral information: Current knowledge and unresolved issues	Canada	Book chapter in <i>Crime linkage: Theory, research, and practice</i>
Pakkanen et al.	2012	The effects of coding bias on estimates of behavioural similarity in crime linking research of homicides	Finland	Book chapter in <i>Journal of Investigative Psychology and Offender Profiling</i>
Rainbow	2014	A practitioner's perspective: Theory, practice, and research	UK	Book chapter in <i>Crime linkage: Theory, research, and practice</i>
Rainbow & Gregory	2009	Behavioural investigative advice: A contemporary view	UK	Journal article in <i>The Journal of Homicide and Major Incident Investigation</i>

Rainbow, Gregory, & Alison	2014	Behavioral investigative advice	UK	Entry in <i>Encyclopedia of Criminology and Criminal Justice</i>
Santtila, Korpela, & Häkkänen	2004	Expertise and decision-making in the linking of car crime series	Finland	Journal article in <i>Psychology, Crime &amp; Law</i>
Snook, Luther, House, Bennell, & Taylor	2012	The Violent Crime Linkage Analysis System: A test of interrater reliability	Canada	Journal article in <i>Criminal Justice and Behavior</i>
Tonkin	2012	Behavioural case linkage: Students, crime analysts, and statistics	UK	(Doctoral dissertation: Behavioural case linkage: Generalisability, ecological validity, and methodology)
Turvey & Freeman	2011	Case linkage: Offender modus operandi and signature	US	Book chapter in <i>Criminal Profiling: An Introduction to Behavioral Evidence Analysis</i>
Woodhams, Bull, et al.	2007	Case linkage: Identifying crimes committed by the same offender	UK	Book chapter in <i>Criminal Profiling: International Theory, Research, and Practice</i>
Yokota, Kuraishi, Wachi, Otsuka, HIRAMA, & Watanabe	2017	Practice of offender profiling in Japan	Japan	Journal article in <i>International Journal of Police Science &amp; Management</i>

## Results

In comparison to the volume of literature investigating the theoretical principles of crime linkage, the number of documents focusing on the practice of crime linkage is much smaller. These articles have been summarised and are presented in Tables 2 and 3. The results section has been organised according to the following four broad themes represented in the documents in the review; a) the process of crime linkage; b) the accuracy of decision making, and factors affecting accuracy; c) the use of computerised databases in crime linkage; and d) suggestions for research based on practitioners' experience.

From the literature reviewed, it is clear that there is not one universal approach or methodology followed when conducting crime linkage. As noted above, rather than 'crime linkage' representing one process, it is an umbrella term under which a number of different approaches to the practice are subsumed. Within each approach, however, there also seems to be a number of different methodologies used to link crimes. For the sake of clarity, this review has made the explicit distinction between 'approach' and 'methodology'. Here, the word approach has been used to describe the context in which links are searched for; using a database to search for potential links versus assessing the likelihood of series membership within a prescribed group of offences, for instance. In this way, CCA and CLA are different *approaches* to conducting crime linkage. The methodology used to conduct crime linkage can also differ; searching for links on the basis of similarity at the individual behavioural level or at the level of themes of behaviour, for example, are different *methods* for identifying links between crimes, but both of these *methodologies* could be adopted by practitioners of either *approach*.

*Table 2: A summary of the academic documents reviewed*

<b>Author(s)</b>	<b>Study aims</b>	<b>Methodology and sample</b>	<b>Main findings</b>
<i>Bennell et al. (2010)</i>	Comparing a logistical model, university students, and police professionals (half of which received training) in their ability to link burglaries accurately, including whether training increases accuracy.	40 students and 31 police professionals were given 38 details of pairs of commercial burglaries, and asked to assess which pairs were linked. Trained participants were given information on how to make these decisions. A logistic regression model was applied to the 38 pairs.	Both the untrained students and police professionals groups performed significantly better than chance. The students, contrary to expectations, outperformed the police professionals. All of the trained participants outperformed the untrained participants, and the statistical model performed significantly better than all of the human participants.
<i>Bennell et al. (2012)</i>	Reviewing the literature available pertaining to computerised systems designed to assist with the process of crime linkage.	Relevant literature was critically reviewed with reference to four areas of discussion; reliable coding of data; accuracy of data used; validity of the principles of behavioural consistency and distinctiveness; and accuracy of those using these systems.	Two articles pertaining to the coding of ViCLAS are discussed. No research was found concerning the accuracy of data used. A number of articles are referenced to discuss the notion of behavioural consistency and distinctiveness, as well as factors that might affect these principles. Three articles that discuss the accuracy of linkage decisions are referenced, although it was noted that none of these studies included participants with particular training in behaviourally linking crimes. A future research agenda for each area of investigation is also discussed.
<i>Burrell &amp; Bull (2011)</i>	Understanding the experiences and views of analysts conducting	Qualitative analyses were conducted on the transcripts of 18 analysts' survey responses. The analysts came from both an urban and a rural	CCA was conducted on a number of different offences, including rape, murder, burglary, and robbery. CCA was typically conducted by searching for all relevant information, including temporal, spatial, forensic, and behavioural data,

	CCA in police services in the UK.	police service in the UK, and were asked questions about why and how CCA is conducted, the information used, as well as the challenges and benefits.	before creating a matrix of factors designed to easily demonstrate similarities across cases. Why some offences were considered easier to link than others was discussed, as well as the potential for CCA to assist with investigations in a number of ways. Lack of quality data, minimising false positives and negatives, and linking different offence types were all highlighted as challenges to the process.
<i>Canter et al. (1991)</i>	Investigating the accuracy of human judges when conducting a linkage task.	Thirty-two UK detectives were given information on 12 solved sexual assaults (four series each containing three offences). Participants were asked to make linkage decisions about the cases, both individually and as part of a group.	In terms of linkage accuracy, there were substantial differences between participants' performances. The largest proportion of participants when conducting linkage individually were correct in 25% of cases. There was some indication that participants were able to identify useful factors to link crimes, although using this information in multidimensional scalogram analysis (MSA) plots yielded better linkage results than those made in the group discussions.
<i>Cole &amp; Brown (2014)</i>	Examining two research questions; whether there was any relationship between offence variables and offender characteristics, and whether any profiling advice would become more reliable further into in the investigation, as more information becomes available.	Information on 312 offences was gathered from SCAS. Descriptive statistics, chi-square calculations, and configural frequency analysis, and logistic regression analysis were all conducted.	Most of the victims in the sample were white adult females, and most of the offenders were white males aged between 18 and 40. If the victim was female, it was less likely the offender had a previous conviction, whereas if the victim was male, the offender was three times more likely to have a previous conviction. More detailed predictions about the offender were able to be made with the increase in information over time in some cases, although some of the logistic regression analyses showed a decrease in prediction accuracy when adding further data. Such findings have ramifications for how advice given by BIAs during the investigative process can be supported, thus giving better justification to decisions made by senior investigating officers (SIOs).

<i>Craik &amp; Patrick (1994)</i>	Reviewing how behavioural information can be used to assess links between offences.	A case study was used to demonstrate how matrices of behaviour can be created, to look for links between offences.	The benefits of using matrices to look for links between offences are discussed, including how information can be more easily assessed when directly compared in this manner. The benefits of behaviourally linking crimes during the course of an investigation or investigations are also discussed.
<i>Davies et al. (2018b)</i>	Investigating the level of interrater reliability of coding demonstrated by analysts working in Belgium's centralised ViCLAS unit (ZAM).	Eight analysts coded four rape cases into ViCLAS. The percentage occurrence agreement (POA) and percentage non-occurrence agreement (PNOA) were calculated for each section, case, and overall, as well as the number of variables in each section reaching 70% and 80% acceptability thresholds. These results were compared to previous research's results. Consistency of reliable coding was also assessed across the four cases.	The mean POA score across all four cases was 55.80%, with scores ranging from 51.60% in case three to 64.80% in case one. In terms of consistency, 13.13% of the variables' POA scores reached the 70% acceptability threshold across all four cases. The mean PNOA score across all four cases was 88.99%, with scores ranging from 87.02% in case two to 92.25% in case one. In terms of consistency, 74.10% of the variables' NPOA scores reached the acceptability threshold across all four cases. Both the POA and PNOA scores were almost universally higher than in previous research, although many sections did not reach the 70% acceptability threshold.
<i>Douglas &amp; Douglas (2006)</i>	Discussing the merits of using the signature analysis to look for links between offences.	Several examples and case studies were outlined to explore the concepts of MO and signature behaviour.	The merits of and differences between an offender's MO and signature behaviour is discussed. The case studies are used to illustrate, in particular, the significance of identifying an offender's signature.
<i>Douglas &amp; Munn (1992)</i>	Explaining the utility of using MO behaviours and an offender's signature to link crimes in the US.	Case study examples were used to explore the utility of using different behaviours to conduct linkage, and the concept of crime scene staging.	The difference between the MO behaviours and the behaviours that form an offender's signature are outlined. Two case studies are also outlined that explore the utility of identifying and using both the MO and the signature to link crimes together. The notion of crime scene staging is also

			discussed, and a further case study has been used to illustrate this concept.
<i>Hazelwood &amp; Warren (2004)</i>	Explaining the process of linkage analysis in the US.	The concepts of the MO, ritualistic, signature aspects of sex offences were explained, and a case study was used to illustrate these points.	The case study is outlined, followed by the step by step process of conducting linkage analysis. Notably, in this case study the analyst was not allowed to testify as to whether they believed the cases were linked, but rather allowed to suggest how similar the offences were, and that a similar signature existed in each of them.
<i>Keppel (1995)</i>	Explaining the process of conducting a signature analysis in the US.	A case study was used to identify how signature analysis can be conducted on a series of murders.	The difference between the MO and the signature is explored. At the request of a deputy prosecutor, the author conducted a signature analysis on three murders which is documented here, concluding that one suspect was responsible. This was subsequently corroborated by forensic evidence.
<i>Keppel (2000a)</i>	As above, explaining the process of conducting a signature analysis in the US.	As above, a case study was used to highlight how signature analysis can be used to link a series of murders.	The difference between the MO and the signature is explained here, as well as the importance of considering an offender's signature. A case study containing two murders is outlined to demonstrate how a signature analysis can be conducted, ultimately leading to the conclusion that the two cases were committed by the same offender.
<i>Keppel (2000b)</i>	Explaining the process of conducting a signature analysis in Canada.	As above, a case study was used to demonstrate how signature analysis can be used to link two murders.	The article outlines the first instance of a signature analysis being conducted for entry as evidence in a Canadian court. (Ultimately, DNA evidence was presented which rendered the signature analysis unnecessary.)
<i>Keppel &amp; Birnes (2008)</i>	Exploring in depth the MO and signature aspects of offender behaviour.	A book dedicated to exploring the MO and signature, with reference to several case studies to illustrate the concept.	The notions of MO and signature are defined, and then explored through the use of case studies. These case studies are used to highlight particular aspects of offender behaviour, e.g. picquerism, in order to demonstrate how they relate to an

			offender's MO and signature. (There is some duplication in this book of case studies found in other articles reviewed here.)
<i>Keppel et al. (2005)</i>	Using signature analysis to assess potential links between the Whitechapel murders.	Information about the 11 relevant crimes was gathered, and their MO and signature characteristics compared. Frequencies of these characteristics were also searched for on HITS.	The rarity of the similar signature characteristics in six of the 11 crimes are noted, taking into account potential offender escalation and the impact of interruptions. These similar details led the authors to conclude that these six offences were the work of the same killer (Jack the Ripper).
<i>Labuschagne (2006)</i>	Explaining how the process of linkage analysis is conducted in South Africa.	A case study was presented to illustrate how crime linkage, specifically linkage analysis in this case, was conducted.	The process of linkage analysis is outlined, using a case study to demonstrate each step, including consideration of several aspects of the manner and circumstances of the crimes. The article outlines how the court went on to accept the linkage analysis testimony and the subsequent sentencing of the offender.
<i>Labuschagne (2012)</i>	As above, explaining how the process of linkage analysis is conducted in South Africa.	A review of the current relevant literature was undertaken, and two case studies were presented to demonstrate how crime linkage is conducted.	What and why use linkage analysis is discussed, as well as the theoretical literature exists that supports the principles of crime linkage. The information needed to complete a linkage analysis and the factors that can influence its completion are outlined, as are the legal considerations of its admission into the courts. Two different case studies are presented that give a more detailed and individual indication of the steps taken in South African linkage analysis.
<i>Labuschagne (2014)</i>	As above, explaining how the process of linkage analysis is conducted in South Africa.	As above, a review of the current relevant literature was undertaken, and two case studies were presented to demonstrate how crime linkage is conducted.	The uses of linkage analysis are discussed, including when caution should be used when attempting to link cases together, such as considering behaviours in isolation as opposed to considering the context in which they are exhibited. Two

			further case studies are also outlined in this article to further detail the process of linkage analysis in South Africa.
<i>Martineau &amp; Corey (2008)</i>	Investigating the level of interrater reliability demonstrated by police officers when coding two fictitious cases into ViCLAS.	One hundred and sixteen police officers coded a homicide scenario and 121 coded a sexual assault scenario into ViCLAS. The overall percentage agreement, as well as the POA and PNOA, were calculated for each section and overall in each case. The impact of training was also considered.	The level of interrater reliability between participants, when looking at the percentage agreement results, was relatively high at 87.70% (sexual assault scenario) and 79.30% (murder scenario). The POA and PNOA scores, however, showed a lower level of interrater reliability (POA: sexual assault scenario = 25.38%; murder scenario = 38.43%; PNOA: sexual assault scenario = 68.80%; murder scenario = 54.67%). No significant difference was found in interrater reliability results between those participants with ViCLAS training and those without ViCLAS training.
<i>Mugford &amp; Martineau (2014)</i>	Reviewing the available literature concerning the accuracy of crime linkage decisions.	All of the studies pertaining to the accuracy with which humans conduct crime linkage were reviewed.	Four studies are identified that explore how accurately humans conduct crime linkage. The limitations of these studies are explored, specifically the type of stimuli used, which type of linkage task is used to test accuracy, how experience is defined, the manner in which decisions are made by participants, and the fact that actuarial models are considered the best alternative to human judges of linkage, as opposed to taking in account the benefit of using experience to make such decisions.
<i>Pakkanen et al. (2012)</i>	Testing whether prior knowledge of linkage status (linked or unlinked) affects the similarity of behaviour coded by participants.	Three groups, each containing 20 Italian university students, were asked to code 10 Italian serial murder cases (five series each containing two offences). The first group was correctly told about linkage status, the second incorrectly informed, and the third given no	Contrary to expectations, the correctly informed group did not code significantly more similarity in the cases, in comparison to the incorrectly informed and the uninformed groups. Further, no significant difference in perceived similarity was found between any of the three groups. Some small, statistically insignificant results were found; the correctly informed group coded slightly more similarity than the incorrectly informed group, and the not informed group coded

		information. Participants were then asked to binary code the information in each case, and correlations were calculated to assess any differences between groups.	more similarity than the correctly and incorrectly informed groups.
<i>Rainbow (2014)</i>	Reviewing the considerations of conducting CLA in the UK.	A review of the information concerning CLA was undertaken, with the use of a case study to illustrate the approach.	CLA is considered within the context of behavioural investigative advice, and both the theoretical and methodological considerations of this approach are discussed. How CLA is conducted is also outlined using extracts from a UK case study. Considering where in the investigative process CLA is used is also discussed, namely its use exclusively at the investigative stage. A proposal to conduct CLA in a more empirical framework is also suggested.
<i>Rainbow et al. (2014)</i>	Summarising what behavioural investigative advice is and its context within the investigative process.	A summary entry in the <i>Encyclopedia of Criminology and Criminal Justice</i> .	Behavioural investigative advice is placed in its criminal context, and where it lies in comparison to international perspectives in this area. The different aspects of behavioural investigative advice are outlined, including generating hypotheses, assessing the crime scene, and making investigative suggestions, conducting case linkage analysis and offender profiling, generating and prioritising suspects and prioritising familial DNA, and giving interview, search, and media related advice. The process of how the BIAs create and compile their advice is also outlined.
<i>Santtila, Korpela, et al. (2004)</i>	Investigating whether experience in investigating car crime was related to the accuracy of linking these types of series.	Two sets of 15 cases (in total, 10 series containing three offences each) were given to four groups of 33 participants; experienced car crime investigators; experienced investigators (not of car crime);	The naïve participants were significantly less accurate at linking cases than all of the other groups. There were no other significant differences between groups, although the experienced car crime investigators' mean was the highest, followed by the other experienced investigators, then the novices. The groups did not significantly differ in the time

		<p>novice participants (with six months or less investigative experience); and naïve participants (with no experience of investigating crime). Participants were asked to link crime series, thinking aloud as they made their decisions, and then rate their performance in and the difficulty of each series. Semi-structured interviews were also conducted with participants to better understand their decision making processes.</p>	<p>they took to complete the tasks, and there was no correlation between individual predictions about performance and actual accuracy. The features used to link crimes differed between groups, with the experienced car crime investigators mentioning less features used to conduct linkage overall. When links were based on the factors ‘vehicle type’, ‘time of theft’, or ‘taken without permission’ they were more likely to be linked, and incorrect links were based more often on the factors ‘extent of property stolen’ and ‘type of property stolen’.</p>
<p><i>Snook et al. (2012)</i></p>	<p>Investigating the level of interrater reliability of police officers’ ViCLAS coding in Canada.</p>	<p>Ten police officers were asked to code a real case into ViCLAS (nine of whom had previously coded information into ViCLAS). The POA was calculated, as well as the number of variables meeting an 80% acceptability threshold.</p>	<p>An overall POA score of 30.77% was found, ranging from 2.36% (weapon section) to 62.87% (administration section). In terms of the number of variables reaching the 80% acceptable threshold, 10.38% of all variables achieved this level of agreement.</p>
<p><i>Tonkin (2012)</i></p>	<p>Investigating the performance of both trained and untrained students and crime analysts in comparison to a statistical linking model.</p>	<p>One hundred students and 37 crime analysts were split into two groups, and asked to identify the links in either 15 burglary or 15 robbery offences (each including three linked and 12 linked pairs). Linkage accuracy using a statistical model was also assessed in both cases.</p>	<p>In the residential burglary condition, the regression models outperformed both groups. In the robbery condition, the crime analysts were significantly more accurate than both the regression model and the student group. In terms of effects of training, training in the burglary condition increased student accuracy, but decreased crime analyst accuracy. Trained participants also increased their use of the intercrime distance in their linking.</p>

<i>Turvey &amp; Freeman (2011)</i>	Explaining the process of linkage analysis.	The premise of linkage analysis (or case linkage as it is also referred to here) was outlined, with reference to an offender's MO and signature.	The differences between the MO and signature are explored, including their significance to linking offences. Specific elements of the MO are outlined, as are significant aspects of the signature, such as repetition.
<i>Woodhams, Bull, et al. (2007)</i>	Reviewing the information on the process of crime linkage.	A review of the available information concerning crime linkage was conducted, with particular reference to UK practice.	The purpose of crime linkage is outlined, followed by the process of conducting crime linkage, specifically CCA. The theory of crime linkage is also explored, as well as the research available which evaluates the principles underpinning crime linkage. One article is identified that pertains to the practice of crime linkage. Further, issues with linking crimes are also addressed, including data limitations, issues with geography, and the obstacles associated with its acceptance in court.
<i>Yokota et al. (2017)</i>	Investigating the use of offender profiling in Japan, as well as assessing the accuracy of the crime linkage and profiling conducted.	Two hundred and ninety-six solved offences were examined to assess whether and how profiling and crime linkage were used. (A survey of 156 people responsible for conducting profiling was also carried out, to obtain demographic details of these participants and understand their profiling related experience.)	In terms of crime linkage, four different methods were identified as being used to conduct CLA (one of which pertained to comparing visual information including offender description, as opposed to using offender behaviour). Some type of crime linkage was conducted in 76% ( $n = 210$ ) of the 280 serial offences.

*Table 3: A summary of the practitioner documents reviewed*

<b>Author(s)</b>	<b>Document origin</b>	<b>Document aims</b>	<b>Summary of information</b>
<i>ACPO (2005a)</i>	Written by the NCPE, on behalf of ACPO	Guidance on the standardised administrative procedures associated with the major incident room was outlined.	This document outlines the main roles within the major incident room and their responsibilities, as well as considering resources, important documents, the management of all aspects of the incident, as well as guidance for investigators, including the linking of major incidents.
<i>ACPO (2005b)</i>	Written by the NCPE, on behalf of ACPO	The ‘core investigative doctrine’ central to policing, promoting investigative decision making which is both reliable and accountable, was outlined.	This document includes information on all aspects of the investigative process, which can be applied to any crime type and to any case regardless of complexity. Amongst other things, the role of the investigator is outlined, as well the legal process, investigative strategies, and how investigators make decisions.
<i>ACPO (2006)</i>	Written by the NCPE, on behalf of ACPO	The policing manual on investigating murder was outlined.	This document introduces the investigation of homicide, implementing and managing its various aspects, the different roles within an investigation and support available, including working with other agencies.
<i>Cole &amp; Brown (2012)</i>	An article in <i>The Journal of Homicide and Major Incident Investigation</i>	The best time for SIOs to use a BIA was explored. 11 SIOs were interviewed regarding their experience of using BIAs. The interview transcripts were content analysed.	The optimum time in an investigation to call a BIA is discussed, with some SIOs suggesting this should not be at the very initial stage of enquiry due to a lack of information, although others disagreed. The different input BIAs could have at each stage is also discussed. The article suggests how SIOs could make the best use of the expertise of a BIA, including giving clear guidelines of what is needed from the BIA, and what the intended use would be of advice received.
<i>Rainbow &amp;</i>	An article in <i>The Journal of Homicide and</i>	The modern view of behavioural science within the context of the	How behavioural investigative advice can be used during the investigative process is discussed, including generating hypotheses from assessment the crime scene and giving investigative suggestions, conducting case linkage

<i>Gregory (2009)</i>	<i>Major Incident Investigation</i>	investigation of major crime was explained.	analysis and offender profiling, generating potential suspect names and prioritisation matrices, conducting risk assessments and familial DNA prioritisation, and giving media and interview advice. It also discusses the limitations of behavioural investigative advice, the information a BIA requires, and how to use advice received from a BIA.
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## How crime linkage is conducted

Most of the sources identified from the systematic search which were concerned with explaining how crime linkage is conducted are focused on CLA (as opposed to other approaches to crime linkage). As noted above, CLA is concerned with obtaining an expert's opinion as to the likelihood of a set of crimes (or some crimes within the set) being a linked series, where the police already suspect that they may have been committed by the same offender. The methods of conducting CLA, however, do differ, and are described using a number of different terms; 'signature analysis' (Keppel, 2000a; Keppel & Birnes, 2008); 'linkage analysis' (Hazelwood & Warren, 2004); 'dimensional behavioural linking'; and 'multivariate behavioural linking' (Winter et al., 2013). There is less information on the methodologies used when conducting CCA, although some information about this crime linkage approach is detailed in the literature. It is worth noting that many of the publications reviewed here are written by practitioners or ex-practitioners (e.g. Hazelwood & Warren, 2004; Rainbow, 2014), which can provide a useful and alternative insight into crime linkage than that provided by academics.

The earliest research on this topic comes from the US and relates to the Federal Bureau of Investigation's (FBI) method of conducting CLA. Keppel (2000a), for example, explores the history of the investigative use of *modus operandi* (MO) in the context of linking crimes, the use of what they deem to be an offender's MO and signature behaviour, and crucially, the conducting of what is termed a 'signature analysis' in order to assess whether crimes ought to be considered linked. It is posited that an offender's MO is 'the way a particular criminal operates' (Keppel, 2000a, p. 124), and consists of behaviours that are subject to change due to an offender learning and subsequently adapting their behaviour. The

signature (sometimes called the trademark; Keppel, 1995), on the other hand, is a collection of behaviours that a) demonstrates the offender's 'personal expression' (Keppel, 2000a, p. 125); b) constitutes a number of unnecessary behaviours that go beyond the criminal act itself; c) may incorporate the unusual; and d) is indicative of an attempt on the part of the offender to satisfy inner fantasies. Furthermore, while the signature may evolve, it is generally consistent; 'The ritual may evolve, but the theme persists' (Keppel, 2000a, p. 132). It is this signature which is used in order to conduct a signature analysis; the crimes suggested to be linked are assessed in order to consider whether they contain the same 'signature', the same set of behaviours indicative of an offender's inner desires. Keppel has described a number of case studies in order to demonstrate the identification of a signature during CLA (1995; 2000a; 2000b), looking for the same underlying theme while also accounting for an offender's escalation which could result in the evolution of the specific signature behaviours.

The next methodology to be described in the US literature by the FBI is termed 'linkage analysis' (Hazelwood & Warren, 2004). As in Keppel's work, Hazelwood and Warren (2004) explain that MO behaviours are the behaviours necessary to commit the crime, and note that learning, confidence, and situation can all change an offender's MO, although they do suggest that successful MO behaviours are likely to remain consistent. Hazelwood and Warren (2004) also introduce the concept of ritualistic behaviours which, similar to the concept of Keppel's signature behaviours, denote the internal psychology of an offender, borne of their motivation and sexual fantasy. These behaviours are deemed to be symbolic and highly individual to the offender and, contrary to what has been previously suggested, are said to be subject to change via escalation which occurs through an offender refining the acting out of fantasies, or through the addition of new behaviours that the offender unexpectedly found to be satisfying (e.g. sexually arousing) in prior offences.

Importantly for this method of conducting CLA, Hazelwood and Warren (2004) explain that the signature is a unique combination of both MO *and* ritualistic behaviours, rather than only ritualistic behaviours. In the search for a signature they outline a number of observations; it is likely more MO than ritual behaviours will be observable; a ritual may not always be present in all crimes across a series; ritual behaviours may be mistaken for MO behaviours; some behaviour may be both MO and ritual; it may not be possible to recognise ritual behaviours; and, if the crime is impulsive, a ritual may not exist at all. In order to assess whether a signature exists, a number of steps are outlined that are designed to assess how likely it is that a series of offences have been committed by the same offender. First, as much information as possible about the crimes is gathered, followed by a review of all of the information to identify the significant features of each crime. These features are either classified as MO and or ritual, before being compared across the series in order to determine whether a signature exists. Finally, a report of the process is written detailing the conclusions of the analysis. Hazelwood and Warren (2004) also use a case study to illustrate how such linkage analysis is conducted. They further note the importance of recognising any dissimilar features between cases in order to assess whether they can be explained based on the context of the crimes. They acknowledge there may be features within cases that may not be easily identifiable as either ritual or MO, for instance, the disposal location of a body may result from the offender deliberately placing it there, or the victim running from the offender to said location; equally, a behaviour may function as both an MO and a ritual behaviour.

As in the articles already outlined, Douglas and Munn (1992) also stress the importance of both the MO and signature for crime linkage (Douglas & Munn, 1992). They also make the important point that an offender's MO may be subject to change, not just because of offender learning, but because of the effect a victim's reaction may have on the

offender's subsequent actions. MO may also be subject to change due to destabilising factors affecting the offender, such as increased alcohol use (Turvey & Freeman, 2011). Douglas and Munn (1992), as in Keppel's work, suggest that the signature never changes, but instead evolves, although as in Hazelwood and Warren's (2004) article they posit that it may not always be present due to interruptions or other external influences. Douglas and Douglas (2006) give examples of how this method may apply to serial murder, serial rape, arson, and terrorist offences. (Keppel predominately writes about murder and sex offences.) One further consideration made by Douglas and Munn (1992) is the notion of staging, that either an offender or those close to the victim may alter the crime scene, either for the purposes of misleading the investigation or to give the victim dignity in death. In either event, these authors caution that any staging can act as a confound when attempting to link offender behaviour.

A similar methodology to that outlined in the US literature – also termed 'linkage analysis' – is used in South Africa, as explained by Labuschagne (2012), the then Head of the Investigative Psychology Unit of the South African Police Service and a clinical psychologist. Labuschagne describes the steps of linkage analysis as starting with those outlined in Hazelwood and Warren's (2004) article, and adding that geographical behaviour should be considered (i.e. considering the geographical proximity of crime scenes). Labuschagne (2012) proposes that the benefit of using linkage analysis, as opposed to signature analysis, is that it is not reliant on the presence of unnecessary behaviours, and can be conducted using MO behaviours which, as Labuschagne (2012) points out, could be used to conduct linkage on the basis that their combination may be unique. Again, Labuschagne uses a number of case studies in order to demonstrate the method of linkage analysis, looking

at both the manner and the circumstances of the crimes, in order to determine the signature observable across the offences (Labuschagne, 2006; 2012; 2014).

CLA has also been written about by the BIAs working in the UK. Some of these publications discuss in broad terms the role of the BIAs, highlighting that it is part of their remit to provide advice as to whether cases may be linked or not, and that the data held on the Violent Crime Linkage Analysis System (ViCLAS; a computer database used for the collation of information used to link violent crimes; Collins, Johnson, Choy, Davidson, & MacKay, 1998) can be used to guide a BIA's decision making or to produce statistics to demonstrate to the investigative team the rarity of individual behaviours or combinations of behaviours (Rainbow et al., 2014). It is also noted that BIAs are mostly consulted in cases of 'serious sexual offences, murder and offences that have extreme violence or ritual, have an unknown motive or are potentially part of a series' (Cole & Brown, 2014, p. 193), providing further insight into the types of instances where CLA may be practiced in the UK. Other articles from the UK BIAs address the process of CLA in more detail; Rainbow (2014), for example, identifies two specific methods used during the UK CLA process. The first is 'dimensional behavioural linking', assessing whether several of the behaviours exhibited are demonstrative of an underlying theme, in order to assess consistency of this theme, rather than the specific behaviours themselves. The second is 'multivariate behavioural linkage', using databases of behaviours to establish the commonality of one or more specific behaviours in combination, and thus their utility in linking crimes. Similar database usage has been highlighted by Keppel (2000b), noting that searches can be run on the Homicide Investigation Tracking System (HITS; a Washington database of sexual assaults and murders) to determine behaviour frequency. Finally, Craik and Patrick (1994) – two detective superintendents within the Metropolitan Police – discuss, in the absence of computerised

databases, the benefits of creating matrices to better visualise similar behaviour across offences and more easily suggest whether they are linked.

Most recently, Yokota et al. (2017) have described how CLA is conducted in Japan. They identified 280 investigated cases (primarily sexual assaults, thefts, robberies, and arsons) for which crime linkage had been used in 210. Yokota et al. (2017) describe four methods of crime linkage used in these cases. First, in 84% of cases, behavioural case analysis was conducted; linking crimes on the basis of offence characteristics. Second, visual information including offender description was used in 68% of cases. Third, five percent of cases were linked using distinctive behaviour across the crime series, and fourth, four percent of links were made on the basis of multidimensional scaling or cluster analysis of offence characteristics. It is important to note that the manner in which crime linkage is conducted in Japan is not explicitly outlined, although mention of the consistency and distinctiveness of offence characteristics suggests the approach is equivalent to what has been outlined here as CLA. Further publications which provide more detail about the different linking methods outlined in this work (such as what constitutes 'offence characteristics') would benefit the field. Because of these omissions, it is currently difficult to ascertain the exact differences between each method; it is not clear, for example the difference between methods one and four, other than the use of statistics in method four. Further, while 'visual information' is something analysts may consider during the linkage process, by themselves they do not constitute offender behaviour.

In terms of CCA, there is much less information about the methodologies used. Burrell and Bull (2011) conducted a survey of 18 crime analysts working in two UK police services in order to gain an insight into their experiences of the practice of CCA. A 23-

question survey was developed using the first author's practical experience of working with crime analysts, and the theoretical literature available at the time. This study was useful in that it addressed specific considerations in the linking process – questions of why and how CCA is conducted – as well as particular evidence for and benefits and challenges to CCA. Interestingly, during the surveys, participants did distinguish between proactive and reactive CCA, although the effect on the linkage process of conducting one instead of the other was not detailed. CCA was conducted either by identifying all of the offences that a known offender has committed, or identifying different series within a particular offence type. Analysts stated that CCA was conducted on a range of offences, including rape, murder, burglary, robbery, and car crime, although it was noted that they didn't tend to specialise in conducting CCA on a single crime type. Analysts said CCA took from as little as 20 to 30 minutes to as long as several weeks to complete, with one of the main factors affecting this being the volume of information that would need to be examined. The typical process was described as first retrieving data from relevant police databases, and then constructing a matrix of factors used to link crimes in order to assess similarity visually across offences. A range of behavioural, temporal, and spatial factors were used to link offences, including the use of a weapon, time and day of the week, and offence location. The potential unreliability of information was highlighted as an issue with regards to conducting linkage, for instance, offender ethnicity being unreliable because of the precautions offenders took to obscure their faces. Analysts also noted data quality in general as a barrier to conducting efficient CCA; having to source additional information because of missing data, for instance, making the process of CCA longer. Once links were suggested they were assessed as to their strengths and weaknesses, with some analysts suggesting they would be inclined to include both strong and tentative links in their reports to officers (provided they were highlighted as such).

Woodhams, Bull, et al. (2007) document the steps of reactive CCA, based on the first author's experience of working as a crime analyst in the UK, and provide a valuable guide as to what could be considered a general, 'standard' approach to conducting CCA. First, all of the available documentation is requested and read, before constructing a list of behaviours shown in the index offence/series (as above, the index offence/series is the term given to the crime(s) to which links may subsequently be made). Analysts then search for crimes with similar behaviour, constructing lists of behaviours for other potentially similar offences. Once this has been done, they then consider a) the similarities and dissimilarities between the index offence/series; and b) the rarity of any similar behaviours, thereby weighting them. Finally, a report is written for the police or Crown Prosecution Service, detailing the analyst's findings (Woodhams, Bull, et al., 2007).

### Section summary

From looking at this research it is clear that, while the approach to conducting crime linkage may remain broadly the same, the method used to conduct crime linkage can vary widely. While the UK based practitioner documentation is relevant in this section, it unfortunately does not provide any further insight into how crime linkage is conducted, other than the information already outlined. These documents merely recognise that series can be linked on the basis of behavioural similarity, and specify that CLA and SCAS can be useful resources for officers if they are considering behavioural links. ViCLAS is also noted to be used to create statistical probabilities and validate linkage hypotheses generated by the BIAs (Cole & Brown, 2012; ACPO, 2005a; 2005b; 2006; Rainbow & Gregory, 2009). What these publications do not do, however, are provide details of when these resources should be called upon or the types of behaviours that may be used to behaviourally link crimes.

The benefit of much of this literature is that it is written by current or ex-practitioners of CLA and CCA. The CLA literature includes case studies of conducting signature analysis using publicly available information about infamous cases, such as Jack the Ripper (Keppel et al., 2005), or on cases on which the author worked first hand (Labuschagne, 2012). The benefit of using case studies is that the author is able to provide a great deal of detail about how crime linkage was conducted in that particular instance. The downside is that because of idiosyncrasies within any one case, the method used to link crimes in one instance may not be applicable to others. In contrast, in the CCA literature, generalised methods are described in one article. While this means the specific behaviours with which offences are considered potentially linked are absent from the article, the benefit of considering a standardised method of conducting CCA means the effects any idiosyncrasies may have on the linkage process are eliminated. Detailing the standardised method to linkage also circumvents the notion that the case studies have been chosen as examples of conducting linkage precisely because a) they are particularly receptive to the practice of crime linkage; or b) they were particularly unusual or difficult to solve. The consequence of the former point is that these cases are not likely to display any common difficulties normally encountered during the linkage process. The consequence of the latter is that, while it would explain why practitioners were asked to consult on the cases, it would also mean the manner in which these cases are treated are likely to be different to how other, more typical cases would be subject to the linkage process. Further, there may be bias in the manner in which a practitioner describes a case if they have personally worked on it. In any event, some of the potential issues that relying on case studies may cause are demonstrated here. A combination of both techniques – for example, a general description followed by a case study – may be a way of best describing the different linkage processes.

### Accuracy of decision making, and factors affecting accuracy

The accuracy of crime linkage decisions is a topic which has been subject to previous review (Mugford & Martineau, 2014), in particular looking at human efficacy of conducting crime linkage, the effect of experience on this practice, and the manner in which linking decisions are made. Previous research has used a number of different participant groups, including law enforcement personnel, lay-people, and even mathematical models, to investigate crime linkage accuracy. In terms of the accuracy of law enforcement personnel, Canter et al. (1991) investigated the accuracy of 32 UK police detectives' linkage decisions regarding series of sexual assaults. Most of the officers' performed at a chance level of accuracy, although there was a significant between-participant variation in linkage accuracy. Performance below chance level was attributed to the difficulty with choosing aspects of behaviour relevant to the linkage task, and considering and combining the amount of information available in order to assess whether cases are linked (Canter et al., 1991). More recently, Yokota et al. (2017) investigated the number of times 156 police professionals used crime linkage, and in how many of the instances the decisions made were correct or not. Links were incorrectly made in 15% of cases, based on participants making links to crimes committed by another offender, and in 52% of cases potential links had failed to be confirmed. The authors themselves recognised that it was likely many of these were unconfirmed, not because of the inaccuracy of the link, but simply because of the difficulty of confirming some links without other evidence (such as forensic evidence or offender confession).

While it is important to understand the decisions made by law enforcement personnel as to what increases accuracy, it is equally important to understand whether decisions that increase accuracy are attributable to the expertise of the participant. In other words, the question is whether law enforcement personnel should be more accurate, based on their general experience of crime, crime series, and potential training received, in comparison to lay-people. Studies testing this notion have typically compared law enforcement groups with experience of conducting crime linkage to non-law enforcement groups with no such experience, or compared different law enforcement groups with varying degrees of linkage expertise. Santtila, Korpela, et al. (2004) investigated whether greater linking accuracy would be demonstrated by experienced car crime investigators compared to experienced investigators of other crime types, inexperienced investigators, and 'naïve' participants (or lay-people). They also recorded the type of information participants used in order to make their linkage decisions, and assessed whether this information was actually useful in linking crimes in terms of being associated with greater accuracy. Thirty-three participants were asked to complete a linking task pertaining to several car thefts during which they articulated their thought process to the researchers. They were also subsequently interviewed to describe the linkage process. In terms of performance, the naïve participants performed significantly worse than all other groups, and while there was no significant difference between the different types of investigators, the mean linkage accuracy was highest in the experienced car crime investigators group.

In order to further assess the notion of expertise as an influence on crime linkage accuracy, studies have also introduced an element of training to certain participant groups in order to test whether this training (designed to introduce an element of expertise) affects linkage accuracy. Bennell et al. (2010) investigated whether differences existed in linkage

accuracy of burglary offences between groups of untrained and trained students, untrained and trained police professionals, and a computerised statistical model of linkage. Perhaps surprisingly, all of the untrained participants performed significantly better than chance; however, there were differences between the different participant groups. The students significantly outperformed the police professionals, and the participants that received training outperformed those who did not. The students placed greater emphasis in their decision making on geographical information about the crimes, and there was also a strong trend that trained participants also placed greater reliance on the same information.

More recently, Tonkin (2012) recruited 37 crime analysts with specific experience of crime linkage and 100 students, and asked them to link a number of crimes. Participants were randomly assigned to groups either linking residential burglaries or commercial robberies, and to groups either receiving training similar to that in previous research (Bennell et al., 2010) or no training. With regards to the commercial robbery condition, the analysts performed significantly better than the students. For the residential burglary condition, however, there was no significant effect of training or experience on performance. Instead, training was associated with increased accuracy by the students but decreased accuracy by the analysts. When looking at the information used by participants, the analysts relied more on the map provided, and those with training relied more on intercrime distance. Some of these results contradict previous research, and seems as though participants were able to identify more effective strategies for linking in Tonkin's (2012) study, which may be explained by the fact that participants had more relevant experience of conducting linkage, and specifically of conducting linkage with the crime type used in the study, than participants in previous research.

Finally, as mentioned above, comparisons have been made between the accuracy of humans versus computerised statistical models. Bennell et al. (2010) found that their statistical model significantly outperformed all human participants in terms of linkage accuracy. Conversely, Tonkin (2012) found that the analysts outperformed the regression models in the commercial robbery condition, and that there was no significant difference in accuracy between the regression models and the student sample. The regression models outperformed both the students and the analysts in the residential burglary condition. There is some contention as to whether the superior performance of the statistical models in some circumstances is due to the complexity (or lack thereof) of the paradigms used in such studies.

As well as assessing the overall accuracy of linkage decisions made, the efficacy of particular parts of the linkage process can also be assessed. Pakkanen et al.'s (2012) study investigated whether prior knowledge of links between cases would create a bias as to the similarity perceived in an offender's behaviour across a series, when participants coded the information in each case as either present, absent, or missing. This is an important research question for the CLA scenario where the police have already put forward an opinion as to whether they consider a group of crimes to be linked before the analyst then conducts their analyses. (It also has ramifications for the population of computerised databases designed to assist analysts with the linkage process.) Participants were assigned to three groups, one with information about links between cases prior to coding, one that had been misinformed about links prior to coding, and one that was given no information. While the incorrectly informed group coded less similarity for their linked cases than both the correctly informed and the uninformed group, this trend was non-significant, and the uninformed group coded the most similarity (although again, the difference between this group and the correctly informed

group was non-significant). As such, no clear evidence was found for the presence of a coding bias. (Interestingly, the analysts surveyed in Burrell and Bull's (2011) study mentioned the notion of bias, their awareness of it, and their desire to remain objective. This may play a part in counteracting the effects of bias, although this notion needs empirical testing.)

### Section summary

The research in this section has shown that there can be large variation in individual performance when conducting crime linkage, and one possible explanation for this may be the types of behaviours that participants focus on when conducting crime linkage. Santtila, Korpela, et al. (2004) demonstrated that experienced car crime investigators relied on fewer variables when making their linkage decisions, with results showing that correct linkage decisions were made when considering vehicle type, time, location, or chains of thefts. Participants who performed better more often mentioned the time of the theft, whereas the type and extent of property stolen was often the basis for errors in linkage decision making. It is worthy of note that the variables resulting in more accurate linkage are those that are under the offender's control, contrasted with those that are more situation dependent (Woodhams, 2008). In Bennell et al.'s (2010) study, potentially useful information, such as the temporal information of the crime, was not given to the participants, information that more experienced police professionals would rely on, and many of whom noted its absence. This indicates that the types of behaviours used to link crimes are important, and that their absence from a research paradigm may affect a study's findings.

A major limitation of each of these studies is that none of them state which crime linkage approach they are attempting to study. Furthermore, all of the tasks in these studies are much simplified in comparison to the real life process as undertaken by practitioners. For example, Pakkanen et al. (2012) used edited summaries of murder case transcripts which wouldn't be reflective of the many case papers generated in a murder investigation. As a consequence, the results of such studies will have limited applicability to real world practice. For example, as alluded to above, a computerised statistical model may function well when completing a simple crime linkage task, but may be much less effective when having to consider the complexities of a real case as outlined in many of the case studies explored above. Such studies need repeating under conditions of greater ecological validity. That students outperformed police professionals (Bennell et al., 2010) may be because the task differed considerably from what the police professionals' normal linkage tasks entail, thus limiting their ability to apply their expertise to the task. As noted above, and as recognised by the authors, the police professionals were not given information that they would normally use when attempting to conduct crime linkage, and furthermore, nine of the 31 police professionals were police officers who may have had little or no previous experience of linking crimes (Bennell et al., 2010). Conversely, while the students in this study had no experience of policing or linkage analysis, there was no mention of their familiarity with behavioural psychology, which may have accounted for a certain level of expertise. Furthermore, training consisted only of the information that previous research had indicated that geographical proximity was an effective indicator of linkage; it is possible that students were more likely to take this sort of training on board, whereas the police professionals may have placed greater weight on their own operational experience, essentially disregarding the training. Tonkin (2012) addressed some of these issues; participants, for instance, were asked for their specific experience of conducting crime linkage, two of the three computerised

models were based on data geographically different to that of the crimes in the questionnaire, and participants were presented with temporal as well as geographical and behavioural information. Some limitations of previous research still stand, however, in that the context of the task was artificially generated and may not reflect the way that crime linkage is conducted in practice. In this way, there is no guarantee that these studies provide a valid picture of the levels of accuracy achieved in practice, or the factors that may affect this accuracy. While there has been an attempt to investigate which behaviours are important in linkage, the exact processes used and the order in which decisions were made by analysts have not been outlined (Santtila, Korpela, et al., 2004), which makes it difficult to attribute potential efficacy to any one decision. All of these factors may also have accounted for the supposed efficacy of the computerised models in comparison to human participants; the simplification of the linkage paradigm may have been to the advantage of the computerised models, whereas a human participant may be able to much more effectively deal with the complications and nuances that would be present in a real life case.

### The use of computerised databases in crime linkage

Interacting with computerised databases can be an integral part of a practitioner's role when conducting crime linkage. Indeed, while no comprehensive review of the practice of crime linkage has been conducted to date, a critical review and research agenda concerning such computerised databases does exist, highlighting a number of key factors that need to be addressed in order to assess the utility of such databases (Bennell et al., 2012). Four key areas for attention were identified. The first stage is to establish whether the information held on such databases is reliable which, Bennell et al. (2012) argue, should primarily be tested by

ensuring a high level of interrater reliability of information coded by different analysts. Second, they posit that the data entered into these databases need to be accurate, and third that the principles of consistency and distinctiveness need to hold true. Last, Bennell et al. (2012) argue that practitioners should be able to accurately conduct linkage using the data held in these databases.

Whether the information entered into such computerised systems is reliable is one of these factors that has been considered by a number of articles. Martineau and Corey (2008) tested the interrater reliability of ViCLAS coding in Canada. While at first glance the results seemed positive, with participants demonstrating interrater reliability of 79.30% when coding a homicide scenario and 87.70% in a sexual assault scenario, when looking at the more stringent measures of percentage occurrence agreement (POA; the percentage of times raters agree information is present) and percentage non-occurrence agreement (PNOA; the percentage of times raters agree information is absent) the results were less encouraging, with an overall POA of 38.43% and 25.38% and an overall PNOA of 54.67% and 68.80% respectively. Snook et al. (2012) replicated Martineau and Corey's (2008) study, making notable changes to the methodology used. Instead of using mock cases, real case details were given to participants to code into ViCLAS. In this instance, only the POA was calculated, with a similarly low result of 30.77% agreement found overall. Snook et al. (2012) suggested a number of reasons as to why interrater reliability was so low; a) that participants may have found the study's task boring or unimportant; b) that participants were unfamiliar with the case materials; c) that participants may have little experience of coding information into ViCLAS; d) that the questions in ViCLAS themselves may be difficult to answer; and e) that the case material was both complex and lengthy. Finally, Davies et al. (2018b) conducted a similar study, using participants from the Zeden-Analyse-Moeurs (ZAM) unit in the Belgian

Federal Police. This study was designed to address a fundamental difference in the manner in which ViCLAS is coded internationally; in some countries, such as Canada, the ViCLAS variables are coded by the officers conducting the investigation, whereas in many European countries, including Belgium, this is done by crime analysts working within a centralised unit. The results in this study were more encouraging, with an overall POA of 55.80% and an overall PNOA of 88.99%. While these results are far from perfect, Davies et al. (2018b) highlight that only the first part of the coding process is investigated in these studies, with the effect of quality control processes used to improve reliability yet to be studied. What the results from this most recent study may demonstrate, however, is that the coding of human behaviour into quantifiable and standardised responses is a complex and difficult process, which may be mediated somewhat by the introduction of analyst expertise and familiarity borne of consistent usage of a computerised database such as ViCLAS.

### Section summary

ViCLAS is typically used to search for potential links to an index offence/series and as such, while not specified, all three studies of the interrater reliability of ViCLAS coding make implicit reference to the practice of CCA. As noted above, Keppel (2000a; 2000b) mentions HITS, which is used in order to determine the frequency of signature behaviours, individually and in combination, to assess their rarity when making linkage decisions. Similarly, Labuschagne (2012) makes reference to the Violent Criminal Apprehension Program (ViCAP), another database that can be used to assist with crime linkage. This demonstrates the reliance on computerised databases in the practice of CLA as well as CCA in some countries, highlighting the importance of evaluating these databases used to support crime linkage decision making.

### Suggestions for research based on practitioners' experiences

There is no current literature which explicitly highlights how or whether specific current theoretical crime linkage research is actually used in practice. The effectiveness of geographical data for linking volume crimes (e.g. burglary and vehicle crime) as demonstrated in theoretical crime linkage research, for example, would suggest that this sort of behavioural information ought to be prioritised in the practice of linking these types of crimes (Tonkin et al., 2008). The difficulty of translating research into practice has been highlighted by Bennell, Woodhams, and Mugford (2014), who explain that research findings may not be useful in investigative settings because a) the samples used in research may not be representative of samples found in real life settings; and b) the nature of the linking tasks used in theoretical research may be different to those within a real world investigative setting. Indeed, while some theoretical research does note the differences in crime linkage approaches (Bennell, Mugford, Ellingwood, & Woodhams, 2013), these practical differences are not always considered, meaning it may not be a straightforward process to infer the utility of theoretical research to crime linkage practice.

One study that goes some way to answering this question is Labuschagne and Salfati's (2015) article, which provides a summary of current academic research which may be of use when conducting crime linkage. For example, they note Horning, Salfati, and Labuschagne's (2015) research on consistency of approach type, which has implications as to whether this type of behaviour should be relied on during the linkage process. It hypothesises about the potential use of specific aspects of research in practice, and importantly, also

suggests that practitioner case work can inform a research agenda for the future – giving examples of such research that needs to be conducted – in order to ensure the translational nature of future research from theory to practice. What it doesn't do, however, is demonstrate how or whether this research is of actual value to practice (indeed, most of the research highlighted post-dates the cases to which the paper refers).

Analysts have demonstrated that they are mindful of the available academic research relevant to their profession (Burrell & Bull, 2011), and as with Labuschagne and Salfati's (2015) article, what is perhaps most useful with regards to this section are the suggestions for further academic research made by practitioners who conduct crime linkage. Rainbow (2014), for example, requests that more research investigates the decision thresholds at which crimes should be considered linked. A low decision threshold, for example, may result in more hits and fewer misses, but increases the likelihood of false alarms. On the other hand, a strict decision threshold would mean fewer false alarms but also fewer hits. Empirical research that can inform such decision making would, therefore, be useful. (Some academic research has calculated what the 'optimal' threshold would be for considering offences linked using Youden's calculation (e.g. Davies et al., 2012; Tonkin et al., 2008). These have not been reviewed here, however, as they do not consider the real world factors that would be associated with setting a linkage threshold, and they are not studies of the practice of crime linkage.) Similarly, Rainbow (2014) calls for research which would further the development of CLA as an evidence-based practice, especially given the legal contexts in which it could be used. Lastly, Rainbow makes the more general observation that his 2014 chapter is the only source to provide a detailed account of the differences between practitioners' approaches (CLA versus CCA), and suggests a change in academic focus to incorporate more concerns of practitioners of CLA.

## Discussion

The aim of this review was to determine the extent of the available literature on the practice of crime linkage. While no information was found that suggests specifically how current theoretical research is used in practice, the review identified writings on how CLA and CCA are conducted using a number of different methodologies. Research on practitioner linkage accuracy was also found, both in respect to comparisons with non-experts and to statistical models. Research into how computerised tools affect the linkage process has also started to be conducted. In addition to its intended aims, this review has also identified novel areas of research need and areas where clarification is required. These are discussed below.

### The variation in practice

The major difference between approaches – namely CLA and CCA discussed in this review – is something that is recognised within the literature but, as highlighted here, there is often variation in the methodology used to carry out each approach, something not often overtly recognised. CLA is (or has been) used in the US and Canada, and is currently used in South Africa and the UK. In CLA, links are searched for in many ways, from using behaviours considered to be of personal significance to the offender (signature analysis; Keppel, 2000a), to identifying common behaviours or sets of behaviours across crimes, independent of their perceived significance to the offender (multivariate behavioural linking; Winter et al., 2013). While many different methods for conducting CLA are described in the literature, much less information exists on how CCA is conducted. In fact, CCA has only

been mentioned in UK research on crime linkage practice, although the ViCLAS interrater reliability studies that exist suggest that CCA is also used in Canada and Belgium. Indeed, the Royal Canadian Mounted Police confirm ViCLAS' current usage in Canada, the UK, and Belgium, as well as France, Germany, the Czech Republic, Ireland, the Netherlands, Switzerland, and New Zealand (Wilson & Bruer, n.d.). This suggests an even wider use of CCA globally than currently recognised in the literature, although the exact methods used to conduct CCA in these countries aren't, to date, publicly available.

### The variation in terminology

Crime linkage has been recognised here as a blanket term which may encompass a number of different processes, but the lack of specific terminology used to describe each process does make the comparison between different research problematic. Furthermore, one of the major issues with writings on the practice of crime linkage is that the same terminologies are used to describe different processes. For example, there are papers on 'linkage analysis' written by practitioners in different countries, where the steps that are undertaken to search for links are, in places, notably different (Hazelwood & Warren, 2004; Labuschagne, 2006). Attempting to describe each process in general terms, away from the nuances of specific case studies, would help to clarify the process underlying each term. It may be that a natural degree of evolution in the practice can account for discrepancies in the meaning of each term, or alternatively, that cultural differences may impact on how linkage is conducted. The addition of the use of geography in Labuschagne's (2012) linkage analysis method, for example, could be attributable to either of these factors. Because these issues

have not yet been explored, it is difficult to be certain whether the approaches and methodologies described here are still reflective of practice around the world today.

### The behaviours used to conduct crime linkage

While a number of studies describe the steps involved in conducting crime linkage, there is little information on precisely what behaviours are chosen when conducting this process. There are, however, some inferences that can be drawn from the literature reviewed. The signature -methodology focuses on unnecessary behaviours, those posited to be important to the offender in terms of fulfilling their fantasy. In contrast, academic research has found 'style' behaviours to be relatively inconsistent at an aggregate level (Grubin et al., 2001; Woodhams, 2008), and only consistent in some offenders. Further, while it is possible for unnecessary behaviour to be present in all types of crime (e.g. a burglar eating food from the victim's fridge), examples given of these types of behaviour often pertain to sex offences and murder, and it is not clear how useful these behaviours would be when attempting to link other crime types. It is also unclear whether unnecessary behaviours are considered to aid the linking process due to their distinctiveness, or whether they are deemed to be useful because of assumed consistency due to their significance to the offender.

The identification of rare behaviours is something that is highlighted in the linkage analysis methodology of Hazelwood and Warren (2004). As with the unnecessary behaviours, however, there is no specification of what behaviours (or combination of behaviours) are distinctive and thus useful for linking crimes (other than those in the case studies outlined, which cannot be generalised to other cases).

Studies of expertise in crime linkage also provide some suggestions as to what behaviours are focused upon during this task. Santtila, Korpela, et al.'s (2004) study of linking car thefts found that experts focused on behaviours under the offender's control, such as the vehicle type, as well as time and location of the offence. In Bennell et al.'s (2010) study, participants with experience of crime linkage suggested that temporal information would have been used in the linkage task if that information had been available to them, and the importance of these types of behaviours was highlighted in interviews of CCA practitioners (Burrell & Bull, 2011). This information suggests that there are certain behaviours perceived to be more useful for linkage than others, presumably because they remain relatively consistent as they are less subject to situational variance. Much of the academic literature would support the notion that geographical, temporal, and MO behaviours under an offender's control are of potential use in linking crimes due to their relative consistency (Woodhams & Bennell, 2014).

### How behaviours are conceptualised in theory and practice

As well as the type of behaviours deemed useful to the process of crime linkage, there is the matter of how these behaviours are actually conceptualised. In theoretical research, consistency is most often considered in terms of whether linked pairs are significantly more consistent than unlinked pairs, measure by creating similarity coefficients between each pair, either for each behaviour, or for domains of behaviours. (Domains are groups of behaviours that share the same function, e.g. control or precautionary behaviours (Tonkin et al., 2008). In this way, behaviours are represented more generally, although it is important to note this

differs from grouping behaviours into themes.). When considering thematic consistency, academic research first categorises cases into different themes, then measures in discrete terms whether or not crimes in series demonstrate the same theme.

Using both themes of behaviour and taking note of individual distinctive behaviours suggests that practitioners may be conceptualising behaviours, not just at a number of levels, but considering these levels simultaneously, something which the academic literature (with two notable exceptions; Melnyk, Bennell, Gauthier, & Gauthier, 2011; and Woodhams, Grant, & Price, 2007) has yet to do. Further, in the academic literature consistency is usually measured at an absolute level. By contrast, practitioners seem to accept behavioural variations and implicitly consider relative consistency (even if this is not formally measured), factoring in small changes due to escalation, for example (Keppel, 2000b) to allow for the consideration of consistency given the context of the situation. Context and its effect on the consistency of behaviour is rarely discussed in the academic literature (although there are a few notable exceptions; e.g. Woodhams, Hollin, & Bull, 2008), despite the importance practitioners' place on this factor (Labuschagne, 2014). These issues warrant further investigation.

### Setting out a research agenda

This review and evidence synthesis has indicated several areas of research and scholarly need. What is also striking is the scarcity of information about the actual practice and process of crime linkage. While there are case studies of CLA written by practitioner authors, there is a need for a more generalised mapping of the processes divorced from the

nuances of particular cases. What differences there might be in practice between countries could be disentangled from any differences potentially being a function of the specific illustrative cases chosen. While the CCA process has been mapped out in general terms in one publication (Woodhams, Bull, et al., 2007), this publication is more than a decade old. Burrell and Bull (2011) have made important inroads in this area by surveying analysts about their experiences of conducting CCA, but much more detailed (published) information is needed about analyst' decision making processes, including exactly which behaviours analysts prioritise and why, how they operationalise these behaviours, how context and the situational influence of cases are taken into account, the chronology of their decision making, and how the threshold at which cases are considered linked is set.

With the publication of more studies that clearly outline the methods of conducting CLA and CCA, it will be easier for academics to design studies that test the accuracy of crime linkage decision making in an ecologically valid manner. The same is true of the investigation into the effects of using computerised databases to assist with the linkage process; the more that is known about the manner in which these programs are used during linkage, the easier it will be to construct studies that test their contribution to the process. While expertise has been touched upon in the research into the practice of crime linkage, there remain many human factors involved in the crime linkage process, such as stress and cognitive fatigue, which have yet to be investigated. The efficacy of crime linkage, including the reliability of the information used for linkage and the reliability with which it is coded, needs to be addressed, as do the error rates of practitioners conducting crime linkage in its various forms.

This review has highlighted discrepancies between the manner in which crime linkage is researched and how it is conducted in practice. This disconnect has been noted already by both researchers and practitioners (Rainbow, 2014). The fact that practitioners are publishing in academic outlets (e.g. Labuschagne, 2014; Rainbow, 2014) and that researchers and practitioners are co-producing research (e.g. the Crime Linkage International Network, or C-LINK; Tonkin et al., 2017; Woodhams & Labuschagne, 2012) suggests there is a desire from both parties to bridge this gap. Closer academic-practitioner working would not only advance the understanding of crime linkage practice, but would also ensure the research better meets practitioner need. While there are challenges associated with such collaboration, such as issues of sharing sensitive data, or differences in academic and practitioner priorities, these are not insurmountable problems. Researcher secondments into practitioner workplaces, practitioner-academic networks and groups, conferences that integrate the perspectives of both parties, and practitioner contributions to special journal issues and books are all useful ways to encourage collaborative working and a two-way dialogue.

### Limitations

The main limitation of this review is that an exhaustive list of all of the available information, in particular practitioner documentation, will not have been included here. Despite the effort to search for practitioner writings, it is likely that much of this type of information will not be in the public domain. Further, there will be documentation from other countries – written by both academics and practitioners – that will have also been omitted here. This factor again highlights the importance of cooperation between practitioners and academics from the international crime linkage community.

## Conclusion

The goal of this literature review was to identify and synthesise what is known about crime linkage practice from academic and practitioner writings. While there is existing literature on the practice of crime linkage, this review highlighted the paucity of such information and the knowledge gaps that now need to be filled, including practitioner authored articles about the crime linkage process, as well as more ecologically valid academic studies. Given that crime linkage is widely used around the world, there is a sense of urgency with which this sort of research ought to be conducted.

**CHAPTER 2:**  
**A RESPONSE TO PROFESSOR MARGOT’S 2009 ASSESSMENT OF THE  
VIOLENT CRIME LINKAGE ANALYSIS SYSTEM (VICLAS): AN EVALUATION  
INTO THE VALIDITY OF CONCLUSIONS DRAWN**

Chapter 2 has been submitted for publication to *Psychology, Crime & Law*. The manuscript is authored by Miss Kari Davies (University of Birmingham), Mrs Hanne Imre (Zeden-Analyse-Moeurs unit, Belgium), and Dr. Jessica Woodhams (University of Birmingham).

Having conducted the literature review in Chapter 1, the author began to collect data for Chapters 3 and 4 of the thesis. By working within the Zeden-Analyse Moeurs (ZAM) unit of the Belgian Federal Police the author was in a unique position to learn about the manner in which crime linkage is conducted in practice, as well as understand more about where crime linkage fits within the landscape of law enforcement more generally. This included gaining a greater understanding of the manner in which academic writing can be either a help or a hindrance to those working in this field. One particular article, written by Professor Margot of the University of Lausanne, had been cited as having had a negative impact upon the perception of the ZAM analysts’ work in their country. Chapter 2 was written to assess the validity of the claims made in this article, and aimed to highlight the difficulties associated with writing on the subject of crime linkage without reference to the appropriate material.

Davies, K.\*, Imre, H., & Woodhams, J. (2018a). A response to Professor Margot's 2009 assessment of the Violent Crime Linkage Analysis System (ViCLAS): An evaluation into the validity of conclusions drawn

Commissioned by Maria De Sterck (Behavioural Sciences Services Director, Belgian Federal Police)

\*All correspondence to be addressed to the first author by email; KAD351@bham.ac.uk; or in writing; Kari Davies, Centre for Forensic and Criminological Psychology, School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

## Abstract

This article collates and explains concerns raised by a number of sources from different European countries about a report evaluating the Violent Crime Linkage Analysis System (ViCLAS), written by Professor Margot of the University of Lausanne in 2009. It finds that there are several key issues with Margot's report, including a misunderstanding of the purpose of ViCLAS, the lack of explanation of the theory upon which ViCLAS is based, and the research chosen upon which to write this evaluation. Having addressed these issues, this article also attempts to address the scope of what such an evaluation of ViCLAS should cover, in order to ensure that this system is used in as efficient manner as possible.

## Samenvatting

De evaluatie van het Violent Crime Linkage Analysis System (ViCLAS) uit 2009 door professor Margot van de Universiteit van Lausanne gaf aanleiding tot het schrijven van dit artikel. Een aantal kritieken uit verschillende Europese landen worden hier verzameld en besproken. Het rapport van Margot omvat verschillende problemen, zoals een misvatting van de doelstelling van ViCLAS, een tekort aan verduidelijking van de onderliggende theorie waarop ViCLAS gebaseerd is, en de door hem als onderbouwing gekozen academische studies. Naast deze kernpunten, tracht dit artikel te bespreken wat een dergelijke evaluatie wel zou moeten behandelen zodat dit systeem zo efficiënt mogelijk gebruikt wordt.

## Résumé

Cet article collationne et explicite les préoccupations rapportées par un certain nombre de sources dans différents pays européens au sujet d'un rapport d'évaluation du Système d'Analyse des Liens de la Violence Associée aux Crimes (SALVAC : Violent Crime Linkage Analysis System ; ViCLAS) rédigé par le professeur Margot de l'Université de Lausanne en 2009. Cet article constate que le rapport de Margot contient plusieurs faiblesses majeures, dont la méconnaissance de l'objet de ViCLAS, le manque d'explication de la théorie sur laquelle ViCLAS repose, et la méthode de recherche choisie pour rédiger son évaluation. Après avoir examiné ces problèmes, cet article essaie également d'examiner quelle devrait être la portée d'une telle évaluation de ViCLAS, afin de s'assurer que le système soit utilisé de la manière la plus efficace possible.

This work was supported by the Economic and Social Research Council.

Note: Quotations have been included in the original language in which Professor Margot wrote his article. Translations have been provided in square parentheses.

Keywords: crime linkage; comparative case analysis; linkage analysis; ViCLAS; crime scene behaviours

## Introduction

This article was written in response to Professor Margot of the University of Lausanne's 2009 paper entitled '*ViCLAS – SALCV – SALVAC: Violent Crime Linkage Analysis System: Système d'analyse de liens dans les crimes violents / de la violence associés aux crimes. Rapport d'évaluation sur les fondements scientifiques du système ViCLAS*'. [ViCLAS – SALCV – SALVAC: Violent Crime Linkage Analysis System: The linkage analysis system of violent crime / of violence associated with crime. An evaluative report on the scientific foundations of the ViCLAS system.] The current article was commissioned by Maria De Sterck (Behavioural Sciences Services Director, Belgian Federal Police) after questions were raised by senior staff in this police service about the efficacy of ViCLAS (Collins, Johnson, Choy, Davidson, & MacKay, 1998) on the basis of Margot's report. Concerns were voiced, however, about the accuracy of some of the arguments put forward in Margot's paper (second author, personal communication, 2015). This article, therefore, aimed to collate and evaluate the issues raised about Margot's article, while simultaneously attempting to clarify the purpose of ViCLAS and the current state of its evaluation.

(A note about the authors: While this article was commissioned by a member of the Belgian Police, with responsibility for the running of the Belgian ViCLAS unit, the first author is a British student studying for a PhD at the University of Birmingham, and the third is her supervisor. Assistance and thanks go to the second author – an experienced ViCLAS analyst in the Belgian Police – for her insight into the practical workings of ViCLAS. The authors also recognise that the expertise shared by a number of sources has come from

European based ViCLAS units, and there may be discrepancies in the usage of ViCLAS in these countries and others, including North America.)

Professor Margot wrote his evaluation on ViCLAS in 2009, destined for the police authorities of the Canton of Vaud, Switzerland. While not published in a peer-reviewed journal, it was made publicly available through its publication on the Canton of Ticino website. Margot states that his paper is a '*Rapport d'évaluation sur les fondements scientifiques du système ViCLAS*' [Evaluative report on the scientific basis of ViCLAS; p. 1]. The mandate of the paper, outlined on page four, calls for Margot to '*évaluer et prendre position sur le plan scientifique sur ViCLAS et sa pertinence*' [evaluate and take a scientific stance on ViCLAS and its relevance]. In other words, Margot's paper should be an evaluation of both the underlying principles of ViCLAS and the theory that underpins and supports it, and an evaluation into the efficacy of ViCLAS as an operational program used today by many police services worldwide (Wilson & Bruer, n.d.). It is within the context of these aims that a number of concerns about Margot's paper were raised from several different sources, both on a theoretical and practical level (second author, personal communication, 2015).

## ViCLAS in practice

Margot's (2009) article clearly states that the relevance of ViCLAS is to be evaluated, and this cannot be conducted without a clear understanding of the system's operation. This is one of the fundamental concerns raised by a number of sources; that Margot does not seem to have a thorough understanding of what ViCLAS is currently used for. The issue of why this may be is discussed later in this article; it first details the issues that this lack of understanding brings, including confusion between the use of ViCLAS in different countries, and between ViCLAS and other law enforcement systems.

### Understanding ViCLAS

Margot gives an outline of the history of ViCLAS' conception on page three of his 2009 paper. The history is comprehensively detailed on the Royal Canadian Mounted Police (RCMP) website (Wilson & Bruer, n.d.); to summarise, it states that ViCLAS was created after Canadian law enforcement recognised the need for a central system to capture details of serial violent offenders, having dealt with a number of difficult homicide cases that spanned several different jurisdictions. The Canadians' first attempt at this system was the Major Crimes File (MCF), but it became apparent that this system was proving ineffective. Inspector MacKay, a qualified Criminal Investigative Analyst in Canada, reviewed the MCF, and with the help of several colleagues and after reviewing a number of other systems designed to conduct crime linkage (the FBI's Violent Criminal Apprehension Program, or ViCAP, among them), ViCLAS was born (Collins et al., 1998).

This is ViCLAS' history through the 1980s and 1990s, but since then ViCLAS has undergone further transformations. While some of the principles upon which ViCLAS was originally based were founded in what was then the most recent research in behavioural profiling, ViCLAS was designed to be, and still is, a crime linkage tool, not a profiling tool. This is an important point because it highlights the context in which ViCLAS should be evaluated.

In Margot's (2009) article, however, there seems to be real confusion as to whether ViCLAS is used for profiling or crime linkage. This is echoed in the hypotheses Margot chooses to use, including '*que la scène de crime présente le reflet de la personnalité du 76dminist,*' [that the crime scene is a reflection of the criminal's personality], and '*la personnalité du 76dminist ne varie pas*' [the personality of the criminal does not vary; Margot, 2009, p. 4]. Both of these hypotheses are concerned with the evaluation of profiling, and are actually taken from Beauregard and Proulx's (2001) paper entitled *Profilage criminel: Évolution et 76dministr perspectives dans l'établissement de modèles prédictifs* [*Criminal profiling: Evolution and new perspectives in establishing predictive models*], an article concerned with evaluating profiling, not crime linkage. In fact, ViCLAS is not mentioned once in Beauregard and Proulx's (2001) article. This issue will be discussed further in the theoretical section of this review, but Margot's unfamiliarity with ViCLAS' usage and evolution also yields other, more practical confusion with the system. Margot appears to base all of his knowledge on the information on the RCMP website (Wilson & Bruer, n.d.), where the original ViCLAS is outlined, and it is from this that some of the misunderstandings about the current usage of ViCLAS seem to arise.

To give a practical example to illustrate this confusion in Margot's article, it is posited that ViCLAS consists of 263 questions. This is indeed the number of questions included at ViCLAS' inception (Collins et al., 1998), but since then a number of newer versions of ViCLAS have been released (versions 3.0 and 4.0 are mentioned on the RCMP website; Wilson & Bruer, n.d.) with updated questions. In 2003, for example, Switzerland was using the third version of ViCLAS, comprising of 168 questions (Blättler, 2009), and Belgium currently uses the fourth version, comprising of 156 questions. Furthermore, if a country decides to invest in ViCLAS further, it can choose to buy the rights to alter ViCLAS to better suit the recording and analysis of crimes committed in that country; Belgium, for example, does not have this right but, by contrast, the United Kingdom (UK) does. Work has also already been undertaken to adapt ViCLAS to reflect cultural differences in the UK, and there is ongoing monitoring of crime trends to ensure that ViCLAS variables remain appropriate (Wilson & Bruer, n.d.). While Margot briefly refers to the reduction in the number of questions contained in ViCLAS (p. 10), and mentions a 2002 version of the system (p. 8), he neither specifies which officially updated version of ViCLAS he is describing, nor does he discuss the capacity to modify ViCLAS or its taking into account of any cultural differences. This either demonstrates the author felt these facts were not important – this would be surprising given that the article aims to evaluate the relevance of ViCLAS – or that the absence of these facts demonstrates a crucial oversight into the workings of this system by the author.

### Intra-country differences

A further issue that arises from Margot's apparent misunderstanding of the practical workings of ViCLAS is the notion that the Swiss usage of ViCLAS is not clearly outlined. As Margot is in Switzerland it seems logical that he would evaluate ViCLAS usage in this country, but this does not seem to be the case (in fact, the Canton of Vaud was approached for data but was unable to provide Margot with any feedback about potential successes; p. 4). A report by the Polizeikommando des Kantons Bern (2007; in Blättler, 2009) summarises the Swiss ViCLAS usage as having the following five functions; suggesting links between cases and offenders; recognising series; identifying offenders; reducing recidivism; and developing the monitoring of criminal careers. The fact that no consideration is given in Margot's (2009) article to the specific usage of ViCLAS in Switzerland is further testament to the lack of knowledge about what ViCLAS is used for. Furthermore, and crucially, the fact that the comparative usage of ViCLAS in different countries is not recognised suggests that Margot is potentially unaware of any inter-country differences in the use of ViCLAS. One notable example of this is the method of coding ViCLAS; in Canada, for example a police officer would complete a ViCLAS booklet that is then sent to analysts to input the information into the database and conduct quality control checks (Wilson & Bruer, n.d.). In other countries, however, such as the UK, Belgium, and the Netherlands, entries into ViCLAS are made by dedicated and trained analysts using the original police files (not on the basis of an officer-completed booklet). While Margot does talk about the Canadian system of ViCLAS coding on page 10 (such as there being a quality control process conducted by a ViCLAS expert after initial coding), there is no indication of an awareness of the coding differences between Canada and other countries.

#### ViCLAS and other law enforcement systems

Within Margot (2009)'s article there is not only a lack of understanding demonstrated between the usage of ViCLAS in different countries, but also between ViCLAS and other systems. Some of Margot's (2009) article, for example, focuses on ViCAP, and as mentioned above, while this was a system that was analysed when the ViCLAS creators were researching linkage systems (Wilson & Bruer, n.d.), the two systems are separate entities and do not operate together. One major difference, for example, is that ViCAP collates reports on missing persons and unidentified bodies, as well as homicides and sexual assaults (Cooper, 2007). While Margot recognises ViCAP's influence on ViCLAS at its creation, it is unclear, given the two systems' independence of each other, why he continues to reference and evaluate ViCAP throughout the article; *'C'est sur cette base que se sont faites les premières classifications du ViCAP'* [This was the basis for the first categorisations of ViCAP; p. 9]; *'Au debut des années 2000 aussi bien ViCAP que ViCLAS réduisent considérablement le nombre de questions'* [In the early 2000s, both ViCAP and ViCLAS significantly reduced the number of questions; p. 10]. Margot's highlighting of the FBI evaluation of ViCAP as being *'cumbersome and difficult'* (p. 10; in Witzig's (2003) article entitled *'The new ViCAP; More user-friendly and used by more agencies'*), for example, seems irrelevant in the context of the evaluation of ViCLAS. While it is understandable that ViCAP is mentioned in the context of the creation of ViCLAS, to refer to it as if the two systems are currently comparable, or interchangeable, only serves to confuse the issue of evaluating the relevance of ViCLAS.

## The theory behind ViCLAS

This article has already discussed the issues surrounding the confusion of what ViCLAS is currently used for. As mentioned earlier, this misunderstanding of the system's current purpose may be explained by the clear confusion over the scientific foundation upon which ViCLAS was, and is, based. There are two distinct topics in forensic psychology that are of relevance here; profiling and crime linkage. Not only is there a lack of distinction or seeming understanding of these two distinct psychological principles within Margot's (2009) article, but Margot, as touched on above, continues to reference and evaluate ViCLAS within the context of profiling, whereas ViCLAS is a crime linkage tool, not a profiling tool. Additionally, given this misunderstanding of the literature, much of the academic research that should have been mentioned is absent from the article, meaning much of the article itself is unsubstantiated.

### The difference between profiling and crime linkage

In terms of the theoretical underpinnings of ViCLAS, it is important here to make clear the distinction between crime linkage and profiling. Crime linkage is the process of finding associations between offences based on the behaviour exhibited at the crime scene (Woodhams & Bennell, 2014; Woodhams, Hollin, & Bull, 2007). Crime linkage is not concerned with the inferences about an offender's character or offender details based on these behaviours, as is profiling (see Woodhams & Toye, 2007, for a more detailed explanation of the two different psychological processes). In other words, crime linkage looks purely at what

behaviour has been exhibited, and whether the behaviour is similar and distinctive enough across a set of crimes to conclude that they might represent a linked series. Profiling, on the other hand, is concerned with what those behaviours demonstrated at a crime scene might mean about the offender(s) (Canter, 2000). As mentioned above, ViCLAS is a tool that was designed to assist analysts in the process of crime linkage. As such, it is unnecessary for analysts to consider what the behaviours that offenders exhibit may mean in terms of deducing their characteristics.

To give an example of the distinction between crime linkage and profiling in the academic literature, Grubin, Kelly, and Brunsdon (2001) demonstrated that behaviours used to control the victim during a sexual assault are useful for finding links between crimes. Offenders demonstrated these types of behaviours consistently enough across a crime series, and distinctively enough from other offenders, that it was possible to recognise patterns of behaviour and link some offenders' crimes together. Note here that at no point does this article attempt to draw conclusions about what exhibiting these behaviours might mean about the offenders themselves. Profiling literature, on the other hand, aims to do just that; Goodwill and Alison (2007), for example, demonstrated that victim age could be used to predict offender age when certain contextual factors were taken into consideration. While the notion that behaviour may give some meaningful insight into the offender has proved somewhat difficult to demonstrate empirically (Alison, Goodwill, Almond, van den Heuvel, & Winter, 2010), there is a growing body of research to support the theoretical underpinnings of crime linkage of behavioural consistency and behavioural distinctiveness. Research has found that offenders' behaviour can be both consistent and distinctive across a range of different crime types, for instance, commercial and personal robbery (Woodhams & Toye, 2007, and Burrell, Bull, & Bond, 2012 respectively), commercial and residential burglary

(Bennell & Canter, 2002, and Markson, Woodhams, & Bond, 2010 respectively), vehicle theft (Davies, Tonkin, Bull, & Bond, 2012; Tonkin, Grant, & Bond, 2008), rape (Slater, Woodhams, & Hamilton-Giachritsis, 2015), and arson (Santtila, Fritzon, & Tamelander, 2004); across crime types (Tonkin, Woodhams, Bull, Bond, & Palmer, 2011); using different methodologies (Bouhana, Johnson, & Porter, 2016; Tonkin, Woodhams, Bull, Bond, & Santtila, 2012); using samples of one-off and serial offences (Tonkin, Santtila, & Bull, 2012); and using samples including both solved and unsolved offences (Woodhams & Labuschagne, 2012).

The reason why this distinction is so important in this literature is that it is crucial for understanding the foundation upon which ViCLAS was built. At its inception, as mentioned above, literature including features of both profiling and crime linkage may have been used in order to assist in its creation, but this was at a time when profiling and crime linkage were often conducted simultaneously as part of a single process. Since ViCLAS' inception, however, crime linkage has emerged more and more as an area of forensic psychology that is independent of profiling, and the recent literature outlined above that focuses solely on crime linkage reflects this shift. Crime linkage, as it is defined today, is not concerned with one of the fundamental principles of profiling, that of the homology assumption, which states that an offender's behaviour will be related to their background characteristics (Alison, Bennell, Mokros, & Ormerod, 2002). That ViCLAS was developed to be a crime linkage tool is stated by the RCMP themselves (Wilson & Bruer, n.d.), and as it is currently used for crime linkage purposes, it seems reasonable to suggest that the crime linkage literature, not the profiling literature, should form the basis of an evaluation of ViCLAS. The purposes of ViCLAS in Switzerland are also outlined above; notice here that there is no mention of profiling, only of crime linkage (Polizeikommando des Kantons Bern, 2007; in Blättler, 2009), further

demonstrating the relevance of crime linkage over profiling literature. As another practical example of this distinction, in Belgium (and some other European countries such as the UK), crime linkage – finding links between crimes; and behavioural analysis – inferring offender characteristics from their exhibited behaviour, are performed by two discrete units, demonstrating the separation of these psychological processes.

Unfortunately, Margot's erroneous supposition that ViCLAS is a profiling tool (2009; p. 7; p. 11) affects the consequent evaluation made about this system. While some current profiling literature is mentioned throughout the article (e.g. Bourque, LeBlanc, Utzschneider, & Wright, 2009; Doan & Snook, 2008; Kocsis, 2004; Kocsis, Hayes, & Irwin, 2002; Kocsis, Irwin, Hayes, & Nunn, 2000; Hicks & Sales, 2006; Snook, Cullen, Bennell, Taylor, & Gendreau, 2008), these articles seem extraneous to the evaluation of a crime linkage tool. Despite its existence the crime linkage literature is largely unexplored; in fact, no real attention is paid to the concept of crime linkage – the actual purpose of ViCLAS – leaving much of the article irrelevant to the purpose for which it was conceived. Margot consistently alludes to ViCLAS as a profiling tool (p. 7; p. 11), something that it is not used for (second author, personal communication, 2015; Wilson & Bruer, n.d.). The article claims to be an evaluation of the scientific foundations of ViCLAS, but they are neither properly outlined nor subsequently evaluated.

### Choice of academic literature

As a consequence of this misunderstanding between crime linkage and profiling, very little relevant academic literature has been consulted by Margot (2009). There are references

within the article, but few are relevant to the current principle and workings of ViCLAS, that of crime linkage. Martineau and Corey (2008) is appropriately cited as a paper that evaluates the interrater reliability of ViCLAS (*'interrater reliability involves determining the extent to which two (or more) different investigators enter the same information about a case into a ViCLAS coding booklet'*; Snook, Luther, House, Bennell, & Taylor, 2012; p. 609), but further literature principally involved with the theory or efficacy of crime linkage is missing. As demonstrated above, this literature is readily available (e.g. Tonkin et al., 2008; Tonkin et al., 2011; Woodhams & Toye, 2007); Blättler (2009) also lists a number of papers deemed to be more appropriate in an evaluation of ViCLAS (e.g. Baurmann, 1999; Baurmann et al., 2009a; Lichterbeck, 2009b; Grubin et al., 2001). Evaluating this literature should have been crucial in a paper investigating the relevance of ViCLAS. Margot also cites research from his own department, l'Institut de Police Scientifique (IPS); it is not apparent why this older literature (Ribaux, 1997; Taroni, 1997), is cited over other, more appropriate, published research as outlined above. (It is necessary to note here that while some of the literature cited in this response is not publicly available, the majority is readily available online.)

### Unsubstantiated opinions

As well as very little of the relevant research being cited, very few papers are cited at all, leading to opinions unsubstantiated by any research. This makes it difficult to support Margot's (2009) suppositions about ViCLAS when there is no evidence shown for these opinions. For example, Margot states that *'l'ensemble des documents associés à ViCLAS restent très généraux, ne laissent pas apparaître d'objectifs clairs, la méthode n'est jamais décrite suffisamment pour pouvoir en comprendre les fondements et les succès proclamés ne*

*sont pas vérifiables et très rarement appuyés par des données empiriques liées aux résultats'*

[all the documents associated with ViCLAS remain very general, do not demonstrate clear objectives, the method is never described sufficiently to be able to understand its bases, and the claimed successes are not verifiable and are very rarely supported by empirical data linked to the results; p. 5]. This statement is not followed with any quotation or citation to verify Margot's supposition. This is of some concern as the reader is not able to draw upon any evidence in order to judge the reliability of the opinion given.

The notion that ViCLAS is a '*monstre administrative*' [administrative monster; p. 2] is also challenged by both the second author of this paper and Blättler (2009). Both point out that, at least in Europe, dedicated analysts work to input information into ViCLAS, and as such, no extra work is expected of police officers, other than sending the relevant documentation to the analysts. Rather than being a burden, Blättler sees such a standardisation of information to be a positive, citing the decrease of subjective decision making as an excellent reason for the continued usage of ViCLAS.

These examples are not an exhaustive list of the unsubstantiated opinions given in Margot's (2009) article, but they are indicative of a larger issue; it seems that the understanding of the theoretical underpinnings of ViCLAS, and the literature consulted, is insufficient to demonstrate that a comprehensive review of ViCLAS has been undertaken in Margot's (2009) article.

## Issues of accuracy

This article has discussed two major concerns with Margot's paper, that ViCLAS' usage is not clearly understood, and that the literature behind its creation, evolution, and current working has either been misunderstood or neglected. There are also some issues with the manner in which the paper has been written. The reason why Margot does not fully explain ViCLAS' current usage may be due to the type of information that was sourced for the article. Concerns are also raised that some of the article is factually inaccurate and, more seriously, that some of the information used is misrepresented.

### The use of open source information

In his 2009 article, Margot attempts to source three types of information; '*Etude documentaire, documents officiels ViCLAS, textes gouvernementaux*' [Documentary review, official ViCLAS documents, government texts; Margot, 2009, p. 4]. Two of these sources, the academic and governmental documents, constitute open source material, meaning that they are publicly available resources. The third source, official ViCLAS documents, are not open source material as they are classified and are only accessible to those with permission to do so (second author, personal communication, 2015). Margot was only able to obtain very limited access to official ViCLAS documents (as explained at the end of page four of his article), and it seems that the author has based his evaluation almost solely on material that was freely available; mostly, it appears, using Google searches (cited on pages four and five). It is difficult to evaluate the utility and accuracy of Margot's article that attempts to assess the

efficacy of ViCLAS when Margot has no apparent access to any of the information about the workings of ViCLAS, the data compiled, or any of the analysts' work itself. The attempt that Margot has made to obtain access to this information should be stressed, as it demonstrates an understanding that research may exist that is not publicly available, and this speaks to a larger issue that often data cannot be accessed by researchers which makes conducting impartial investigation into the topic difficult. What is apparent, however, is that the remaining sources used in Margot's evaluation are inappropriate to the type of article written. In short, there is no evidence of a knowledge of ViCLAS that is absolutely necessary to write an expert report (Blättler, 2009). Moreover, there seems to be little or no real consideration by Margot of the implications using only open source material would have had on the accuracy of his article's conclusions.

#### Errors within the article

A number of errors in the article have been raised from several sources. Both the second author and Blättler (2009) highlight Margot's (2009) supposition on page eight that the ViCLAS booklet has been reduced to a three-page format as erroneous. Blättler (2009) and Houben (personal communication, 2010) suggest that Margot may have confused this supposedly shortened version of ViCLAS with an information report police officers can fill in; this is a three-page document that officers in Switzerland can submit to the ViCLAS unit when no official crime has been reported, but when officers have information they feel would be of benefit to bring to the unit's attention. This information report is not a ViCLAS report.

On page 15 of Margot's (2009) article it states that the question of whether or not DNA is present at the scene is no longer included in the ViCLAS questionnaire. While it is true that ViCLAS and systems holding information about DNA may not be integrated with each other, the notion that information on DNA presence is no longer included in ViCLAS is false; as both the second author and Houben (personal communication, 2010) point out, questions about trace materials were added to later editions of ViCLAS and would have been present in the third edition used in Switzerland since 2003 (Blättler, 2009). Similarly, on page six, Margot draws from the RCMP website to state that there are 20,000 files currently held on the Canadian version of ViCLAS, but Blättler (2009) points out that this information is out of date, and that as of 2007 there were 300,000 files on Canada's ViCLAS. This also is the number given on the current version of the RCMP website (Wilson & Bruer, n.d.).

Margot (2009) acknowledges only four cases (p. 12) that have been solved using ViCLAS, but Blättler (2009) states that at the end of August 2009 in Switzerland there were around 100 avenues of investigation resulting in positively linked crimes, around 30 of which were still to be confirmed. While it is difficult to evaluate the direct success of ViCLAS due to the lack of studies dedicated to this question, Blättler (2009) highlights a section in ViCLAS Switzerland that was added in 2008 for officers to provide feedback on the usefulness of ViCLAS; positive feedback has since been received giving the ViCLAS unit credit for closing several investigations. Both of Blättler's (2009) assertions give credence to the notion that ViCLAS has a greater influence, at least anecdotally at this point, on the progress of criminal investigations than Margot allows for.

The number of errors highlighted in Margot's (2009) article by those working with ViCLAS on a daily basis only serves to highlight the information gap Margot is faced with after having failed to gain access to relevant and current ViCLAS information.

### Misrepresented information

A further concern to do with the accuracy of Margot's (2009) article is that some of the information used to write this evaluation is misrepresented. On page six of Margot's article, for example, the Interior Minister of Belgium makes the point that ViCLAS must have complete and quality information entered into it in order for it to work properly (Dewael, 2008). On page seven Margot talks about this argument being commonly made as an excuse for ViCLAS' failings and references users complaining of the laborious nature of ViCLAS and the resources required to use it. This information was taken from a Canadian governmental report (Ogrodnik, 2002) but is misquoted. It actually states *'A few respondents raised the example of ViCLAS (Violent Crime Linkage Analysis System) as a very burdensome system requiring one designated full-time employee, as well as requiring the divisional crime co-ordinators to keep on top of the front-line members to complete reports.'* (p. 19). While the respondents do call ViCLAS burdensome, Margot makes inferences about how the respondents feel about using ViCLAS, which is not detailed in the report. The respondents may have called ViCLAS burdensome, for example, but felt that the results produced by ViCLAS justified the means. Furthermore, this report's subject was organised crime; as such, it is unclear for what reason ViCLAS was raised as an example, or what relevance this report bears on whether or not it is an effective tool in the crime linkage of sexual assault and murder. Participants may simply have been stating that a tool such as

ViCLAS would not serve their, potentially hugely different, objective of combating organised crime.

Most concerning is Margot's (2009) claim on page two that ViCLAS contributes to linkage blindness. Linkage blindness is the notion that crime series are missed because they cross jurisdictional borders (Egger, 1984). Linkage blindness may be a problem in Belgium, for example, because the different police zones operating in the country keep details of crimes committed in their area on separate databases. As a consequence, different police zones may be susceptible to missing links that cross jurisdictional borders, as officers would not have access to behavioural information detailed enough to look for behavioural links to cases in other zones (Houben, personal communication, 2010). While a centralised database does exist in Belgium – the Algemene Nationale Gegevensbank / Banque de Données Nationale Générale (ANG / BNG; the National Behavioural Database) – it contains information too general for behavioural comparisons to be made (Houben, personal communication, 2010). Given that linkage blindness is a product of a lack of cross-border communication, it would seem logical to suggest that any national database such as ViCLAS would only serve to decrease linkage blindness. Even if a system was relatively ineffective and only highlighted links between a very small proportion of cross-border crime series, this would still constitute a decrease (and not an increase) in linkage blindness. Furthermore, this argument suggesting that ViCLAS, in essence, contributes to increased error rates seems to directly contradict Margot's (2009) argument about ViCLAS that '*Ceux-ci n'étant pas documentés, il n'est pas possible d'estimer un taux d'erreur*' [As they are not documented, it is not possible to estimate an error rate; p. 15]. Margot (2009) is unclear about how any system, including ViCLAS, could possibly increase linkage blindness, a claim which seems particularly spurious with no reliable evidence with which to substantiate it.

## Moving forward with ViCLAS

There are positives to using ViCLAS that are neglected in Margot's (2009) article. Fundamentally, ViCLAS has made connections in cases that other methods may have missed (Blättler, 2009). In Germany, for example, 61 cases over a four-year period were linked on ViCLAS, cases that were subsequently confirmed through other means (e.g. DNA and identity parades; Lenertz & Meinert, 2004). In Belgium, there were recently a number of sexual assaults and rapes committed by taxi driver offenders in different police zones. The ViCLAS unit was instigative in separating the several series of offences committed by these different offenders, suggesting the unit's use in determining a more efficient allocation of police resources. Furthermore, a link was found within these different series by the ViCLAS analysts, which then went on to be confirmed by DNA evidence; this link may have been missed without the support of the ViCLAS unit (second author, personal communication, 2015). Blättler (2009), as noted above, also posits that using a structured system is preferable to using subjective judgement, as there is more scope for misinterpretation without structured systems. While improvements to the efficacy of ViCLAS may be possible, it is currently the only system available which serves to structure the information used by analysts and assist in the reduction of such subjectivity.

Ten Brinke, the Dutch ViCLAS coordinator until 2016 (personal communication, 2010), outlines two fundamental positives of using a centralised ViCLAS unit; that it guarantees a set quality of coding, and gives law enforcement a national overview of crime. Sutton (2005; in Blättler, 2009), the head of the unit in the UK (the Serious Crime Analysis Section, which uses ViCLAS to identify potential links between cases) makes the point that

the purpose of ViCLAS is to assist in the apprehension of offenders as speedily as possible, and without a specialised unit dedicated to the task, the assimilation and use of behavioural information becomes more difficult and time-consuming. He goes on to note that ViCLAS reduces the cost of a police investigation by streamlining the process of data collection. While the cost of the investigations themselves is secondary to the impact these offenders have on others, the cost without a single expert system would be much higher, given that decisions would otherwise be based on subjective and non-evidentiary criteria (Blättler, 2009).

Not only do several sources suggest that the core requirements of ViCLAS are met, at least to a degree, by this current system, there are also unexpected bonuses that have arisen from its use. In the Netherlands, the ViCLAS analysts assist in maintaining a high quality of victim interviewing, as they can highlight inconsistencies or missing information to the investigating officers when entering the case into ViCLAS (ten Brinke, personal communication, 2010).

It is also necessary to point out the potential importance of behavioural crime linkage as an investigative tool. In offences where physical evidence is unavailable, the need for a method of linking crimes that is not reliant on such trace evidence is vital. Margot is highly supportive of using DNA to link crimes (2009, p. 15), and it is clear that forensic science can play a critical role in the apprehension of offenders. Forensic science and forensic psychology, however, as both the second author and Houben (personal communication, 2010) are keen to point out, are not mutually exclusive, and do not have to be evaluated as competitors in striving for effective crime linkage. When forensic evidence is not present, the possibility of using crime linkage should be explored.

### Avenues for future research

The main aim of this article was to address concerns raised about Margot's (2009) article, rather than writing a full evaluation of ViCLAS itself. The authors of this article, however, appreciate the clear need for a thorough, evidence-based evaluation of ViCLAS, and the continued investigation into the theory of crime linkage. While they recognise that they may be in a privileged position by having increased access to ViCLAS data, they suggest that perhaps practitioners and researchers working in tangent are the best people to conduct such research, given that they have access to data necessary to undertake these analyses, and are able to combine different skills to effectively engage with the task at hand. Work being undertaken by the Crime Linkage International Network, or C-LINK, demonstrates perfectly the benefits of academics and practitioners working together to improve crime linkage services (see the C-LINK website – [www.crimelinkage.org/](http://www.crimelinkage.org/) – for further details). Studies are currently being conducted by this network to address the limitations of existing crime linkage research, and work is also being carried out to advance the best practice principles for crime linkage research (Tonkin et al., 2017).

In terms of the evaluation of ViCLAS specifically, perhaps Margot (2009) is closer to what such an evaluation should be addressing when he says '*Aucun argument scientifique n'est mis en avant*' [No scientific argument is put forward; p. 9]; the fact is that little evaluation has been conducted on ViCLAS. He is wrong, however, to suggest that ViCLAS *can't* be evaluated (p. 2). Martineau and Corey's (2008) article, which Margot does reference, is a good example of already published research addressing the evaluation of ViCLAS. It

seems unreasonable to denounce a system that, as Margot himself points out, has not yet been rigorously evaluated. This research is vital because evaluation of a system can only mean its subsequent improvement; Snook, Bennell, Taylor, House, MacDonald, and Luther (2012) provide a succinct and clear outline of the work that is required. Happily, more of this research is starting to be undertaken; see Snook, Luther et al. (2012) for a further example of an evaluation of the interrater reliability of ViCLAS. Similarly, research is currently being conducted in Belgium in order to replicate the Canadian studies of ViCLAS interrater reliability in order to determine any discrepancies in coding that ought to be addressed. There are also many unpublished papers written by internal researchers that aim to assess and improve the service that ViCLAS provides (Lenertz & Meinert, 2004), although as Margot recognises, these are often difficult to access, both internally across different countries' ViCLAS units, and externally, due to the security clearances required to read them. Because of this, the scope of these studies is difficult to estimate. The principles of crime linkage, however, as mentioned above, are well documented in publicly available academic literature.

In essence, any evaluation into ViCLAS should be focused on an impartial and rigorous testing of its current aims and objectives. It is a shame, in fact, that the course objectives of participants learning how to use ViCLAS were not referenced in Margot's (2009) article. They provide a much clearer idea of the purpose of ViCLAS than do the hypotheses outlined by Margot as taken from Beauregard and Proulx's (2001) paper. They state analysts should be able to *'analyse behaviours of violent offenders; establish patterns of behaviour in order to link violent crimes; extract key information to analyse complex cases; and utilise ViCLAS computer programs to conduct a thorough case analysis'* (Wilson & Bruer, n.d.). These points might have been a more appropriate basis for the forming of hypotheses of a paper aiming to evaluate ViCLAS.

It is important here to note a final key factor in this discussion that has so far been neglected, that of the analysts' role in ViCLAS. As Lenertz and Meinert (2004) point out; *'It has also been possible to make it clear that it is a myth that series can be recognised automatically using the ViCLAS database by simply entering search criteria'* (p. 25).

ViCLAS is a database designed to store relevant behavioural information, but all aspects of the analysis conducted using ViCLAS is done by analysts using these data to search for potential links between cases. As such, even at the system's best, human expertise will always be required to operate it. It must also be remembered that, while ViCLAS is a system that will surely undergo further transformations, in the meantime the analysts using the system must work with the system available to ensure that as many links between crimes can be made as possible.

## Conclusion

Margot's (2009) article, sadly, does not provide the comprehensive review of the scientific foundations on which ViCLAS is built that it promises, nor does it provide a thorough evaluation of ViCLAS' current relevance to the application of crime linkage. There are many concerns raised about Margot's choice of literature used to conduct a review, as well as the understanding of the psychological theory upon which ViCLAS is based. Additionally, errors have been highlighted within Margot's article that seem to demonstrate further misunderstandings of the system under review, as well as an outdated understanding of what ViCLAS is actually used for. While some of Margot's concerns surrounding the lack of evaluation of ViCLAS may be justified, it seems more appropriate to focus on conducting

these evaluations before condemning a system that, at least anecdotally, provides assistance to police services that are continuously looking for ways to better integrate and analyse large amounts of data over large geographical areas.

**CHAPTER 3:**  
**AN INVESTIGATION INTO THE PROCESS OF COMPARATIVE CASE**  
**ANALYSIS CONDUCTED BY ANALYSTS WORKING IN THE SERIOUS CRIME**  
**ANALYSIS SECTION IN THE UNITED KINGDOM**

Chapter 3 was an official report written for the Serious Crime Analysis Section (SCAS) of the National Crime Agency in the UK. The manuscript is authored by Miss Kari Davies (University of Birmingham), Dr. Dalal Alrajeh (Imperial College London), and Dr. Jessica Woodhams (University of Birmingham).

Both Chapters 3 and 4 were designed to fill some of the knowledge gaps identified in Chapter 1. As noted above, the author worked collaboratively with analysts to obtain data for both of these chapters, including collecting interview data from SCAS analysts. Specifically, Chapter 3 aimed to address the gaps in knowledge identified in Chapter 1 of exactly how different types of crime linkage are conducted in practice; in the case of the SCAS analysts, of conducting comparative case analysis. In Chapter 3 a qualitative approach and template analysis were used to map and better understand one approach to crime linkage, comparative case analysis, as it was felt that these would better capture any nuances within the analysis process itself, including any differences between analysts.

There were a number of ethical issues that needed to be considered before conducting this research. (Ethical approval was obtained from Imperial College London's Research Ethics Committee since this research was part of a larger project led by Imperial College London.) The information that SCAS holds is sensitive and potentially distressing, so both

the security of the data and the wellbeing of participants and the author needed to be considered. All data were held on a secure external hard drive, and the audio recordings of the interviews were deleted once the interviews had been transcribed. While analysts have their own internal structures in place to ensure their wellbeing, the researcher had both Dr. Woodhams and Dr. Alrajeh for support if it was needed. It was also necessary to ensure participants' data was confidential, in order to assure those taking part that their responses would not be used for any purpose other than to answer the research questions (for example, they would not be used for performance management). Prospective participants were invited to attend a one-hour seminar to ascertain the nature of the project, before being given the contact details of the researchers and being allowed time to decide whether they would like to participate. It was stressed that there would be no negative repercussions for deciding not to participate. Participants who agreed to take part were given a consent form detailing all of the potential ethical issues and how they had been considered by the researchers.

Please note: A small amount of information has been removed from the original report submitted to SCAS, as it is sensitive information about ViCLAS which was not permitted to be reproduced here. The following chapter clearly states where information has been removed in square parentheses. Because the information was written up as an official governmental report, quotations were not included. An outline of the themes, however, as well as corresponding quotations, have been provided for reference in Table 1 in Appendix 5.



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Imperial College  
London



Davies, K.\*, Alrajeh, D., & Woodhams, J. (2018). An investigation into the process of comparative case analysis conducted by analysts working in the Serious Crime Analysis Section in the United Kingdom

An official report submitted to the Serious Crime Analysis Section in the United Kingdom

\*All correspondence to be addressed to the first author by email; [KAD351@bham.ac.uk](mailto:KAD351@bham.ac.uk); or in writing; Kari Davies, Centre for Forensic and Criminological Psychology, School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

## Abstract

While there is a growing body of research investigating the principles underlying crime linkage, little attention in academia has been paid to how crime linkage is conducted in practice. This article addressed the question of how crime linkage – specifically comparative case analysis – is conducted by the analysts of the Serious Crime Analysis Section of the United Kingdom’s National Crime Agency who work to find potential links between sex offences and sexual murders. Eleven semi-structured interviews were conducted with analysts, lasting approximately two hours each. Template analysis was used to analyse the interviews, with several themes identified. Consideration was given to both the decision making processes of the analysts, and the interaction between them and the database used to assist them in the analysis process, the Violent Crime Linkage Analysis System. The analysis process was mapped, and a number of key considerations at different stages of the analysis were discussed with the interviewees. The challenges of conducting comparative case analysis were discussed, and a number of observations were made as to the developments that could further assist analysts during the analysis process. Avenues for future research were also considered that have implications for further bridging the gap between theory and practice.

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Keywords: crime linkage; comparative case analysis; behavioural analysis; decision making;

ViCLAS

## Introduction

Crime linkage is the notion that a crime series can be identified through the detailed examination of the behaviour an offender exhibits at each crime scene (Woodhams & Bennell, 2014). The aim is to identify shared behaviours between a set of crimes that are relatively distinctive from the behaviour of other offenders. Crime linkage is often used to identify series of sex offences or series of murders, and is also used with types of volume crime (Burrell & Bull, 2011). While there is an established literature on the underlying theory of crime linkage (Woodhams & Bennell, 2014), in order for crime linkage to be successful and considered an evidence-based practice, research also needs to consider the practice of crime linkage itself. This study was an attempt to address the lack of research on the practice of crime linkage, and to start to bridge the gap between theory and practice.

### Research into the theory of crime linkage

More than a decade of academic study has been dedicated to evaluating the theory of crime linkage, testing its two fundamental principles (Woodhams & Bennell, 2014; Woodhams, Hollin, & Bull, 2007). The first is the assumption of behavioural consistency; an offender must demonstrate the same or similar behaviour(s) across their series of crimes such that it can be identified as a linked series of offences (Canter, 1995). The second assumption is behavioural distinctiveness; the behaviour exhibited by one offender must be distinguishable from other offenders in order for crimes to be attributed accurately to a given offender (Bennell & Canter, 2002). Several methodologies and approaches have been used in

order to test these principles (Bateman & Salfati, 2007; Sorochinski & Salfati, 2010; Tonkin, Grant, & Bond, 2008; Woodhams, Grant, & Price, 2007), and while there are exceptions, this research has generally found support for the principles of behavioural consistency and distinctiveness. These findings have implications for the practice of crime linkage, not least by affirming its basic utility, but particularly by suggesting that there are certain individual behaviours or groups of behaviours that, if relied upon, may lead to more accurate decision making regarding crimes being linked. While this research can be useful to practitioners, what it does not do is explicitly consider how such findings may translate into practice; whether in reality the behaviours posited as useful in crime linkage research are actually used by or are useful to practitioners, or whether there are additional concerns that an analyst must consider when conducting crime linkage which renders these behaviours less useful.

### Research into how crime linkage works in practice – an introduction to comparative case analysis

Before addressing the research that exists on the practice of crime linkage, it is worth considering what is actually meant by ‘the practice of crime linkage’. In practical settings, crime linkage is often described using different terms, and these terms delineate the important differences in approaches that exist. In the United Kingdom (UK), for example, comparative case analysis, or CCA, is used to describe the searching of a large database by analysts for potential links (Rainbow, 2014). This can either be done reactively, in response to a request from law enforcement to search for other crimes linked to a particular index offence or set of offences, or proactively, searching for links without the specific starting point of an index offence or series (Woodhams, Bull, & Hollin, 2007). Conversely, case linkage analysis, or

CLA, is used to assess whether a given number of crimes presented to an analyst – usually provisionally suggested as linked by law enforcement – are linked or not (Rainbow, 2014). These differences need to be recognised when investigating the practice of crime linkage, yet they are rarely acknowledged by academia. While the principles underpinning these two methods remain the same, the manner in which they are operationalised are quite different (Rainbow, 2014). CLA may be conducted in an unofficial capacity by officers or other law enforcement in the UK, however, it is currently only conducted in an official capacity by the behavioural investigative advisers (BIAs) of the UK’s National Crime Agency (NCA). In contrast, in the UK at least, it is more common for CCA to be conducted by analysts employed within police forces or agencies, in a unit such as the Serious Crime Analysis Section (SCAS). Rather than comparing a small set of offences in order to assess the likelihood of them having been committed by the same offender, analysts conducting CCA (specifically in this case, reactive CCA) must manage much larger datasets, searching for links to an index offence or series in datasets that can reach tens of thousands of cases. Furthermore, CCA is practiced internationally by national units in several countries that employ analysts to conduct linkage analyses for the majority of their time and for the most serious of crimes (Tonkin et al., 2017).

With these challenges in mind, a brief review is presented of what research currently exists that focuses on the practice of crime linkage, or specifically in this case, of CCA. It would be expected that such literature would cover the following:

- a) a detailed account of how CCA is conducted in practice;
- b) the accuracy and reliability of CCA conducted in the field, and;
- c) whether the theoretical research is useful to CCA practitioners, including where the gaps between theory and practice lie.

A recent review of the literature investigating the practice of crime linkage (Davies & Woodhams, 2018) identified a number of relevant articles (as well as several other articles that made reference to the practice of crime linkage, but whose focus was not predominantly that of understanding this practice). What is clear from this review is that rarely has any distinction been made between CLA and CCA in the published literature, and in several studies it is unclear whether the intention was to conduct a study of CLA or CCA. Of the articles identified, some were case studies of the CLA process (e.g. Hazelwood & Warren, 2004; Labuschagne, 2006), and some included a written description of the CLA task (e.g. Hazelwood & Warren, 2004; Labuschagne, 2006; Rainbow, 2014). There were also papers that described the CCA process (e.g. Burrell & Bull, 2011; Woodhams Bull, et al., 2007). Burrell and Bull (2011), for example, conducted a qualitative study of 18 crime analysts within two police services in the UK, in order to better understand their experience of conducting CCA. Specific behaviours important to analysts during the analysis process were discussed, as well as the types of offences that lend themselves well to CCA. Analysts were aware of relevant academic literature that may be useful during the analysis process, and they suggested a number of improvements that could be made to the process of CCA, including improving the recording of relevant data, and using databases and systems specifically designed for the purpose of analysis. Woodhams, Bull, et al. (2007), as well as outlining the differences between proactive and reactive CCA, outline the process of reactive CCA, from receiving the initial information about the case(s) to disseminating a report to law enforcement.

There are also a handful of studies by academics which have attempted to research the 'practice' of crime linkage under laboratory-type conditions (e.g. Bennell, Bloomfield,

Snook, & Taylor, 2010; Canter et al., 1991; Santtila, Korpela, & Häkkänen, 2004). None of these studies stipulate whether their intention was to study CCA or CLA, however, the experimental manipulations most closely resemble what Woodhams, Bull, et al. (2007) termed proactive CCA. They are, in essence, proactively searching for linked series within a dataset, although the datasets in these studies are much smaller than those within which an analyst would search in practice. For example, in Santtila et al.'s (2004) article, participants were asked to look for links between 30 car crimes. In contrast, analysts working at SCAS in the UK, for example, search for potential links to index offences/series within a database containing over 25,000 cases. Additionally, they are required to utilise this database, a computerised support tool called the Violent Crime Analysis System (ViCLAS; Collins, Johnson, Choy, Davidson, & MacKay, 1998). Worthy of note is that participants in the aforementioned studies had no such access to ViCLAS or an equivalent computerised database in order to support their decision making, tools which are becoming increasingly commonplace given the large amounts of data analysts are searching through. What these studies do suggest is that analyst performance can vary depending on the participant conducting the linking (Bennell et al., 2010), and depending on the types of behaviours that are focused on (Santtila et al., 2004). Finally, there are a handful of studies that have researched the reliability of coding crimes into computerised systems that support the practice of CCA (e.g. Martineau & Corey, 2008). While these are obviously relevant to the practice of CCA, they are only concerned with the population of the database which serves to assist with the CCA process, and do not examine the process of linking *per se*.

In summary, while there are some publications providing a detailed explanation of the CLA process, there is only one that outlines the CCA process in any detail. This article is more than a decade out of date (Woodhams, Bull, et al., 2007), and only one additional

published article has supplemented this information by surveying analysts in the field (Burrell & Bull, 2011). Other than the information provided within these two sources, how CCA is conducted in practice is largely unknown. While analysts have been asked for their views on CCA in previous research (Burrell & Bull, 2011), the amount of time that is spent specifically on CCA by analysts has not been outlined. Further, specific behaviours that are considered by analysts during the linkage process have been detailed (e.g. Burrell & Bull, 2011; Santtila et al., 2004), but there is no current knowledge as to the specific decision making processes analysts follow. The chronology of specific decision making is missing, as is the weight given to each decision made. Similarly, there is some mention of distinctiveness being useful to link crimes (Burrell & Bull, 2011), but no specific information as to how or when this may be used in the process. While some laboratory studies have attempted to understand the accuracy with which CCA can be conducted, they do not have high ecological validity (as noted by the authors themselves; Bennell et al., 2010). Finally, only Burrell and Bull (2011) have given explicit consideration to the gap between theory, research, and practice for analysts engaged in CCA, and whether the published literature is useful to practitioners during the analysis process. The analysts themselves have suggested that more theoretical research is needed, especially into behavioural consistency (Burrell & Bull, 2011). A more detailed look into where theoretical research informs practice, where the gaps between the two lie, and specifically what research would be useful to analysts would also be helpful. (The current authors do recognise that some of this information may exist and be available to analysts working 'in-house' to conduct CCA; these gaps in knowledge here are defined by information that is not publicly available to academics or lay-persons who are not directly involved or employed in a law enforcement setting.)

## The current study

Based on the evidence currently available there is a pressing need to research the process of CCA under conditions of high ecological validity. On the basis of the current gaps in the research, this study aimed to address questions a) and c) above; how CCA is conducted in practice, and whether theoretical research is useful to practitioners of CCA, including identifying any gaps in knowledge between theory and practice. It was designed as an exploratory study of CCA with specific focus on sex offences, given that the participants upon which the research was based all worked at SCAS at the time of the interviews, the primary aim of this unit being the identification of the potential emergence of serial killers and serial rapists at the earliest stage of their offending (NCA, n.d.). This study did not aim to evaluate the efficacy of these analysts, rather, it attempted to map the CCA process used, and understand how the analysts interact with the tools at their disposal designed to aid them (specifically ViCLAS). The major difference between this study and previous research was its focus on specific decision making processes. Given that SCAS is a unit dealing predominantly with sex offences, some of the considerations of previous research (e.g. analysts' previous assertions of the difficulties of linking across crime types; Burrell & Bull, 2011) would likely be irrelevant in this case. This study also provided the opportunity to assess what the supposed improvement of data collation and management using a dedicated computer system, as suggested by analysts in Burrell and Bull (2011), may have on analysts' ability to conduct CCA. In this way, this study was designed to enable a better understanding of the interaction between the analysts' linkage decisions and the technology available to them, as well as their interaction with theoretical research. Finally, questions have been raised in legal proceedings as to whether there are standards of practice for CCA internationally (e.g. *Thomas Ross Young v. Her Majesty's Advocate*, 2013) or whether its practice has been

subject to peer review (e.g. State of New Jersey v. Fortin, 2000). The first step towards agreeing standards for practice is to inform one another of how CCA is practiced within different units in the world.

This study was the first of its kind and was unique in its attempts to understand and document in detail the nature of the practice of CCA within SCAS. In summary, the aims of the study were as follows:

1. To map the analysis process(es) used by SCAS analysts, from receipt of each index offence/series to the sending of a report detailing the result of the analysis to police officers;
2. To understand specific decisions made by analysts throughout the analysis process, particularly with regards to the choice and utility of particular behaviours, and the impact different conditions in each crime may have on the process;
3. To establish exactly what theoretical research is known and useful to analysts, as well as any further research that may be helpful to analysts;
4. To understand how ViCLAS assists the analysts with the linkage process.

## Method

SCAS is a unit within the NCA with specialist expertise in sex offences, where one of its primary responsibilities is to conduct CCA on such offences. In the UK, it is mandatory that the details of all offences meeting the SCAS criteria are sent to the unit for potential analysis. The predominant criteria are any cases of stranger rape, sexually motivated murder, or other serious sex offences where aggravating factors exist (e.g. the use of a weapon, a burglary element etc.). These criteria reflect SCAS' primary aim, as noted above, of identifying the potential emergence of serial killers and serial rapists at the earliest stage of their offending. Analysts in SCAS use ViCLAS to assist them with conducting CCA, which allows information about relevant crimes to be coded and searched for in a standardised manner. All employees who work at SCAS are required to undergo training, both in how to use ViCLAS, and regarding the behavioural principles relevant to conducting CCA.

## Participants

Participants were recruited from SCAS at the NCA, UK. They were recruited via a one-hour seminar that took place at the NCA one month before the interviews were scheduled to take place. All employees of SCAS were invited to attend this seminar, provided that they met the criteria for participating, namely that they were employed by SCAS in the position of analyst, triage analyst, or senior analyst. (Before progressing to their current roles, both triage and senior analysts would have been analysts, whose main responsibility is to conduct CCA.) There were no other inclusion or exclusion criteria, as it was felt that it was important to

represent the views of all analysts, regardless of length of employment or particular experience. Once the seminar had taken place, potential participants were given a month to decide if they wished to participate, at which point they were invited to select an interview slot. Twelve participants agreed in principle to participate. Before each interview, participants were asked to read an information sheet, and to read and sign a consent form. This included agreeing to the audio recording of the interview. If participants agreed to the terms of the consent form, the interview was then conducted. Eleven participants who initially agreed to participate subsequently completed the interview – two male and nine female – which represents 58% of the staff that were eligible to participate. One participant was unable to continue with the project as it was impossible to find a suitable interview time for them to attend. No participant refused to continue with participation once they had read the information sheet and consent form, and no participants withdrew from the study during or post-interview.

### Procedure

The study was approved by Imperial College London's Research Ethics Committee, and was conducted with the full approval of SCAS. The first author conducted a semi-structured interview with each participant individually. The average length of each interview was two hours. Participants were asked to bring with them to the interview the details of an index offence/series that they had previously conducted CCA on where they had found at least one potentially linked offence or series (sometimes referred to as an 'included' offence/series) to send to the relevant officer in charge (OIC) of the index offence/series. Analysts were asked, if possible, to bring potentially linked series that had subsequently been

confirmed as linked by officers (e.g. by offender arrest and subsequent conviction). Due to operational constraints, however, this was not always possible; analysts were asked in this event to bring cases they felt confident were linked. They were also asked to bring details of the included offence/series. Participants also brought with them the precise searches they had conducted during the analyses, any notes they had made as part of these analyses, and details of any considerations they had made when deciding whether or not crimes were potentially linked. In the first part of the interview participants were asked to describe the process of how they identified potential links between the crimes they had brought with them. Questions that were asked by the first author during this section were designed to establish exactly how decisions had been made throughout the analysis process. In the second part of the interview, questions were asked that focused in more general terms on the analysis process (for a full list of questions, see Appendix 1). The participants were able to ask for breaks between the different parts of the interview, or as required. They were asked not to discuss the interview with their colleagues so as not to advise other participants of the questions they would be asked.

### Analysis

Once all of the interviews had been completed they were transcribed and the audio recordings deleted. Template analysis was used to analyse the interviews. This was an appropriate form of analysis as it allows an initial template to be constructed around the themes covered in the interview, but is also flexible and can accommodate emerging themes that were not anticipated in the interview schedule. Further, it allows for the qualitative, as opposed to statistical, analysis of emerging themes (King, 1994). These factors were

important given the exploratory nature of this study and the level of detail it was anticipated could be captured. Before the interviews, broad initial themes were identified in the form of the four aims of the study; the results section is structured around these themes and outlines the more specific sub-themes identified during the analysis of the transcripts. Participant numbers have been allocated to specific information in order to preserve participants' anonymity.

## Results

The results section is structured into the following sections which reflect the aims of the study as outlined in the introduction:

1. A map of the analysis process (aim one);
2. Main topics of discussion about the analysis process (aim two);
3. Challenges and future work (incorporating aims three and four).

### 1) A map of the analysis process

In the first section of the interview the analysts took the first author through the different stages of the analysis that they had conducted on their chosen case, from receiving the case through to the report being sent to the OIC. The various steps have been mapped and are presented in the three diagrams that follow (see Figures 1-3). The process has been split into three main stages; the pre-analysis process, the analysis process itself, and the post-analysis process. Further sub-headings have been used to distinguish in greater detail the various stages of the analysis process.

The steps that were conducted in the same order by all analysts are coloured blue; those that vary in order depending on analyst are coloured yellow. These discrepancies and their ramifications are discussed in more detail in the sections below. It must be highlighted at this juncture that this study was not undertaken to reproduce the ‘official’ method of

conducting CCA – or the business model – that exists in a professional organisation such as SCAS. The purpose of mapping this process was to capture the nuances within the analysis process that occur, further to the adherence to a prescribed set of guidelines. Such differences might emerge, for example, due to the different circumstances of index offences. Analysts were clear about the existing professionalism of the unit, and how research was used to inform their decision making and justify their reasoning (P006, p. 42; P007, p. 54). But, as one participant pointed out, analysts have to constantly moderate their decision making according to the case they are working on, and gain experience of what works most effectively in different situations (P007, p. 16). The variations in the process outlined below are a reflection of the analysts’ thought processes, and demonstrate the flexibility that is required of analysts when attempting to find potential links.

Pre-analysis process

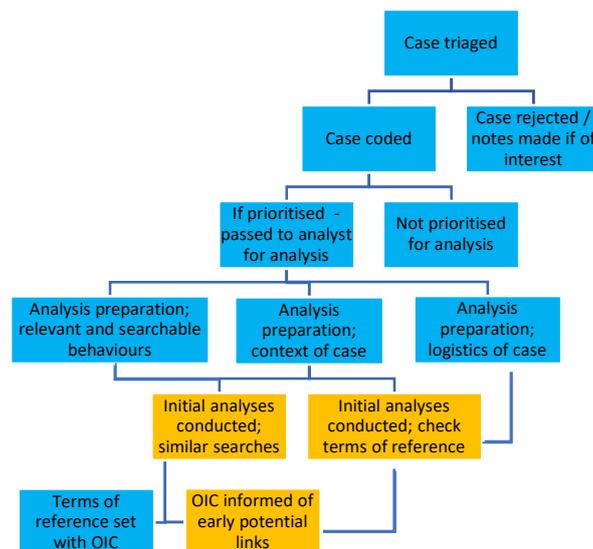


Figure 1: Pre-analysis process

### Case triage

On arrival to the unit, a case is first triaged by analysts, which is a standardised process of assessing the most appropriate analytical response and prioritisation of cases. Within the prioritisation process, which was developed with input from the NCA BIAs, cases score points according to elements including whether the case involves unidentified offenders, weapon use, or particular violence. Such aspects indicate risk to the public, and as such cases that score highly are prioritised for analysis (P004, p. 3). While the SCAS triage process has been represented in Figure 1 and is briefly described here, it is not explored in any further depth since it is not part of the CCA process itself.

### Coding of cases

Cases are coded into ViCLAS by assistant analysts. Due to operational constraints, or the fact that it may not be appropriate or required, not all cases that are coded are analysed; however, even where cases are not processed for analysis they still remain on ViCLAS in order that links may be found to them in other analyses (P005, p. 33). The prioritised cases are then passed on to an analyst who completes a number of steps in preparation for conducting analyses on the index offence/series. Again, while represented in Figure 1, the coding process is not explored in any further detail here.

### Analyst preparation

When an analyst receives a prioritised offence/series, they will begin by reading all of the case papers, including any pertinent information about a suspect in cases where the offender is known and, if possible, watch the recording of the victim's police interview (P006, p. 1). As already intimated, the index offence can actually be an index series which has been linked either where the offender is known, or by DNA where the offender is unknown. While reading through the ViCLAS entry analysts will also conduct a quality control on the coding, ensuring they agree with the assistant analyst's coding (P004, p. 14). They conduct a behavioural interpretation on the index offence/series, making notes about the case, assessing which behaviours they believe to be relevant and searchable, looking at the context of the case and how it may impact upon the behaviour displayed by the offender (P006, p. 4), and considering the logistics of the case, such as any vehicles that may have been used. One aspect of the preparation for analysis is the setting of terms of reference with the OIC. This involves the analyst confirming the service that SCAS is able to provide to the investigation, ascertaining whether the case is still open, and if so outlining the types of searches that could be conducted. This is also an opportunity for the analyst to obtain any further information about the case from the OIC, and to take into account any ideas the OIC has as to the searches they may wish to be conducted. The OIC's expectations can be managed here by explaining the process of CCA in order that they appreciate what may and may not be possible. (Following discussion with the OIC, the analyst will likely conduct further behavioural interpretation, all of which informs a more comprehensive search of ViCLAS.)

### Conducting initial searches

It is at this point where some differences in analyst practice appear. Some analysts will start to conduct initial, exploratory searches. The purpose of this includes searching for any potential ‘screamers’ (cases that are almost behaviourally identical to the index offence/series), or establishing what viable searches will be possible so they can appropriately manage the OIC’s expectations (P007, p. 30). While some analysts, as above, first establish terms of reference with the OIC before conducting any exploratory searches on the database, in contrast, other analysts will first conduct these exploratory searches before telephoning the OIC, in order to then establish the terms of reference, discuss whether the officers would like specific searches conducted (P006, p. 2) and, in relevant cases, notify them of any positive results of very similar cases found during their initial searches (P011, p. 13). The decision on whether or not to undertake initial, scoping searches is often led by the circumstances of the index offence/series.

Analysis process

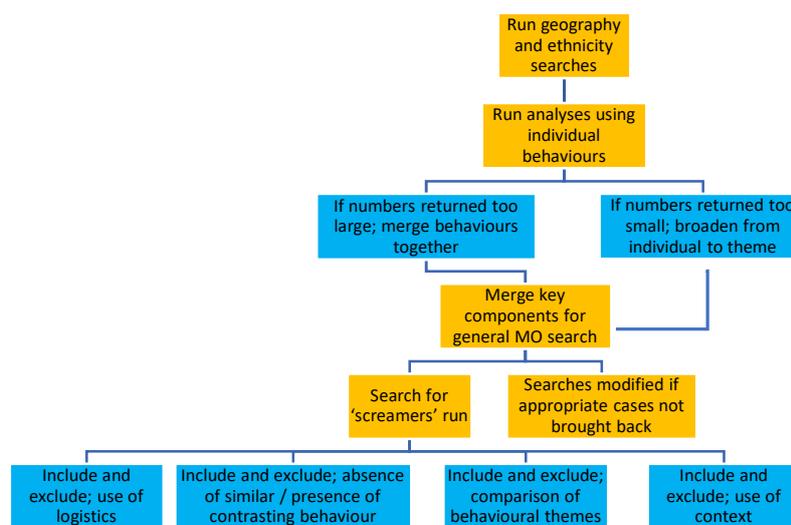


Figure 2: Analysis process

### Running the searches

Once the analyst is ready to conduct their analyses, they must decide on the different searches that they will run on ViCLAS. Often the first types of searches that analysts will run are searches on the geography associated with the index offence/series, as well as the geography of the offender's anchor points, and their ethnicity where known (P009, p. 3). (Geography will be discussed in further detail below, as searching for this reflects the best practice guidelines established by SCAS with regards to the relevant literature on distance travelled by sex offenders (Rossmo, Davies, & Patrick, 2004). Offender ethnicity is also considered further, as there are a number of factors that analysts are required to take into account when considering this variable.)

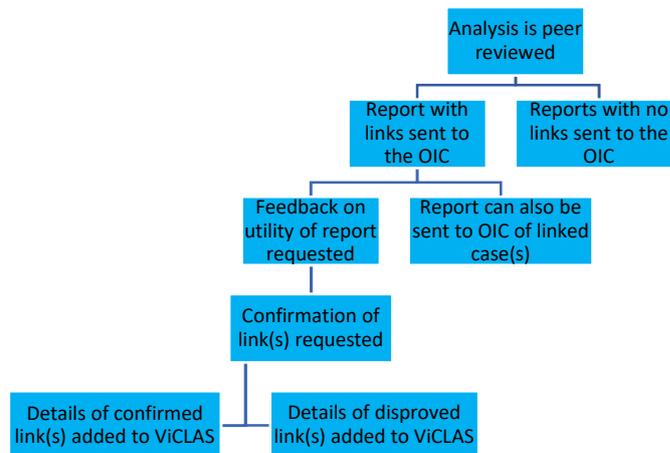
Once these searches have been conducted, other searches will be conducted using additional behavioural information available to the analyst. The analysts will run different searches using ViCLAS depending on the information available to them and what they deem to be important in that particular instance. Each search returns crimes that satisfy the search criteria. If the number of crimes returned in the searches is too large (either exceeding the system search limit or being considered disproportionately high by the analyst to read through), the analyst will combine behaviours together to create a modified search that will return fewer results (P007, p. 22/23). If the numbers returned in the modified searches are too small, (this being informed by the individual judgement of the analyst based on their experience) behavioural searches will be broadened to include a general or thematic element as opposed to individual behaviour(s) (P004, p. 8). Analysts, either at this point or before conducting other searches, will combine what they consider to be the key components of the

crime for a ‘general *modus operandi* (MO) search’; it is also at this point that some analysts will conduct their searches for ‘screamers’ (P001, p. 13). The manner in which these searches are created is flexible, and in actual fact analysts will almost always complete a number of searches. (The notion of thematic and specific similarity is discussed in further detail below, as it pertains to the importance of an offender demonstrating either absolute or relative behavioural consistency.) Depending on the results the analysts obtain they may decide to modify their searches or create new ones if they feel the appropriate cases are not being returned; this continuous process of evaluation and amendment can happen throughout the search process (P009, p. 18/19).

#### *The inclusion/exclusion process*

Once the searches have been run, the onus is on the analysts to read through the search results and make judgements as to whether to include an offence as a potential link or exclude it as unlinked. Such decisions are based on a number of considerations. For example, analysts consider what is logistically possible (e.g. if the named offender was in prison at the time of the index offence/series, the returned offence or offences are discounted). They also consider the absence of similar behaviour that is deemed to be salient, or the presence of contrasting behaviour that is incongruent with the offender’s manner of offending. Such considerations can be at the individual, general, or thematic behavioural level, or can be considered using a combination of behaviours.

## Post-analysis process



*Figure 3: Post-analysis process*

Finally, there are a set of post-analysis stages which all analysts go through in the same order. When the analysis stages have been completed, details of the searches conducted and results found are passed to a fellow employee who peer reviews the results, something which was highlighted by the analysts as being extremely beneficial (P006, p. 44). The peer review may result in further searches being suggested which would then be run. Once the analysis has been peer reviewed and any suggested actions taken, a report is sent to the OIC of the index offence/series, detailing either a) that potential links have been found (a ‘positive report’), with brief details of the searches conducted, summaries of the potentially linked offences, and reasons why the links have been made, or b) that no potential links have been found (a ‘negative report’), still including brief details of the searches conducted. It is important to note that a report detailing the fact that CCA has been conducted is *always* sent out, regardless of the outcome of the analysis. The dissimilarities as well as the similarities of the potentially linked offence(s) to the index offence/series are explained, helping to justify the final inclusions to the OIC. This is accompanied by a summary of the geography of

potentially linked offences where relevant (P006, p. 39; P009, p. 33). All reports are accompanied by a form requesting feedback on the utility of the report. A copy of a positive report can also be sent to the OIC of any cases identified as potentially linked if authorised by the OIC of the index offence/series (P004, p. 60). Finally, analysts will ask officers to provide updates on any of the proposed links that are subsequently confirmed or disproved; details of these confirmed or disproved links are then recorded on ViCLAS so that analysts conducting searches in the future are aware of these outcomes (P001, p. 26).

## 2) Main topics of discussion about the analysis process

Each stage of the analysis process was discussed with the analysts. Their responses are given below under the heading of the stage in which they would occur. In addition, an overview of analysts' experiences of conducting CCA and any differences in practice is given. Often the analysts' opinions and practice were relatively uniform; any discrepancies are highlighted below.

### What behaviours are selected

One of the most fundamental topics discussed during interview was the selection of the behaviours used for the analysis process. Overall, there appeared to be five main areas for consideration when selecting behaviours. The first were behaviours that analysts seemed to expect the offender to repeat over time. These were referred to interchangeably as 'consistent', 'reliable', or sometimes 'important' behaviours (P008, p. 53). The second were behaviours thought to distinguish the offending of one individual from another. They were referred to as distinctive, or unnecessary for the commission of the offence (P001, p. 2). It is important to note that a range of terms were used by the analysts to refer to these two areas of consideration. These were often used interchangeably and the clear divide drawn between consistent and distinctive behaviours seen in the academic literature was not so apparent here. Whether this difference is merely one of semantics, or whether there is a larger disconnect between academics' and practitioners' understanding of these terms, requires further investigation. The third were behaviours that pertained to the geography of the offence (P002, p. 14). The fourth main area of consideration was whether the index offence/series was

solved or unsolved, and finally, the fifth consideration included logistical factors analysts considered relevant for the search process.

Analysts often referred to the selection of ‘salient’ behaviours for constructing searches and for analysis. Sometimes salient behaviours were conceptualised as those apparently important to the offender, with the assumption being that they would, therefore, be repeated either within an offence or throughout a series. Importance to the offender was interpreted from a behaviour being exhibited which was unusual, repeated throughout an offence, or inessential to the commission of a crime (P001, p. 6; P002, p. 12; P003, p. 2; P006, p. 17). Exhibiting risky behaviours was also seen by some analysts as salient and something likely to be repeated; exhibiting these high-risk behaviours despite the consequent increased chance of apprehension indicating to some analysts that the repeated risky behaviour was important to the offender in meeting their needs through their offending (P005, p. 22; P006, p. 10). More often than not, however, saliency seemed to be a term that many analysts used in order to describe the behaviours they selected for analysis, whether they were chosen for their consistency, distinctiveness, or for any other reason.

### *Consistent behaviours*

Analysts referred to consistency in terms of absolute consistency in specific or general behaviours (a specific weapon or the general use of a weapon, for example), as well as thematic consistency (explained further below; P006, p. 14; see Woodhams & Bennell, 2014, for a discussion of the notion of absolute consistency). A number of behaviours were thought to be most likely to be consistently displayed throughout a series. These included geography, which was described by some analysts as often one of the most consistent aspects of an

offender's behaviour (P002, p. 28). The offender's approach was also described as remaining consistent based on the experience of the analysts (P003, p. 3; P006, p. 6), a behaviour they believe is consistent because it is the offender's first action, before there has been time for the victim or situation to have any great influence on the offender's behaviour. This leads to an important point raised by many of the analysts, that the behaviours deemed to be more consistent are those over which the offender has the most control (P004, p. 29; P009, p. 10/13; P010, p. 2). An offender, for example, is deemed to be fully in control of decisions about their approach and offence preparation, and as such these behaviours are considered more reliably consistent (P003, p. 17; P011, p. 19). In one instance, an analyst chose to focus on the burglary and weapon aspects of a crime, suggesting they were the most salient features as they were under the offender's control; this was a decision taken based on the analyst's behavioural training (P005, p. 8). Training and experience also tells an analyst to place more influence on those behaviours that have been pre-planned (such as bringing restraints to an offence scene), rather than those in reaction to a victim (such as restraining a victim with the clothes they were wearing), as those that are pre-planned will be similarly less influenced by the victim or the situation. The analysts' reasoning here is entirely in line with what the theoretical literature from personality psychology and theoretical crime linkage literature would suggest (Woodhams & Bennell, 2014; Woodhams, Hollin, et al., 2007).

Not only was it asserted that behaviours over which the offender can exercise control were important, but that an offender's ability to effectively carry out certain tasks was also important. This reflects commentary in the academic literature that behavioural consistency can be affected by the task demands within the situation and the offender's competency to manage these (Woodhams, Hollin, & Bull, 2008). With this in mind, the approach should also remain consistent as it is dependent on an offender's capability in certain situations; for

instance, the social skills required for a successful con approach (P005, p. 8) will either be something the offender does or does not possess. This is an interesting proposition because, again, it would fit with the theoretical literature regarding behavioural consistency; the notion that people choose situations that suit their personality and competencies, thus creating similar situations and, as a consequence, behavioural consistency (Woodhams & Bennell, 2014).

In many analysts' opinions, repetition of a behaviour was important (P004, p. 45). Analysts often noted that it was difficult to determine which behaviours an offender would demonstrate consistently when there was just one index offence, as opposed to an index series, available for analysis (P008, p. 12/13). In these instances, analysts' training and experience suggest that repetition of a behaviour within an offence is equivalent to behaviours exhibited consistently over an offence series (P009, p. 26); analysts were more confident that a behaviour repeated within an offence would also be repeated within other offences (P006, p. 27).

When analysts had an offence series to analyse they would initially focus their searches on behaviours already demonstrated consistently within this series (P008, p. 12). The repetition of a behaviour within a series could overrule what would typically be the analyst's decision to exclude this behaviour from searches on the basis of it usually being considered unreliable. Conversely, discrepancies in behaviour within a confirmed index series presented challenges to the process of behaviour selection (P005, p. 28). Often, analysts would deal with this situation by conducting separate behavioural searches based on the behaviour displayed in different cases within the series (P007, p. 19). The importance placed on establishing patterns of consistent behaviour was not limited to considering

behaviour within a linked index series, it was extended to the consideration of criminal tendencies demonstrated in the offender's criminal history (e.g. evidence of a general propensity for violence, perhaps indicated by a history of intimate partner violence; P001, p. 4; P003, p. 22; P006, p. 29). A handful of academic studies exist which have demonstrated such cross-situational consistency; the utility of geographical proximity, temporal proximity, and some MO behaviours for statistically linking crimes of different types has been demonstrated (e.g. Tonkin & Woodhams, 2017; Tonkin, Woodhams, Bull, Bond, & Palmer, 2011), but these have not included sex offences when considering MO.

There was some contention as to whether some behaviours could always be considered consistent, with some analysts stating that there was no one behaviour they would always rely on during the analysis process (P005, p. 25). Furthermore, some analysts argued that nothing stays consistently the same within a series, even something as 'factual' as offender description (P002, p. 40), and that consistent behaviours are actually only identifiable on a case-by-case basis (P008, p. 16; P009, p. 11). There was also recognition that some offenders are simply more consistent than others (P008, p. 50). This is an observation repeatedly made in academic studies of serial sex offending (e.g. Bennell, Jones, & Melnyk, 2009; Slater, Woodhams, & Hamilton-Giachritsis, 2015; Woodhams & Labuschagne, 2012).

#### *Distinctive and unnecessary behaviours*

The second type of consideration given when selecting behaviours for analysis related to their distinctiveness. Distinctiveness was operationalised in several ways. The most common reference made by analysts in this respect was to any behaviours that were rare or

uncommon (P001, p. 2), and while experience teaches the analyst what behaviours fall into this category (P002, p. 4; P010, p. 4; P011, p. 5), ViCLAS (as well as other analysts; P004, p. 5) can also be used to confirm how rare behaviours actually are (P007, p. 30; P008, p. 18; P010, p. 4). Statistics can also be generated from ViCLAS searches to demonstrate to OICs the rarity of particular behaviours (P007, p. 30). Examples given by interviewees of uncommon behaviours included abduction (P009, p. 7), the slashing of a victim's clothes, headbutting, and certain speech (P006, p. 18); their distinctiveness consequently making them salient (P002, p. 4). The analysts also talked about behaviours being distinctive, not just if they were unusual in the context of a sex offence, but if it was behaviour that in general terms would be considered unusual or bizarre (P006, p. 20).

Distinctiveness was not solely considered at the discrete behavioural level; a group of behaviours exhibited by an offender could be considered distinctive, particularly if it is uncommon for them to occur together (P004, p. 6). Analysts considered some combinations of behaviours to be rare, for example, if they represented behaviours from different themes of rape behaviour according to Davies' (1992) study (P011, p. 21). Examples given of these combinations of behaviours included the initial contact in a victim's residence and a stranger offence (P005, p. 6), or pseudo-intimate behaviours demonstrated in offences against sex workers (P001, p. 15; see section on thematic, general, and individual behaviour searching for more details on behavioural themes). Statistics, as with individual behaviours, can also be produced using ViCLAS to demonstrate the rarity of combinations of behaviours (P006, p. 24).

Repetition of a behaviour throughout an offence, while described as consistent (P006, p. 27), was also referred to as distinctive (P001, p. 6). It is possible, however, that in this

context analysts are referring, not to the rarity of such a repetition, but to the saliency of said repetition, that the repetition of a behaviour implies that it held a special significance for the offender and would therefore likely be seen in their other offences (P004, p. 26; P005, p. 26). As with behaviours deemed to be important because they have been chosen by an offender and are not subject to situational influence (P007, p. 16), repeated behaviour is interpreted as representing what the offender wants from the offence (P003, p. 2) because perseverance is shown in order to achieve (or attempt to achieve) it. During such discussions, analysts were quick to point out that it is not the motive of the offender that is being considered, merely that the repeated occurrence of the behaviour is significant (P003, p. 7). In this way, they are inferring that a repeated behaviour is important to the offender, but not interpreting *why* that may be.

When considering if a behaviour was distinctive, analysts also reported considering this in terms of where the behaviour would fall on an underlying continuum. For example, they reported considering the *degree* to which an offender took precautions; highly precautionous behaviour being distinctive (P011, p. 4). Similarly, extreme violence was considered to be rare and distinctive (P011, p. 9). The temporal ordering between behaviour could also be considered to be distinctive, with behaviours showing an unusual temporal order being noteworthy (P011, p. 21). For example, only engaging in precautionary behaviour late in an offence, in contrast to throughout the offence, was perceived to be distinctive (P011, p. 22).

Not only was distinctiveness considered to be a property of offender behaviour, but it was also considered with regards to the physical descriptions of suspects (e.g. an unusual tattoo; P006, p. 8). While the analysts were rightly aware of the problems associated with the

accuracy of witness recall (P010, p. 14; Thomas, Aitken, Lucy, & Feist, 2004) and so were duly cautious in their searches based on such features (P001, p. 4; P002, p. 10; P006, p. 8), many felt it was worth conducting this kind of exploratory search, as long as the results were not relied upon exclusively.

Analysts agreed that they always looked within the database, often before doing anything else (P011, p. 12), for other offences with these distinctive or odd behaviours. It was generally agreed that working on offences composed of more 'generic' behaviours is more difficult and searches return lots of cases, meaning analysts having to be stricter with their decision making (P005, p. 13). The disadvantage of searching for distinctive behaviours is that they often need to be searched for in free text sections (P001, p. 8) which can be more time consuming as several permutations of wording need to be considered (P009, p. 27). In order to combat this, the unit have written a quality control (QC) guide, which contains details of keywords used to code distinctive behaviours not already covered in the existing ViCLAS questions (P004, p. 12). A QC team also exists to give guidance on existing coding precedents, or to create new coding precedents and keep the QC guide updated (P004, p. 13). The perceived difficulty associated with searching for distinctive behaviours may be due to the time it adds to the analysis process, rather than any concerns about inaccurate coding of free text, given the existence of these keywords.

Treated in a similar manner to distinctive behaviours were those behaviours that were deemed unnecessary for the commission of an offence. There was recognition that while these behaviours can also be distinctive or rare, such as excessive violence, this is not always the case (P002, p. 7). For some analysts, unnecessary behaviours were particularly salient and interesting, and potentially indicative of a trait of an offender (P002, p. 7). It was also

suggested that cases returned by searches which contained, for example, unnecessary speech that was not present in the index offence/series were less likely to be put forward to the OIC for consideration (P003, p. 19). Analysts explained that they learn what behaviour is unnecessary through experience and behavioural interpretation training (P003, p. 8). Interestingly, there was some contention as to whether both distinctive and unusual behaviours also tended to be the more consistent behaviours. Distinctive behaviours were deemed by some to be discriminating, but not necessarily more consistent (P011, p. 3), and others noted that it completely depended as to whether distinctive behaviours are useful at linking cases or not (P005, p. 13). Others felt that distinctive and unusual behaviours would be displayed by offenders with greater consistency than other behaviours (P003, p. 2); abduction being cited as an example of a behaviour considered to be both distinctive and consistent (P009, p. 3/4/7).

### Geography

The third consideration used in the initial search process is geography which, as mentioned above, is a behaviour deemed by some analysts to be more consistent than other behaviours (P002, p. 28). Indeed, many analysts felt that geography was a very useful, if not key, part of the analysis process (P002, p. 14; P010, p. 6). Analysts also noted that similar geography can play an important part in the analysis process if there is little other behavioural information (P004, p. 60). A factor contributing to its importance in the analysts' opinions was the large amount of research conducted in this area (P005, p. 28; P006, p. 15). Using MapInfo (a geographic information system, or GIS, which is used for location analysis and mapping; P001, p. 10), an analyst can conduct different searches. These can be national, service area specific, encompassing surrounding forces and counties, or follow research

conducted by Rossmo et al. (2004) on the distances rapists travel to commit their offences (P004, p. 18; P006, p. 15). Such searches do not need to be limited to the offence location; if there are various sites relevant in an offence, all can be plotted on MapInfo (P011, p. 16). Many analysts would conduct an individual search focused solely on geography (P003, p. 12; P007, p. 21) using Rossmo et al.'s (2004) geographical ranges of sex offender travel in order to create such searches, for example, by creating a radius of 8.2 kilometres around an offender's home location to search for all offences that had occurred in that area.

The type of area in which the offence had been committed could impact the utility of geography as the basis of a search. In some urban areas, such as London, conducting geographical searches with no other behaviours was often deemed futile due to the volume of offences committed in a small geographical area (P004, p. 40; P007, p. 21). While it was acknowledged that searching within a smaller geographical area than that suggested by academic research was not ideal (P004, p. 37), it was sometimes deemed unavoidable. In order to combat this, some analysts felt it was preferable not to perform a search purely using geography, but to instead adhere to the guidance from the geographical research and use other behaviour to further refine the number of cases returned (P004, p. 38).

While all analysts highlighted the importance of geography, it was pointed out that ideally offender behaviour should be searched for nationally as well (P005, p. 13), reflecting the fact that SCAS is a national unit (P003, p. 13) designed to avoid linkage blindness (the notion that links may be missed because the offences occur in different jurisdictions, and as such are investigated by different police services using separate databases; Egger, 1984). Analysts often spoke of striking a balance between using geography and searching as comprehensively as possible; using research on which to base their search radiuses,

narrowing these if the number of results returned was unmanageable, and attempting to search at least the surrounding counties, with the possibility of merging behaviour into these searches in order to make the number of returned cases a feasible number to look through (P003, p. 12). Other factors could affect whether a national search was deemed necessary or not, including specific intelligence on an offender, such as them being transient (P004, p. 17), or particular aspects of crime scene behaviour, such as the use of a vehicle (P006, p. 15). Victimology was also thought to affect offence geography, as discussed in further detail below (P006, p. 15).

### Solved/unsolved offences

During the search process, whether the index offence/series is solved or unsolved is a key point for analysts. Just as behaviour from different crimes in a series can be combined for analysis purposes (P001, p. 3), as mentioned above, the same is true of behaviour exhibited in previous offences, including non-sex offences (P001, p. 3). If the offender is known, then not only can their previous offending be taken into consideration (P007, p. 9), but also details held about them on the Police National Computer (PNC) or the Police National Database (PND) (P005, p. 28; P008, p. 10/11), their custody history (P008, p. 10/11), and even extra geographical information (P003, p. 23). This also includes allegations of other sex offences where no conviction was obtained but the offender has not denied the offence (P007, p. 3). (In this instance, the behaviour is not debated by the offender, but consent is the disputed issue.) Crucially, if the OIC is confident as to the identity and culpability of the offender, analysts can automatically search only within other unsolved cases on ViCLAS, excluding other solved crimes (P007, p. 20; P010, p. 4). This reduces the number of cases they need to

search through considerably (P004, p. 20). If the offence is unsolved then analysts have to revert to using the other outlined considerations in order to conduct their searches.

### Logistical considerations

Several logistical considerations were also used during the search process. One such consideration used was any distinctive features that were not considered behaviours, for example, a particular aspect of a car's description (P009, p. 28); analysts feeling that it was worth conducting speculative searches for these features in case any results were returned. The other logistical consideration most often mentioned was whether the offender (either in the index offence/series if solved, or in the returned cases if solved) was in custody at the time of the potentially linked offence (P011, p. 21). Databases such as PNC and the Violent and Sex Offender Register (ViSOR) can be searched to check an offender's custody history and this can be, but is not always, built into searches (P008, p. 11).

Offender ethnicity was another logistical consideration that was often included in analysts' searches. Ethnicity was only included in the search process if the victim was confident of the offender's ethnicity or if the offender had been identified (P001, p. 8; P009, p. 3/4), and even then only in consultation with the OIC, given the research suggesting how often victims can be mistaken regarding offender characteristics (P002, p. 10). The analysts also considered that victims in cases returned in the search results may not have been as certain about offender ethnicity as the victim(s) in the index offence/series. (There are also inherent difficulties with defining and describing ethnicity consistently.) Furthermore, when using ethnicity in searches, allowances were still made for differences in victim interpretation and recollection (P009, p. 14), for example, searching for all offenders 'not IC1' (white)

when the offender has been described as ‘IC3’ (black). (Offender description in general is returned to below, as it was also considered during the inclusion/exclusion process.)

### How the database is searched

The next key topic of discussion during the interviews was the method by which searches of the database were conducted, with a distinction made between thematic, general, and individual behaviour searching. Some issues that occurred during the search process were also outlined.

### *Thematic, general, and individual behaviour searching*

Analysts explained that behaviours can be considered at a number of levels; the individual, the general, and the thematic (P001, p. 23), for example, searching for a *specific* weapon, a weapon in *general*, or the *theme* of control (P003, p. 9/21). Behavioural themes are something analysts are taught to identify and consider during training, and something they learn about with experience (P003, p. 45). In terms of determining which behaviours represent a coherent theme, academic research and theory were used as a guide (P001, p. 28; P002, p. 19; P005, p. 26/27). This included Davies’ (1992) three-aspect model of rape (P001, p. 13) and the themes identified by smallest space analyses (SSA) conducted in-house by the BIAs (P003, p. 24). By referring to the literature on behavioural themes, analysts are also able to identify and note any behaviours occurring in the same offence that represent different themes (P001, p. 13). As noted above, several analysts suggested that behaviours from contrasting themes – for example, violence combined with pseudo-intimate speech (P004, p.

6) – were a useful basis upon which to conduct searches (P004, p. 42; P005, p. 26/27; P008, p. 56; P010, p. 8). It was noted that an offence may not clearly represent a behavioural theme as denoted by the literature, which can be noteworthy in itself (P006, p. 14).

Some analysts preferred to conduct searches on individual behaviours first, while others preferred to create more general or thematic searches first, and some felt that the order in which the searches were conducted was case-dependent (P008, p. 25). One analyst suggested that the specific behaviours would be searched for if they were distinctive, with a more general search subsequently being conducted if no cases were returned from these first searches (P004, p. 8; P010, p. 10). Some analysts placed greater weight on searching using more general or thematic behaviour rather than its specific description (P002, p. 18). One analyst, for example, said they tended to search for approach type, rather than specific approach behaviour, and that most of the time they searched for behaviour at a higher, thematic level, rather than for specific behaviour (P005, p. 8). This allowed for consistency to be noted despite situational influence which may result in small behavioural changes within a series (P007, p. 55/56). While analysts discussed absolute consistency, as noted above, they reflected that offenders can act in *relatively* the same way across a series, without their behaviour being identical (P004, p. 28; P010, p. 7). Another reason for conducting more general behaviour searches was because they were perceived to negate issues of inaccurate or incomplete victim recall, or inaccurate recording of offence details (P009, p. 21).

In contrast to this, other analysts felt that searching for specific behaviours was of equal value, and they reported constructing both specific and general behaviour searches (P003, p. 30; P004, p. 8; P007, p. 24/25). Specific behaviour searches were often designed to bring back cases almost identical to the index offence/series; as noted above, these were often

named 'screamers' (P001, p. 13). Typically, this was one of the first searches an analyst would run (P009, p. 25). If a case highly similar to the index offence/series was found, some analysts would call the OIC to alert them to this potentially linked case, before any official report was sent out (P011, p. 13). Again, as noted above, analysts would also conduct a general MO search, combining what they consider to be the key aspects of the index offence/series.

The distinction between searching at the thematic or individual behaviour level was often illustrated to the interviewer by reference to the example of offender speech. Speech can be analysed either by searching for verbal themes or by free text searching specific words or phrases (P001, p. 3; P002, p. 25; P003, p. 20). One example given was an offender who referred to himself using a distinctive name that could be searched for in the free text sections and, in addition, particular aspects of this offender's speech were tagged as belonging to the theme of 'verbal cruelty', which could also be searched for (P001, p. 6). As with other behaviours, searching by verbal theme means that the speech used by the offender does not have to be exactly the same in order for it to be comparable (P001, p. 24). Specific speech can also be searched for in conjunction with the verbal theme it belongs to, to ensure it is searched for in the appropriate context (P005, p. 5). Speech was often deemed interesting and consistent (P003, p. 20; P004, p. 9; P006, p. 12), particularly if it was not victim led (P007, p. 25), and was deemed especially relevant when unnecessary (e.g. verbal abuse; P003, p. 20).

### Issues with the search process

When constructing their searches, a key consideration for many, if not all of the analysts was the trade-off between a search being comprehensive versus returning a

manageable number of cases for analysis (P004, p. 19; P006, p. 21). This number varied across analysts with some indication that the number decreased with growing experience and confidence (P006, p. 43). The way crimes are retrieved from ViCLAS at the moment does not produce a rank-ordered list of offences in order of behavioural consistency, distinctiveness, or geographical or temporal proximity to the index offence/series, which means analysts often have to alter the parameters of their searches to yield a manageable number of search results (P001, p. 18).

The current set-up of ViCLAS requires analysts to select salient behaviours to form the search parameters rather than consider all the behavioural information in a crime simultaneously. The analysts, therefore, select and search using behaviours that they believe are likely to be consistent and distinctive. While this is an entirely appropriate strategy bearing in mind how ViCLAS works, the trade-off is that there may be offences in the database that share many identical but more generic behaviours which have not been analysed. It might, however, be possible to link these more generic offences if a different search strategy is used. Researchers of crime linkage have suggested how the statistical models they use could be adapted in just such a way to aid practice (Tonkin et al., 2017; although this would necessitate a change in software design, or the development of new software).

#### The inclusion/exclusion process – how cases are ‘linked’

The behaviours analysts select for their searches are used because they perceive them to be stable and resistant to change (on the whole), and as such would be expected to be

relatively consistent within a linked series. Once an analyst has conducted their searches, the cases that are returned in the results are read and a decision is made as to whether they believe them to be linked to the index offence/series. At this stage, consideration is not limited to the behaviours used in the searches; therefore, at this point the analyst will consider behaviours believed to be more susceptible to situational influence (e.g. victim-offender interaction). Analysts will also consider offender description, victimology, and any absence of behaviours within offences, as well as the geographical proximity, temporal proximity, and temporal ordering of the crimes being compared, the number of offenders implicated in the same offence, the sex acts and risk-taking behaviour within the offences, and the offence type.

### Context

Context is considered by analysts from the very start of the analysis process. Even before the inclusion/exclusion process, context can mediate what is prioritised in analysis, for example, geography becomes challenging to use as a search parameter if the offender is known to travel (P001, p. 27). Context can inform the logistical aspects of the search process, for instance, the involvement of a nightclub or car can lead to a stricter offender age inclusion (P003, p. 15). Furthermore, context is considered in the initial read through of the index offence/series in the creating of the analyst's behavioural interpretation of the case, for example, determining what past behaviour might be comparable to current behaviour, such as how an offender that has targeted a victim online may have done this 10 years ago (P001, p. 7). Regarding the inclusion/exclusion process (P003, p. 26), analysts recognised that the context of the offence is crucial in understanding any behavioural discrepancies exhibited between offences; in other words, in identical situations behaviour should be the same, but it

is the context that changes it (P003, p. 36). Such comments draw directly on forensic psychology literature that have applied theory from personality psychology to the crime linkage scenario (e.g. Woodhams, Hollin, et al., 2007). Personality psychology theory would propose that as situational similarity increases, so too should behavioural consistency (Mischel & Shoda, 1995). There was universal acknowledgement that the analysis process was not just about presence or absence of behaviours (P004, p. 24); by considering context, analysts are able to understand what behaviours could be considered comparatively similar under different circumstances (P003, p. 36; P007, p. 14). Context can also explain different 'levels' of behaviour, for example, greater levels of violence if the victim happened to be cut with a knife when pushed as opposed to the deliberate cutting of a victim (P003, p. 32).

Analysts explained that the context in which a behaviour was expressed needed to be evaluated, for example, whether behaviour could be explained by the time of year, such as the type of gloves worn at the time of year the offence is committed (P002, p. 20), or the use of a Halloween mask around Halloween (P003, p. 2). Context can also inform why certain behaviours may be used in combination with other behaviours; the use of sighting precautions when the offence location is close to the suspect's home location, for instance (P003, p. 15; P003, p. 26). It can also be used to judge whether behaviours or actions are opportunistic (P003, p. 4), and consequently how likely it is that these behaviours will be repeated. Analysts explained they were more confident including cases in their reports if the absence of a behaviour seen in the index offence/series could be explained by contextual change (P003, p. 41). Conversely, if context could not explain a behavioural difference then it was likely a case would be excluded, for instance, if high levels of violence were used in a returned case whereas in the index offence/series no violence was shown despite high levels of victim resistance (P007, p. 31).

One key aspect of context that warrants further explanation due to the importance placed on it by analysts is victim-offender interaction (P004, p. 53; P011, p. 9). This is the notion of how an offender might react when faced with different victim reactions (P001, p. 7), in other words, the impact of victim behaviour on offender behaviour (P003, p. 16). The level of victim resistance, for example, may change the amount of force the offender is required to use in order to maintain control of that victim (P002, p. 5). The victim's role is crucial because their reactions have the capacity to completely change the behaviour demonstrated in the offence (P004, p. 7; P005, p. 15; P007, p. 15); much of the variation in offender behaviour can be accounted for by victim-offender interaction (P002, p. 29). This links to the notion outlined above; that the behaviours an offender is in control of are more likely to be consistent, precisely because they demonstrate the choices the offender has made without the influence of victim interaction to moderate them (P007, p. 16). While much of the discussion above has focused on the behaviours which are resilient to change and which are offender led, an offender's reactions to victim behaviour are also important (P005, p. 28). If similar victim reactions are displayed it may be expected that consequent similar reactions or interactions would be displayed by the offender (P005, p. 15). Again, this directly reflects the academic research which has asserted that similar situational triggers (which can include victim behaviour) will elicit similar offender behaviour (Woodhams et al., 2008). Furthermore, as with the above reasoning about the repetition of behaviour, greater weight may be placed on behaviours that are repeated despite a victim's reaction which makes the behaviour difficult to complete, the inference again being that such a behaviour is important to the offender (P008, p. 17; P010, p. 26).

Analysts expected to observe consistency in behaviours that had previously proven successful in the commission of past crimes (P002, p. 6). This relates to academic writings from Davies (1992) and could include consideration of a suspect's non-sex offending (P004, p. 42). The temporal context of crimes was also given explicit consideration, as while offenders may demonstrate consistency due to the success of some behaviours, it was explained that offenders can adapt their behaviour across a series due to learning (P002, p. 13). Offender learning was deemed to have an impact on offence location (P003, p. 17). One analyst pointed out that learning may impact on the level of risk seen across a series, given that a suspect may learn to minimise risk of apprehension (P009, p. 8/9). Analysts explained how they would try to account for potential changes in behaviour due to learning by conducting further searches (P002, p. 7). In the academic literature, both Davies (1992) and Woodhams (2008) give similar examples of progression and learning within series. Despite such observations being an example of behavioural change or evolution, analysts referred to this as a type of consistency, for example, stating that offender consistency is not as simple as seeing exactly the same behaviours repeated consistently across a series (P006, p. 5). Changes in suspect behaviour were also argued to be explainable if there was a temporal gap between offences (P004, p. 31), a premise which is echoed in personality psychology literature (Pervin, 2002). Analysts further explained that escalation of behaviour should be considered (P002, p. 13; P004, p. 32/33; P007, p. 57; P011, p. 29). Here, the temporal context is important because it incorporates the idea of progression and behavioural change. An example given was the use of a knife to control the victim in later offences (P003, p. 16), after the suspect had encountered difficulties controlling victims in previous offences. The concepts of learning and escalation by suspects are part of the analysts' training on behavioural interpretation (P002, p. 12), and were described as being learnt about experientially (P005, p. 17).

### Offender description

While context, including victim-offender interaction, was the primary focus of discussions about how the inclusion/exclusion process was conducted, analysts cited several other factors which influenced this decision making. Offender description, while mentioned above as being used under certain circumstances during the search process, was often cited as being used in the inclusion/exclusion process. Offender ethnicity, for example, was likely to be used in the inclusion/exclusion process as opposed to the search process given, as noted above, research on victim recall suggesting that descriptions may not be always be accurate (Thomas et al., 2004). The offender's age was another aspect of their description that was used to assist with the inclusion/exclusion process. This was caveated, however, with the notion that offender age cannot always be relied on (P011, p. 14) as victims are often mistaken in this aspect of offender description, so if it was used to assist with the inclusion/exclusion process a large margin for error was considered (P007, p. 35; P007, p. 45). Offender description was generally discussed in the context of a behaviour that could be used to give strength to a decision during the inclusion/exclusion process, and that this was knowledge gained with experience as well as with training (P006, p. 6; P007, p. 53).

### Victimology

While occasionally considered at the searching stage, victimology was another important aspect of the inclusion/exclusion process. There was some assertion that offenders may show consistency in victim choice (P005, p. 2; P007, p. 32), given that they are perceived to be more in control of their choices at the start of an offence and, therefore, the

choice of who they offend against (P010, p. 2). For example, some analysts would rule out cases where very young or very old victims had been targeted if the victimology did not match the index offence/series (P003, p. 17). Analysts recognised academic findings that gender preference can be more variable if the targets are younger children (P007, p. 10; e.g. Levenson, Becker, & Morin, 2008), with some expecting greater consistency in victim gender if an offender targeted adult males compared to young children (P007, p. 10). Other analysts conversely asserted that some offenders choose victims of varying types (P008, p. 29/30), reflecting the academic research on the prevalence of crossover offending (e.g. Cann, Friendship, & Gozna, 2007; Heil, Ahlmeyer, & Simons, 2003).

In general, it was noted that it was difficult to identify linked series where victim type varied (P005, p. 14). Some analysts suggested that the behaviour demonstrated against a child and an adult victim can be markedly different because of differences in victim-offender interaction (P005, p. 2), such as the different effect certain speech might have on a child as opposed to an adult (P005, p. 5). It was also noted that the information recorded in the case files could differ due to different victim recall capabilities (Thomas et al., 2004). As such, while analysts recognised the likely occurrence of crossover offending (P005, p. 10), they suggested it can be difficult to link such crimes in practice (P005, p. 3). It was also highlighted that victim age may not be a reliable inclusion/exclusion parameter as a victim's age may be difficult for an offender to ascertain (P007, p. 11). Other analysts also pointed out that it was not advisable to refine by victim age because age itself may not have been the driving factor for victim selection, for example, a child might have been chosen because of their vulnerability and not their age (P009, p. 15).

Some analysts reported including cases where the victims were similar in terms of profession, namely if the victim was a sex worker or not (P001, p. 14). Conversely, however, one analyst suggested ViCLAS demonstrated that offenders will, on occasion, target both sex workers and non-sex workers (P004, p. 19). Where there is such crossover, analysts did not expect the same approach style (P004, p. 51; P011, p. 26). It was also suggested that targeting sex workers can affect the geography of a suspect's offending (P002, p. 43). Similar observations have been made in academic research regarding the geographical clustering of targets (e.g. Bennell & Jones, 2005).

Some analysts explained that victim characteristics can affect offender behaviour, a point made in early academic work on crime linkage (e.g. Davies, 1992). For example, in one analyst's experience more violence tended to be used against sex workers (P011, p. 9/10). Furthermore, the impact of offender behaviour can be different for different victims, for example, a similar level of violence could result in much more serious injuries to a physically frail victim. In terms of including offences that involved a single or multiple victims, offences would be particularly likely to still be included if the offender appeared to target lone victims as well as groups of victims, if those victims targeted were children, the logic being that several children may be easier to control (P009, p. 6).

### *Absence of behaviour*

Absence of behaviour is the next topic to be discussed as, again, while occasionally considered during the search process, it was more likely to be considered at the inclusion/exclusion stage (P003, p. 5). The absence of some behaviour was suggested to be salient (P002, p. 4) and searchable (P001, p. 24), with some analysts considering it just as

important as the presence of behaviour, and also stating that absence was used frequently in the inclusion/exclusion process (P003, p. 5) in order to take into account certain situations such as an interrupted offence (P006, p. 25). Some specific absences of behaviour were deemed to be significant, for instance, the absence of any offender speech despite the victim attempting to verbally engage them (P002, p. 4; P004, p. 9; P006, p. 13/14). This topic is slightly more contentious, however, as other analysts felt that looking at the absence of behaviour was not useful at all (P002, p. 41). It was also said that absence was only included in the search process when the numbers of cases being brought back in initial searches were unmanageable (P002, p. 40). In this instance analysts may return to the search process and add an absence of behaviour into an existing search if it had consistently been used to exclude cases, for example, if several cases had been excluded because, unlike in the index offence/series, the offender had a weapon, then 'absence of weapon' may be added into the search (P009, p. 18/19). What confounds this issue, however, is the notion that the absence of behaviour does not necessarily mean that it did not occur, rather that it may not have been recalled or recorded, which might explain the discrepancies in opinion surrounding this issue. This issue is also discussed in academia when considering the relative value of similarity coefficients (see Bennell, Gauthier, Gauthier, Melnyk, & Musolino, 2010, for further discussion of this).

### *Single versus multiple perpetrator offences*

Linking offences committed by a lone offender to those committed by a duo or group of offenders was noted as a challenge. Several analysts highlighted that both their training and examples on ViCLAS demonstrated that offenders can commit both single and multiple perpetrator offences (P004, p. 34; P011, p. 7), and that behavioural consistencies could be

observed within series of mixed types (P002, p. 15). As such, crimes of both types could be included in their reports (P008, p. 35). It was felt, however, that it was often very difficult to compare behaviour across these offence types (P001, p. 14) due to differences in interaction, not just between offender and victim, but also between different offenders when more than one was present (P009, p. 6). One suggestion in order to combat this problem was to look at the offenders' roles and behaviours within the offence, and the type of context in which the offence was committed (P002, p. 15). This difficulty in terms of determining potential links between single and multiple perpetrator offences is not one that is singular to analysts; while academic research has identified different roles within multiple perpetrator offences (sexual and non-sexual) and differentiated between leaders and followers (see Porter, 2013; Woodhams, Cooke, Harkins, & da Silva, 2012), there are limited research findings regarding linking single and multiple perpetrator offences within the same series (see Burrell, Bull, Bond, & Herrington, 2015, for an example of existing research in this area). Woodhams & Cooke (2013) also note that the difficulties in determining the leader in a multiple perpetrator offence means that the attribution of specific behaviours to certain offenders can be problematic (although see Woodhams, 2008, for a discussion of the different linking possibilities of simultaneous and sequential multiple perpetrator offences).

#### *Geographical proximity, temporal proximity, and temporal ordering*

Geography was asserted by many analysts as one of the major search parameters, but once the search results have been returned further comparisons could be made as to just how close offences are to each other and this helped inform the inclusion/exclusion process (P006, p. 24). The more geographically close offences were to each other, the more likely they were to be considered linked (P002, p. 29). It was also noted by several analysts that training with

the BIAs had taught them that the closer offences had occurred together, the less behaviourally similar they needed to be for an inclusion to be considered (P003, p. 11; P006, p. 38; P009, p. 10; P010, p. 6), and this was taken into account during the inclusion/exclusion process. It was also highlighted that it was harder to justify to OICs the inclusion of a potential link geographically far away from the index offence/series, without a high degree of similarity across the other behaviours (P009, p. 10).

In terms of temporal proximity, while some analysts prioritised the cases returned from the searches on the basis of their temporal proximity to the index offence/series (P001, p. 11; P002, p. 16; P011, p. 29), it was felt that offences that were closer together in time were not necessarily more likely to be linked (P002, p. 17), only that temporally similar cases may be more interesting to compare and, as with geographical proximity, would warrant further attention (P003, p. 35). Analysts, however, didn't feel that temporally proximal cases could be less behaviourally similar and still merit inclusion, in the same way as geographically proximal cases (P004, p. 49).

Due to the constraints within ViCLAS, the temporal order of behaviours exhibited during an offence cannot be searched for, and as such this is something that can only be considered during the inclusion/exclusion process. Analysts did consider the temporal order of behaviours, rather than merely whether or not a behaviour occurred at any point in an offence (P003, p. 7). It was said that when the same behaviours were seen in a similar order this created a feeling of familiarity which assisted in the decision as to whether to consider the crimes linked or not (P002, p. 36).

It was also suggested by analysts that if, during the inclusion/exclusion process, cases were brought back that were very geographically or temporally close to the index offence/series, that this may merit a discussion with the relevant OIC (P007, p. 44). This, however, was still with the caveat of considering the context of the cases, for instance, two offences committed within the same week may be unusual for a rural area of low population, but not for an urban area which is densely populated (P007, p. 44).

### Sex acts

At first glance it may seem counter-intuitive not to have more extensive detail on how the sex acts exhibited in the offences were considered in the inclusion/exclusion process but, as some analysts pointed out, the fact that ViCLAS is a database of sex offences (populated by a subset of crimes within a specific criteria) means that many of the sexual behaviours are so commonly entered into the database that, with the exception of very rare sexual behaviours, such as anilingus (P007, p. 11/12), they often don't have the discriminatory power for assisting with either the search or inclusion/exclusion processes (P002, p. 21; P004, p. 26; P007, p. 13; P008, p. 23; P009, p. 16). In terms of consistency, while some analysts suggested that offenders were relatively stable in the sex acts they engaged in (P006, p. 51), others did not agree (P003, p. 33). It was also suggested that the type of sex act seen may influence whether victims of different genders would be considered in the inclusion/exclusion process, for example, if the index offence/series contained a female victim where anal intercourse was attempted, male victims may be more likely to be included in potential links (P010, p. 19). Sex acts may also be subject to high levels of change because of interaction with the victim or environment, so some analysts would not exclude cases if the sexual behaviours were different in the returned cases (P007, p. 14).

### Risk-taking

While not discussed by a large number of analysts, risk-taking was deemed a salient aspect to an offender's behaviour. There is no section on ViCLAS for recording risk-taking, rather, behaviour was interpreted to be risky by analysts due to the environment in which it was displayed by the offender. This impression of risk might emerge from the co-occurrence of a set of behaviours which, on their own might not be risky, but appear to be when observed in combination (P006, p. 25). One analyst, for example, noted the complete disrobement of the victim in an outdoor location as a salient behaviour given the risk associated with the time taken to ensure the victim complied with such a request and the potential for being observed by third parties (P006, p. 13). Such behaviour was expected to be consistent (P009, p. 8), potentially reflecting what the offender wanted or needed to achieve despite the risk taken in a given environment. Other analysts, however, said they would not exclude cases where such behaviour was not repeated (P005, p. 3).

### Offence type

A final point that has not yet been explored is the role of offence type in the inclusion/exclusion process. Some distinction was made by analysts between linking non-homicidal sex offences and sexual murders. The fact that some offenders escalate to killing their victims was acknowledged by analysts (the notion of escalation is also recognised in the academic literature; Hazelwood, Reboussin, & Warren, 1989), and as such, even if the index offence/series was a murder or murders then consideration would need to be given to the sex offences an offender may have previously committed (P004, p. 32/33). It was suggested that

non-fatal sex offences and murders could also be potentially linked where there was violence present in the sex offence that might amount to lethality in other circumstances (P004, p. 33; P010, p. 21). In this sense, it seems that murder was considered as being at the extremely violent end of the scale in terms of sex offences, and so wouldn't be comparable to some offences in the same way that very violent (non-lethal) sex offences would also be excluded (P004, p. 33). (The literature would suggest that the level of victim resistance or the failure to use precautions may also affect whether an offence escalates to homicide; for a discussion of linking homicidal and non-homicidal sex offences and potential patterns of offence progression see Davies, Woodhams, & Rainbow, 2018.)

### Summary

To summarise, there are a wide range of factors that analysts must consider when deciding whether or not to include a case or series in their reports as potentially linked to their index offence/series. It appears that it is predominantly the offender led behaviours that analysts use to form their searches, with behaviours more susceptible to situational influence considered at the inclusion/exclusion stage (P006, p. 23). Cases were often more likely to be linked, or at least given further consideration, if they had been returned in multiple searches created by the analyst (P004, p. 47). It was also explained that the inclusion/exclusion process was somewhat of a balancing act, taking into account the search results and the context of the crimes along with all of the other relevant factors, and weighing up the volume of similar behaviours the cases shared, versus the perceived differences (P003, p. 32; P006, p. 24; P011, p. 20). Similar decision making has been articulated in published material about the linking process (e.g. Woodhams, Bull, et al., 2007). While some analysts had internalised guidelines as to how many similarities and differences they had to observe before including or excluding

a case – for example requiring a minimum of two reasons for excluding a case (P006, p. 30) – others made these decisions on a case-by-case basis, either because of a lack of similarity or the presence of markedly different behaviours (P005, p. 16).

### Analysts' experiences and differences in practice

The last of the themes from the interviews pertained to the analysts' own experiences of the analysis process, and any potential similarities and differences they felt existed between the methods they adopt and the steps they follow and that of their colleagues. Many analysts said that experience in their role had given them confidence in their ability to make decisions, in accepting the premise of behavioural consistency, and also accepting when there was no further analysis that could be conducted (P003, p. 45). Analysts also said that they had continued to gain knowledge about what does and doesn't work during the search process (P002, p. 41), following their initial training. They recognised that this experience had changed their analysis process (P007, p. 54), including being more comfortable in accepting the risk of missing a link if it didn't adhere to the premises upon which SCAS conducts CCA (P004, p. 25; P007, p. 35). Analysts felt that with experience came the ability to conduct analyses more efficiently (P010, p. 27), and the confidence to search for combinations of behaviours, as well as being more selective about the number of cases read during the inclusion/exclusion process (P006, p. 43/44). It was also noted that the information on ViCLAS had altered how they conduct their analyses (P007, p. 53). While some analysts recognised that other colleagues may do things slightly differently, such as not using a basic MO search (P002, p. 42) or being more selective in the cases they look at, it was argued that there are lots of ways to construct searches, ultimately leading to the same end result (P003,

p. 46). Whether this assertion is correct or not would merit empirical testing. There was also the feeling that analysts' thresholds for including potential links in a report could differ slightly to that of their colleagues (P008, p. 30). Despite differences in ways of working, there was a feeling that the unit had continued to become more and more professionalised (P005, p. 30), with an emphasis on evidence-based decision making (P007, p. 54).

### 3) Challenges and future work

During the interviews with analysts a number of challenges experienced within the analysis process were highlighted. These included specific issues with ViCLAS and suggestions for its improvement, as well as gaps in the academic literature, which if filled would be of use to analysts.

#### Challenges

The most frequently mentioned challenge by analysts was not receiving confirmation of links and feedback from officers. It is currently the responsibility of the police services that receive SCAS reports to provide case updates for offences falling within SCAS' remit, and while numerous attempts are often made to receive feedback on reports sent out (P003, p. 33), there are lots of cases where no information is received (P005, p. 23; P006, p. 40). Even when information is received, it is often not useful to the analyst, i.e. it does not provide them with an explanation as to why a particular decision has been made about the suggestions detailed in their report (P008, p. 33). This has obvious ramifications for the effectiveness of

ViCLAS; it is possible that there are case outcomes that are not currently on the system because the information has not been provided to the unit (P011, p. 34). It was often recognised by analysts, however, that officers have many operational priorities which could account for this lack of feedback (P004, p. 61). While officers are also required to justify why they have not investigated potential links highlighted by SCAS analysts, a further issue with this communication between SCAS and officers is the perceived unjustified dismissal by officers of some of the potential links suggested by analysts. Some of this seems to be due to a lack of knowledge on the part of police officers, for example, being unaware of the unreliability of victim and witness descriptions of suspect ethnicity and thus rejecting potential links because the suspect of a potentially linked case differs in ethnic appearance to the index offence/series (P002, p. 9), or differing offender description in general (P009, p. 36). Similarly, potential links were said to have been disregarded between single and multiple perpetrator offences despite analysts' recognition that these types of links do exist (P010, p. 14). ViCLAS can be used to help inform the opinions of OICs (P003, p. 7), such as the frequency with which certain behaviours occur, as officers' perceptions of what is important or useful in the linking process can be different to that of the analysts (P006, p. 40). While officers have local knowledge and while some may have investigated a number of sex offences, SCAS analysts build up a picture of both local and national patterns of behaviours (P010, p. 13) and, as such, are experts in these particular types of offences (P008, p. 34). It should be noted that the analysts also referred to occasions when they received positive feedback, highlighting the utility of demonstrating similarities between offences (P010, p. 10/11). Finally, the manner in which information is passed between the investigation and SCAS is sometimes problematic; information is not always received – for example, the summaries written by the OICs (P001, p. 5) – the implication being that ViCLAS will be

unable to produce accurate outputs if the information entered into it is inaccurate or incomplete (Bennell, Snook, MacDonald, House, & Taylor, 2012).

As well as issues with the receipt of information from officers, there are also a number of difficulties associated with the process of analysis itself. Cases where there is limited information, such as attempted or incomplete offences, means the analysis process can be challenging (P001, p. 2). Similarly, if such offences are brought back in an analyst's searches, these cases are often difficult to make linkage decisions about (P003, p. 16/17). The same is true of the analysis of murders; because there is no victim account, there is less behaviour recorded that can be analysed (P002, p. 14). As noted above, if a sex offence is particularly violent, there is the potential that it could be part of a series including murders (P003, p. 16), and while it may be possible to make inferences about behaviour in consultation with the OIC (P002, p. 42), making associations between behaviours demonstrated in sex offences and murders is not straightforward.

The increasing number of cases on ViCLAS was cited as being responsible for the increased difficulty in conducting broad searches, despite analysts' frequent preference for doing so (P009, p. 11). Obviously, this is not a factor that can be altered because of the unit's legislated remit. The increase in cases entered means that trends seen are subject to change; certain sex acts, for example, were cited by one analyst as becoming less useful when searching for linked cases (P001, p. 16), and geography is used much more frequently in order to narrow down searches. This is of concern to analysts who, while recognising it is sometimes unavoidable, are aware of the importance of maintaining the unit's status as a *national* crime linkage tool (P005, p. 29).

Many analysts mentioned that the inclusion/exclusion process is where analysts would benefit from the most assistance (P011, p. 38). This part of the process was deemed laborious, subjective, and potentially subject to human error (P001, p. 31), which is hardly surprising given that analysts often read several hundred cases during the analysis of just one index offence/series (P006, p. 51). Logistically, there are also issues with this process, such as the inflexible nature in which search results are presented to the analyst (P001, p. 16) and the inability of the system to highlight cases returned in more than one search (P008, p. 72). Again, the number of cases on the database is a factor that only serves to compound this issue.

Another issue is that repetition of a behaviour within an offence cannot be searched for, something that, as noted above, many analysts cited as important in terms of understanding what was consistent in the index offence/series (P004, p. 67). As well as this lack of search capability, repetition of behaviour – other than violence and some verbal themes – cannot currently be captured on ViCLAS (P001, p. 7). The comparison of an offender's behaviour across a series as a whole (some behaviours being present in certain cases in a series, but not all of them) was also highlighted as impossible to search for (P008, p. 74). Furthermore, the order in which the behaviours were enacted by the offender was often cited as important in the behavioural interpretation of a case (P003, p. 35), yet difficult, if not impossible, to search for (P003, p. 13; P008, p. 55; P011, p. 22). It was highlighted by analysts that, while these gaps in the search process did exist, their awareness of these issues meant that they could be taken into account in the inclusion/exclusion process (P002, p. 5). Finally, in terms of general challenges to the analysis process, free text searching was also a factor that raised a number of issues. There are often a number of different ways that behaviours can be described within a free text field, and while the peer review stage can

highlight alternative terms for searches (P001, p. 30), it is possible that these variations may be missed (P009, p. 27). As mentioned above, however, the unit's QC guide does detail keywords that should be used. Furthermore, the unit undertakes data integrity reviews to ensure that coding and data capture are consistently accurate.

In terms of challenges relating to specific behaviours, analysts highlighted a number of issues, a full list of which can be seen in Appendix 2.

### Suggestions for improvements to ViCLAS

Many analysts were complimentary of ViCLAS as a tool for conducting CCA, highlighting that many behaviours are easily searchable (P011, p. 12). In terms of improvements to the current system, many analysts mentioned that it would be useful to be able to search – or search more easily – for the above-mentioned behaviours, as well as for the repetition and temporal ordering of all behaviours, currently only assessable at the inclusion/exclusion stage at which point several hundred cases might have to be read (P004, p. 27; P011, p. 22). There are difficulties associated with repetition and temporal coding, however, such as its subjective nature, the greater level of interpretation needed, and the level of victim recall, which may make it untenable to develop such capability. It was noted that ViCLAS continues to be improved and has already been made simpler and easier; it has been condensed well, and duplicate questions as well as unused questions have been removed (P009, p. 40). There were, however, several other specific suggestions for improvements to ViCLAS. [Unfortunately, due to the sensitive nature of ViCLAS, exploring these suggestions here is beyond the capacity of this article, although they were included in the original report

written for SCAS.] Such suggestions may prove instigative in the updating of ViCLAS, given that they come from analysts who have a great deal of experience of working with such a tool and this particular type of offence. What must be noted at this point is that any changes to ViCLAS need to be considered with regards to how it will affect all of the cases already coded into ViCLAS. If it is not possible to automatically convert all of the existing cases, then any new changes will make new cases incomparable with existing ones, at least for the areas where alterations are made.

### Suggestions for new academic research

There were a number of research papers that analysts described as useful, either helping to inform them of searches to conduct, or in defending the choices they had made during the analysis process. The two most common were Rossmo et al.'s (2004) paper on the distances offenders travel in the commission of rapes, and Thomas et al.'s (2004) paper on the limitations of victim recall (P004, p. 57/58). Both internal and external research was cited as useful, such as the above-mentioned BIA's work on themes of behaviour, as well as Davies' (1992) three-aspect model of behaviour, Grubin, Kelly, and Brunsdon's (2001) paper, and Woodhams' research on behavioural consistency (P011, p. 41). Other research mentioned included literature investigating the prevalence of gender crossover when offenders targeted child victims (Levenson et al., 2008), and information given to the unit by the BIAs, in particular the decreasing need for high levels of behavioural similarity as the geographical proximity of cases increases. The unit's training programme was frequently cited as integral to analysts' knowledge of the subject, but their experience gained when conducting analyses was deemed just as important. While research was said to be useful in

helping to justify decision making, it is important to note that analysts pointed out its capacity for misuse, such as inappropriately using or citing it to validate arguments (P005, p. 29). It was also pointed out that any research conducted using SCAS data is more useful to them, given its direct applicability to the unit (P004, p. 66).

It was suggested by analysts that more research in the area of crime linkage and CCA is needed, and that they would like to see research conducted on all aspects of offender behaviour and the analysis process (P002, p. 44). Several specific ideas for future research were proposed, and have been documented in Appendix 3. Importantly, it was highlighted that any research conducted needed to be applicable to the analysts' work (P003, p. 47), in order that it could be used to support decision making, especially during the inclusion/exclusion process (P003, p. 48).

## Discussion

### Interpreting the results

This study had a number of aims which were addressed in the different sections above. The analysis process conducted by SCAS analysts was mapped, from receipt of each index offence/series to the sending of a report detailing the results of the analysis to the OICs. The process consisted of three key stages, of which only the analysis stage was assessed in detail here. While there were some differences in the order in which the analysis steps were conducted, the analysts were largely unified in the manner in which they completed this process. Any differentiation appeared to be the function of the different circumstances in the index offences/series which moderated what analysts were able to search for.

What was particularly interesting about the interviews with analysts was that they allowed for the specific decisions made throughout the analysis process to be explored in detail, particularly with regards to the choice and utility of particular behaviours, and the impact that the different conditions in each crime may have on the process as a whole. A number of behaviours were established as useful, and a number of different contexts were shown to be important when linking. Furthermore, behaviour was conceptualised at multiple levels; individual, general, and thematic. The concept of different levels of behaviour, and particularly the analysts' use of these different levels of behaviour to construct different types of searches when linking crimes, is not something that has been addressed in academic research before in such a level of detail.

A better understanding was gained of how ViCLAS assists the analysts with the linkage process, as well as specific improvements to the system that analysts would find useful. [While challenges relating to the searching of certain behaviours were discussed, it was not possible to explore potential specific improvements to ViCLAS here.] It could be argued that using analysts' expertise in order to maintain and improve these types of systems makes intrinsic sense, given their frequent use of the database. In an attempt to establish exactly what was known about existing academic research and to address, where possible, gaps between research and practice may lie, the interviews established what theoretical and empirical writings the analysts drew upon and found useful, as well as any further research that may be helpful. In writing this report, the concepts discussed by the analysts during the interviews have been able to be linked with existing theory and research, therefore highlighting where decision making is congruous with existing academic knowledge. This may be indicative of its use by the analysts (or that it is the foundation of the initial analytical training), even if it wasn't explicitly referred to during the interviews.

There are a limited number of instances where inferences made by analysts are contrary to what current academic research might suggest. Analysts suggested that behaviours that are unnecessary to commit an offence are expected to be consistent, based on the fact that they reflect what is important to the offender while offending. Most of the current research available actually shows the opposite, that for most offenders, they are not consistent in 'style' behaviours (Grubin et al., 2001; Woodhams, 2008), although there is some research to suggest that such behaviours are highly consistent for some offenders (Woodhams, 2008). More research is needed into this in order to understand why some offenders may show consistency in this area, while others may not.

With regards to establishing what theoretical literature is known and useful to the analysis process, it is noteworthy that the analysts made a number of interesting assertions about behaviour that have not yet been validated by research. A full list of these points is given in Appendix 4. These points are an example of where the research community could learn from practitioners, i.e. these observations could be used to form research hypotheses.

#### Next steps – research

In addition to the wealth of research suggestions put forward by our interviewees, some interesting avenues for future research were implicated in our study that warrant further attention. While the CCA of sex offences was the focus of this study, there are other types of offences that CCA is applied to, as well as other approaches to crime linkage (most notably CLA) that could be studied in the same way. In addition, it would be interesting to compare how CCA is conducted when supported with a database, such as ViCLAS, and when there is no such database. SCAS analysts suggested their analysis process changes with experience as well as with training, and this would be interesting to investigate, as well as analysts' supposition that differences in the order of searches conducted do not affect the results generated.

This article has also highlighted some interesting differences between the theoretical and practical operationalisation of concepts such as consistency and distinctiveness. In the theoretical literature, consistency has been studied in relation to individual behaviours, as well as domains or themes of behaviours. What it has not yet considered, however, is how behaviour can be conceptualised as relatively (as opposed to absolutely) consistent when

considering the influence of the situation. While this may be more difficult to empirically test, it would add a dimension to the theoretical research which would reflect the reality of conducting crime linkage. Distinctiveness, in the theoretical literature, has been conceptualised only as those behaviours that occur less frequently than others. From the interviews with the analysts, it appears that distinctiveness can refer to rare behaviours, but also to those which are often repeated in the same offence, or occur with other behaviours that seem thematically incongruent (and do not co-occur often). It seems that the definitions used by analysts (the notion of ‘salience’, for instance), not only to describe the approach with which they conduct crime linkage (such as CCA and CLA), but also to describe the methods they use to search for potential links, are often different to those used in the academic literature, which merits further attention in order to bridge the gap between theory and practice.

#### Next steps – ViCLAS

[As noted above, discussion of specific improvements to ViCLAS cannot be represented here.] A more general discussion can be had as to what might assist analysts with the process of linking cases using ViCLAS, with particular focus on the manner in which the analysts interact with ViCLAS to understand how it can better meet their requirements.

The triage system prioritises offences for analysis where searches are most likely to be beneficial due to the distinctive nature of the behaviour reported by the victim. This is an entirely appropriate strategy to take in light of the way ViCLAS works. As noted above, however, this will mean that series that share many more generic behaviours will not be

analysed. It may be possible to link such series, though, if a different search strategy was used. In much of the research on crime linkage assumptions, statistical models are used to calculate the relative similarity of pairs of crimes based on all of the MO behaviours displayed in the offence. Such a search strategy could be built in to a computerised support tool, allowing for more generic crimes with multiple behaviours to receive this sort of attention.

As well as having the capacity to consider and compare all behaviours in an offence at once, this type of support tool could list search results in order of similarity to the index offence/series. The analysts would then be able to toggle through different views where the crimes are rank ordered in terms of behavioural consistency, geographical proximity, and temporal proximity to the index offence/series. This would help overcome the difficulty of having to alter search parameters to make the returned number of hits manageable. (Rank ordering the search results may have the effect of biasing analysts' decision making, as has been found with the use of other police databases such as the Automated Fingerprint Identification Systems (AFIS; Dror, Wertheim, Fraser-Mackenzie, & Walajtys, 2012), and is something which would require empirical testing.) This system could also have the capacity to conduct proactive searches (as defined by Woodhams, Bull, et al., 2007); as a new crime comes into the unit and is coded into ViCLAS, the computer system would run a background search based on all behaviours in the offence to see if there are any highly similar crimes already on the database. A particular threshold could be set so only very similar crimes are flagged, and these searches could be tailored for solved versus unsolved crimes.

It would also be helpful if a computer support tool used by analysts could regularly provide them with an update as to the statistical frequencies of behaviours on the database, so

that distinctiveness could be determined conveniently without having to run specific searches. The system could also calculate what discrete behaviours are distinctive as well as what combinations of behaviours are distinctive. In doing so, crimes sharing discrete rare behaviours or distinctive combinations of behaviours, as long as they are consistent, could be identified for further attention (another form of proactive linking). In terms of developments that could support searching based on temporal ordering, text analytics could be run on the narratives contained within ViCLAS to distinguish behaviour combinations specified by analysts as particularly unusual (e.g. anal rape followed by fellatio; P003, p. 14). Research to assess the feasibility of such suggestions are part of a current funding bid.

### Limitations

There are limitations with this study that need to be considered in future research. First, this study focused on conducting CCA with sex offences, and it is possible that the process will not be the same for other offence types. Second, and similarly, it is also possible the process of CCA will not be the same without the support of a computerised database like ViCLAS. As noted above, both of these limitations require future research attention, although some of the principles reported in this study may be applicable to all offences, for example, placing greater weight on behaviours under an offender's control, or the importance of geography. Third, not all crime analysts employed within SCAS were interviewed, therefore it is not possible to claim that what has been presented here is an exhaustive analysis of the CCA process as conducted in SCAS. It is hoped, however, that having interviewed analysts from a range of job roles and with varying degrees of experience will have helped to mediate this issue. Finally, allowing the analysts to self-select the cases they brought to the interviews

may have introduced an element of bias as to the type of case discussed during this study (such cases may have been selected because they were particularly amenable to CCA; Davies & Woodhams, 2018). While worthy of investigation in itself, in this case, this potential issue was outweighed by the need for analysts to bring cases they were familiar with, and as such be able to explore how CCA is conducted in as much detail as possible.

### Conclusion

This paper was novel in its attempt to understand the specific processes undertaken when conducting CCA of sex offences. Analysts demonstrated that CCA is a complex and time consuming process that requires a great deal of training and skill. Interviewing these analysts gave the authors a unique insight into the process of CCA, and has produced a myriad of different avenues of further research for both theoretical and practical developments.

**CHAPTER 4:**  
**A TEST OF THE INTERRATER RELIABILITY OF THE VIOLENT CRIME  
LINKAGE ANALYSIS SYSTEM (VICLAS) CODING IN BELGIUM**

Chapter 4 has been submitted for publication to the *Journal of Criminal Justice*. The manuscript is authored by Miss Kari Davies (University of Birmingham), Mrs Hanne Imre (Zeden-Analyse-Moeurs unit, Belgium), and Dr. Jessica Woodhams (University of Birmingham).

Chapter 4 was the second study that aimed to address some of the research gaps identified in Chapter 1. While Chapter 3 focused on exploring how comparative case analysis was conducted in its entirety, Chapter 4 aimed to investigate one specific aspect of the process of comparative case analysis, namely the coding of information into a computerised database aimed to assist with the linkage process, the Violent Crime Analysis System (ViCLAS). Previous research into the interrater reliability of ViCLAS coding had only been conducted in North America, so it was the aim of Chapter 4 to replicate and extend this research by asking analysts working in the centralised ViCLAS unit in Belgium to code four cases. In this way, this study filled a knowledge gap, firstly by collecting and analysing data from a country whose coding process is markedly different, and secondly by assessing the coding across a number of cases to ascertain where coding may be consistently reliable or unreliable.

There were ethical considerations to address when conducting the research in Chapter 4. (Ethical approval was obtained from the University of Birmingham.) As in Chapter 3, all

data were stored in accordance with agreements made with the data providers, and confidentiality of all responses were guaranteed in order that participants could be assured that no evaluation of their performance would take place. Participants were invited to attend a presentation where the research was explained. As in Chapter 3, it was also stressed that participation would be entirely voluntary, and that there would be no negative repercussions for deciding not to participate.

Davies, K.\*, Imre, H., & Woodhams, J. (2018b). A test of the interrater reliability of the Violent Crime Linkage Analysis System (ViCLAS) coding in Belgium

\*All correspondence to be addressed to the first author by email; KAD351@bham.ac.uk; or in writing; Kari Davies, Centre for Forensic and Criminological Psychology, School of Psychology, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

## Abstract

The Violent Crime Linkage Analysis System (ViCLAS) is a database used by law enforcement to collect behavioural information about sex offences. In some countries, it is used on a daily basis to identify behavioural links between cases and inform police investigative decision making, therefore, it is important that the information coded into ViCLAS is reliable. While this premise has been tested in North America, where police officers code information into ViCLAS, it has not been assessed in Europe, where ViCLAS is coded by analysts working within a centralised unit. This study, therefore, investigated the interrater reliability of ViCLAS coding in Belgium. Eight analysts working in Belgium's centralised ViCLAS unit coded four cases into ViCLAS. The percentage occurrence agreement and percentage non-occurrence agreement were calculated overall, for each case, and for each ViCLAS section. Results showed that Belgian analysts demonstrated a higher level of interrater reliability than in previous studies, with an overall percentage occurrence agreement of 55.80% and a non-percentage occurrence agreement of 88.99%. Much of the coding, however, still fell short of the 70% acceptability threshold. By looking at the coding across the four cases, the study was also able to identify specific sections of ViCLAS that were coded consistently well or poorly. The implications of these findings in terms of how ViCLAS is coded, and the levels of training and expertise required, are discussed.

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Public significance statement: In order for the Violent Crime Linkage Analysis System to be used efficiently to search for links between sex offences, the manner in which information is coded into it must be uniform. While Belgian analysts showed a higher level of interrater reliability than demonstrated in previous research, coding was not completely uniform. While this requires further investigation, the difficulties in interpreting complex behaviour in a standardised manner may account for these discrepancies.

Keywords: crime linkage, comparative case analysis, ViCLAS, interrater reliability, behavioral analysis

## Introduction

### An introduction to crime linkage

Behavioural crime linkage rests on the premise that two or more crimes can be linked together on the basis of the behaviour exhibited by an offender at their crime scenes (Woodhams & Bennell, 2014). It relies upon two key assumptions; behavioural consistency and behavioural distinctiveness (Bennell & Canter, 2002; Woodhams, Hollin, & Bull, 2007). An offender must exhibit behaviour similar enough that it can be identified across their crime series, and distinctive enough that this behaviour can be distinguished from that of other offenders. Crime linkage tends to be used when other, more traditional methods of linking crimes together – such as through the use of physical evidence – are unavailable (Grubin, Kelly, & Brunson, 2001). Crime linkage can assist in the efficient deployment of law enforcement labour, as well as inform investigative decisions made by law enforcement practitioners (Grubin et al., 2001). In some countries, crime linkage may also be used as similar fact evidence in court (Labuschagne, 2006; Pakkanen, Santtila, & Bosco, 2014).

While there are evident benefits of crime linkage, inaccurate crime linkage could have serious consequences. Given that research into the theory of crime linkage has shown that the underlying assumptions do not hold true for all offenders all of the time (e.g. Grubin et al., 2001; Woodhams & Labuschagne, 2012), the margin for error must be considered. If crime linkage is conducted incorrectly, police resources may be inappropriately assigned or wasted, fear that a serial offender is operating within a community may be unnecessarily heightened and, perhaps worst of all, erroneous crime linkage has the potential to be, at least in part,

responsible for falsely accusing individuals of crimes they did not commit (Snook, Luther, House, Bennell, & Taylor, 2012). Given these consequences, it is important to minimise as much as possible the potential for error in crime linkage decision making.

While there is a growing body of research focusing on the assumptions of crime linkage, the practice of crime linkage has been largely neglected by the academic literature (Rainbow, 2014). A handful of academic papers have outlined the different ways in which crime linkage can be conducted and the steps involved (e.g. Hazelwood & Warren, 2004; Labuschagne, 2006; Woodhams, Bull, & Hollin, 2007). The steps involved in conducting case linkage analysis (CLA), for example – the process through which an expert practitioner is given a series of crimes suspected as linked and asked to give an expert opinion as to linkage likelihood – are outlined in several publications (Hazelwood & Warren, 2004; Rainbow, 2014). Comparative case analysis (CCA) is another approach to conducting crime linkage (Burrell & Bull, 2011) and is often conducted reactively, whereby an index offence or series is taken as a reference point, and other possible crimes from the same series are searched for, often within a crime database (Woodhams, Bull, & et al., 2007). Woodhams, Bull, et al. (2007) also suggested that proactive CCA can be conducted, whereby large-scale crime databases are proactively searched for potential series already recorded within them. These approaches to crime linkage are conducted by different practitioners in different countries; for example, in Belgium most questions regarding both CLA and CCA are referred to one unit, the Zeden-Analyse-Moeurs (ZAM; translates as *sex offence analysis*) unit. In contrast, in the UK CLA is conducted by behavioural investigative advisers (BIAs; Rainbow, 2008), compared to other crime analysts in the UK who use CCA (Rainbow, 2008).

As alluded to above, in several countries around the world CCA and CLA may be supported by the use of large-scale databases. The most notable and widely used of these systems is the Violent Crime Linkage Analysis System (ViCLAS; Collins, Johnson, Choy, Davidson, & MacKay, 1998). ViCLAS is a computerised database that allows for information about sex offences to be coded into it in a standardised manner, such that analysts are then able to create searches to look for links between crimes. Today, ViCLAS is widely used around the world; as well as being used in Canada – its country of origin – it is also widely used in Europe, including Belgium, the Czech Republic, France, Germany, Ireland, the Netherlands, the UK, and Switzerland, as well as in New Zealand (Wilson & Bruer, n.d.).

There are a number of factors that must be considered when understanding how these types of databases can assist with the process of crime linkage, which are comprehensively outlined in Bennell, Snook, MacDonald, House, and Taylor's (2012) review. One fundamental consideration is that in order for analysts to use a computerised system like ViCLAS effectively to conduct crime linkage, information must be entered into the system in a reliable manner. Not only is reliable coding crucial to ensuring that crime linkage decision making is as accurate as possible, but it also has implications for its use in legal proceedings. In recent years, several courts in different countries have considered the reliability of the methods used to arrive at crime linkage decisions when ruling on its admissibility in legal proceedings. This would include consideration of the reliability of data entry into such systems. Examples of such cases include the State of New Jersey v. Fortin (2000) and the Thomas Ross Young appeal in Scotland (Thomas Ross Young v. Her Majesty's Advocate, 2013).

It is necessary to highlight here a fundamental difference in the manner in which information is coded into ViCLAS (Snook et al., 2012), which has the potential to affect coding reliability. In Canada, for example, the information is coded by police officers working in their local regions. Officers first obtain all the crime files, including the initial police reports and victim and witness statements; any material that may contain information pertinent to the case. The officers code all the relevant information into a paper ViCLAS booklet, and this booklet is then sent to a central unit. Here a quality assurance review of the booklet is conducted, before the information is entered into the computerised version of ViCLAS (Wilson & Bruer, n.d.). By contrast, in European countries, such as Belgium and the UK, the crime files of cases to be entered into ViCLAS are sent by officers to a centralised unit. Analysts working in these units then code and quality control the information, before conducting analyses on the data entered to search for potential links (Slater, Woodhams, & Hamilton-Giachritsis, 2015).

This key difference means that, in practical terms, the manner in which data are entered into ViCLAS is very different depending on the country using the system. All those using ViCLAS have access to the original Canadian Field Investigators' Guide (FIG) created alongside ViCLAS in order to assist with the coding process. In certain countries, such as the Netherlands, Belgium, and the UK, for example, an additional quality control (QC) guide has been created (De Sterck, personal communication, 2015). Similar to the FIG, these QC guides have been written by analysts working within centralised ViCLAS units, and help to avoid discrepancies in the coding process. (While it is understood that the RCMP have a similar QC guide, only those working in the central units and the ViCLAS coordinators in each police agency or department have access to it; second author, personal communication,

2016).

To further combat any coding discrepancies, as well as the introduction of QC guides, quality control processes have also been implemented in some countries. In Belgium, for example, once a case has been coded by an analyst, it is assessed by a second analyst who conducts a review of this coding, noting where their opinion differs with their colleague, and subsequently discussing any differences until a consensus is reached as to the most appropriate way of coding the information. The first analyst then modifies any of their initial coding as required (second author, personal communication, 2016). These decisions about coding discrepancies are subsequently recorded in the Belgian QC guide so that there is a precedent on how to code the information should that particular discrepancy arise again. While this process may not work in exactly the same way in other countries, other European countries do have equivalent quality control processes in place (De Sterck, personal communication, 2015). The UK, for example, have access to their own QC guide and a comparative quality control process, as well as a dedicated team who assess any new coding discrepancies (Slater et al., 2015).

#### Evaluating the interrater reliability of ViCLAS coding

As noted above, Bennell et al. (2012) have highlighted how establishing the interrater reliability of ViCLAS coding is an integral part of ensuring crime linkage best practice, and in previous research it has been measured in a number of ways. The simplest measure is the percentage agreement; the total percentage of times that two raters agree. It has been suggested that a more informative measure of interrater reliability is to measure the

percentage occurrence agreement (POA) – the percentage of times raters agree a variable is present – and the percentage non-occurrence agreement (PNOA) – the percentage of times raters agree a variable is absent (Snook et al., 2012). The POA has the advantage of not being inflated by high levels of missing data. In the context of ViCLAS, however, the importance of the PNOA should not be underestimated because adding information to ViCLAS that ought not to be present means that the case in question will erroneously come back in analysts' searches for that behaviour. Furthermore, analysts are able to search for absent behaviours as well as those present in a case (Kanora, personal communication, 2015), highlighting the importance of both the POA and PNOA. In terms of an acceptable threshold for the interrater reliability of ViCLAS, 80% agreement has been proposed in previous research (Snook et al., 2012), chosen because this has typically been deemed to be a level at which coded data can be relied on (Hartmann, 1977).

To date there have been two published articles evaluating the interrater reliability of ViCLAS coding, both conducted in Canada. Martineau and Corey (2008) asked 237 police officers to code either a fictitious sexual assault scenario or a fictitious murder scenario. They evaluated the interrater reliability of the coding using the percentage agreement, the POA, and the PNOA. While the results seemed promising when using the percentage agreement (87.70% for the sexual assault scenario; 79.30% for the murder scenario), the results were less encouraging when considering the measurements of POA and PNOA. In these cases, the PNOA results found were 68.80% in the sexual assault scenario and 54.67% in the murder scenario, and the POA results were even lower at 25.38% in the sexual assault scenario and 38.43% in the murder scenario. Furthermore, when looking at the interrater reliability of individual sections, the results dropped to as low as a POA of 3.74% in the scene section (homicide scenario), and a PNOA of 1.19% in the weapon section (sexual assault scenario).

More recently, Snook et al. (2012) published a second study on the interrater reliability of ViCLAS coding. In this paper, 10 police officers were asked to code a ViCLAS booklet based on real criminal case materials. Despite the reduced sample size, the ecological validity of this study was much improved by the use of real and more detailed case materials than used in Martineau and Corey's (2008) study. The POA scores for each section were generated, as well as assessing the number of variables within each section that reached an acceptable threshold of 80%, although the PNOA was not calculated. Snook et al. (2012) also found a low POA of 30.77% overall, with scores ranging from 62.87% across the five variables that constituted the administration section, to 2.36% across the five variables in the weapon section. Snook et al. (2012) proposed a number of reasons for such low figures, in particular the participants' unfamiliarity with the task, and the fact that coding ViCLAS may be an inherently difficult task.

### The current study

While these studies provide a good basis for the study of the interrater reliability of ViCLAS coding, they possess a number of limitations that the current study aimed to rectify. First, all existing research has been conducted in Canada and, as such, the findings may not generalise to other countries because of the notable differences in coding practice as discussed above. This study was the first of its kind to expand research of the interrater reliability of ViCLAS coding to one of the European countries that uses ViCLAS in a centralised unit, specifically, Belgium. Second, the ecological validity of Martineau and Corey's (2008) study was diminished by the use of mock cases that participants were given to

code. The current study followed the lead of Snook et al. (2012) and gave participants real cases to code. Third, the ecological validity of both previous studies was diminished due to participants being taken out of their usual working environment to complete the coding task and being given an allotted time period in which to complete the coding. In reality, such coding would be undertaken as part of a larger workload, with other tasks placing demands on analysts and with the added pressure of external distractions. The ecological validity of this study was increased by asking participants to code the test cases during their usual working hours, rather than giving participants a dedicated amount of time to complete the coding, thereby simulating as closely as possible participants' usual working conditions.

A final limitation of previous research was the number of cases that participants were required to code. In asking participants to code only one case (Snook et al., 2012), conclusions cannot be drawn as to the reason why interrater reliability of particular ViCLAS questions or sections was low or high. While Martineau and Corey (2008) asked participants to code two cases, they related to different crime types, again preventing such questions from being answered with any certainty. In the current study, participants were asked to code four real cases of sexual assault. By analysing the interrater reliability of the coding of several cases, a more reliable assessment of the interrater reliability of ViCLAS coding could be conducted. It was also possible to assess whether high and low levels of interrater reliability were observed across the same sections of questions in each of the cases, highlighting potential problems with particular areas of the ViCLAS coding scheme.

To summarise, the aim of this study was to assess the interrater reliability of ViCLAS coding by analysts in Belgium. To enable comparisons of the findings of this study with those conducted previously, this study followed Snook et al.'s (2012) and Martineau and Corey's

(2008) methodology in the calculation of the POA for each variable, section, and case as a whole. This study also calculated the PNOA, as in Martineau and Corey's (2008) study, for reasons outlined earlier. Finally, the number of variables whose coding reached an 80% level of acceptability were also assessed, in order for comparisons to be made with Snook et al.'s (2012) calculations, as well as the number of variables reaching a 70% acceptability threshold. It also aimed to investigate in more detail the particular sections of ViCLAS that were particularly well or poorly coded, in order to begin to hypothesise about the reasons for any discrepancies in coding.

## Method

### Participants

Participants were recruited through the ZAM unit of the Belgian Federal Police. The requirements of the study were that participants utilised ViCLAS as part of their daily responsibilities, and had worked in the unit for at least three years, in order to ensure a degree of familiarity with the system. At the time of conducting the study, the unit was comprised of 12 employees; one manager and one administrator, both of whom do not code information into ViCLAS, as well as eight analysts and two trainees. All eight analysts met the requirements for participation, and all eight agreed to take part. The participants' first languages were both French and Dutch, and all participants spoke both languages to at least a competent degree. This was assessed by determining whether participants routinely worked in both languages, all of whom did. The primary researcher gave a presentation on the study in order for the analysts to decide whether or not they would like to participate; this was given in French, with the second author available to translate into Dutch if necessary. It was stressed that participation was completely voluntary, that individual performance would be kept confidential, and that the study was not being conducted as part of an evaluation into their performance.

### Materials

The participants were asked to code four case files, all of which had been sent to the unit by police officers at the time of the study being conducted. When cases are usually sent to the unit, they are read by an analyst who makes an initial decision as to whether it meets the criteria for ViCLAS entry. Cases that are considered suitable for ViCLAS entry in Belgium are all rapes (the definition of which in this country is any sexually penetrative act, of whatever sort and by whatever means, committed against anyone who does not consent; Article 375 of the Penal Code, 1867), as well as cases of sexual assault that are considered by the reviewing analyst to be particularly unusual or violent (De Sterck, personal communication, 2015). If the analyst believes the case should be entered into the system it is sent to the manager, who verifies this decision before creating a new file on ViCLAS for the case. The case papers are then given back to the original analyst who codes the information in the case file into the computerised version of ViCLAS.

The cases used in this study went through the usual process to ensure they met ZAM's criteria for entry into ViCLAS; however, rather than giving the cases back to the analysts, the manager passed them to the primary researcher to verify they were suitable for the study. The only additional criteria imposed by the researchers were that a) it was required that between the four cases some behaviour in all of the ViCLAS sections was present; and b) that all of the cases were completed incidents of rape. These additional criteria were imposed to ensure there was sufficient information in the files for participants to code and for the study's proposed analyses. Finally, two cases written in French and two cases written in Dutch were chosen. This was done to mitigate any language differences between the analysts; in this way, all analysts coded two cases in their first language, and two in their second.

The implication of this selection process was that, for each of the case files, one analyst would have read the information through once before the study commenced. It wasn't considered, however, that this would give these analysts any significant advantage over the other participants, considering a) the time delay of several weeks between this initial read through and subsequent coding; and b) that all analysts were given unlimited access to the case papers for the duration of the study (as is usual when coding cases in ZAM), meaning they could re-read them as many times as they wished.

Belgium uses ViCLAS version 4.0, which contains 156 questions that are divided into 11 sections: administration; victim; offender; additional names; vehicle; scene; additional locations; offence; if victim died or was left for dead; weapon; and additional information. The four cases contained varying amounts of information in each of the sections; for example, two had known suspects, and therefore more offender information, while for two there was no known suspect. Two contained details of a weapon, and three of a vehicle. Despite best efforts, no suitable cases were sent to the unit at the time of the study that contained information to be coded into the if victim died or was left for dead section and the additional locations sections. These sections were, however, still represented in the PNOA results.

Under normal circumstances the analysts would code the case files directly into the computer system, but the duplication of the cases entered as part of this study would have caused technical issues. Instead, participants were given four blank paper copies of the ViCLAS booklet. The researchers modified this paper booklet slightly to ensure it accurately represented the questions and possible answers within the computerised ViCLAS 4.0 version. Coding guidelines in either French or Dutch were given to analysts (according to their first

language) along with these paper ViCLAS booklets to ensure their coding process was as similar as possible to their usual process (see Appendix 1 for an English translation of these guidelines).

### Procedure

The researchers made every attempt to conduct the study according to the normal working conditions of the analysts. In addition to the steps taken above, normal working conditions were mimicked by allowing participants their usual access to the Canadian ViCLAS manual (supplied in French, and also translated by the unit into Dutch), as well as the French and Dutch copies of the units' own QC guide. The analysts were also permitted to access whichever additional databases they routinely use to gather further information about a case. Examples of this include searching for full details of a car on their vehicle registration database where a vehicle registration plate was given in a case file, or details of employment and living circumstances of both the offender and victim on their national registry database. In accordance with usual turnaround times (De Sterck, personal communication, 2015), participants were given three weeks from the date of receiving the files to complete the coding process. The only difference to the analysts' usual coding process was that participants were explicitly asked not to confer with their colleagues about the cases. Once participants had completed coding the four cases they were asked to return the cases and completed ViCLAS booklets to the primary researcher.

### Calculations

The POA and PNOA were generated for each of the 156 variables when information was available for each ViCLAS section, for each case as a whole, and across the four cases. To calculate the POA, the number of times there was agreement on the presence of a variable was ascertained. This was then divided by the number of pairs where at least one participant had noted the presence of the variable. (Where participants had both agreed the variable was not present, this pair was disregarded as it counted as a non-occurrence agreement.) Finally, the figure was multiplied by 100 to create a percentage. The same process, but measuring non-occurrence, was used to calculate the PNOA. Where sub-variables existed, the POA and PNOA was calculated for the variable as a whole, including all sub-variables. Previous studies have also investigated how many variables' POA scores in each section reached an acceptable reliability threshold (Snook et al., 2012), using a cut-off of 80% as an acceptable threshold of agreement (Hartmann, 1977). Other researchers, however, have outlined alternative levels of acceptability; Kelly (1977) chose to use a threshold of 90%, while others have suggested using a threshold of 70% (Skindrud, 1972, as cited in Patterson, 1977, p. 317). Given that the measurements of POA and PNOA are somewhat stricter than the overall percentage agreement, 70% was adopted as a threshold for acceptable POA and PNOA in this study. While Snook et al. (2012) are absolutely correct in their assertion that the potential gravity of inferences drawn from ViCLAS necessitate a high threshold for acceptable reliability, as outlined above, the initial coding into ViCLAS in Belgium is only the first step of the overall coding process (which is followed by a quality control process and any subsequent amendments to the coding). As such, for the first stage, 70% was proposed here to be a suitable cut-off point. Finally, due to the number of analysts taking part in the current study, if only one participant's answers deviated from the other analysts, this would result in a POA or PNOA score of 79%. Perfect interrater reliability would, therefore, be required to

meet an 80% threshold for acceptable interrater reliability. While it was decided in this study to calculate the number of variables reaching the threshold of 70% in this paper, the number of variables reaching a threshold of 80% was also calculated, in order for these results to be directly comparable to previous research.

The number of variables included in each case are detailed in the results section to demonstrate the amount (or lack) of data that can be present in the case papers that analysts work with. The only variables that were removed from the analyses were as follows; a) one pertaining to the identities of the analysts; b) two administrative variables that are entered by the manager of the unit when creating a new file on ViCLAS, and not the analysts themselves; c) the two questions detailing the apparent ages of victim and offender, when analysts were not required to manually generate or override existing information<sup>1</sup>; d) one question regarding area of vehicle registration, as this information is never available to analysts in Belgium; and e) the two summary variables. These last two variables were excluded in order that this study's methodology was as comparable to previous studies' as possible; this meant that only one variable (the presence of biological samples) was present for analysis in the additional information section. Any time information about a country had to be entered into ViCLAS (as part of an address, for example), it was also not counted in the calculations of POA and PNOA<sup>2</sup>. The only other differences to previous research were that

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<sup>1</sup> The apparent ages of the offender and victim are generated automatically when a date of birth is entered into ViCLAS. If, therefore, the analyst has a date of birth to enter, the apparent age will be automatically completed, and there will be no need for the analyst to change this information. The only times an analyst would need to manually complete these variables is if a) there is no offender or victim date of birth but a description has been given which includes an apparent age; or b) if a date of birth is present, but a description of either the victim or offender has specified that their apparent age is different to that of their actual age, e.g. an offender looks 18 years old when, in fact, they are 30 years old. In either of these instances an analyst would need to manually enter or change the apparent age variables.

<sup>2</sup> Country in itself is not a variable on ViCLAS, only part of a variable, and the general consensus in ZAM is that the country field is always left blank unless the answer is anything other than 'Belgium' (as in the majority of cases 'Belgium' is the only answer entered; second author, personal communication, 2016). In the cases selected for this study, 'Belgium' was the only relevant information available for entry into ViCLAS, and as such the field was always left blank.

details about any weapon use are recorded under one instead of five questions on the computerised version of ViCLAS 4.0, and that additional locations and additional names sections were analysed separately, as these are counted as sections in their own right on the computerised version of ViCLAS 4.0. The additional information section in this study is comparable to what Snook et al. (2012) call the summary section, and Martineau and Corey's (2008) biological sample section.

While ViCLAS questions often consist of a yes/no or multiple choice response, it is worth noting that many of the questions demand free text responses. The information requested can be relatively simple, such as names and addresses, or more complex, such as providing summaries of the offender's speech. For the free text questions, the methodology of previous research was followed; the content of each answer was analysed and compared with the information in the case files, then each answer was coded according to the presence of the correct information. For example, if a description of an item of clothing was required (e.g. jeans), the analysts' answers were assessed, and the correct information (i.e. those analysts who wrote 'jeans') was coded as present. (A discussion of how information is judged to be correct follows later, as this is not necessarily a straightforward task.) Previous studies (Martineau & Corey, 2008; Snook et al., 2012) did not detail how incorrect answers given in free text questions were coded. In this study, in these circumstances any incorrect answers were disregarded in calculating the POA because the analysts were not agreeing on one answer. The calculation of the PNOA was more straightforward; any answer counted as an occurrence, so only when no answer (right or wrong) was listed did this count as a non-occurrence. If analysts wrote the correct information and extra information in the free text boxes, this was coded as both present and correct (the extra information was essentially disregarded). Two questions relating to victim resistance/offender reaction require analysts to

record the chronology of behaviours (i.e. list the behaviours in the order in which they occurred). While the presence or absence of any information given was recorded, it was beyond the scope of this study to explore the details of the chronological ordering of behaviour.

In order to assess the consistency of coding across the four cases, variables were labelled according to whether their POA and PNOA coding levels had reached 70% in all four cases (high), in no cases (low), or some but not all cases (mixed). Variables were excluded if they had not been coded in any of the cases, or only coded in one case (meaning no comparison to another case or cases could be made). To compare the results found in this study to previous research's results, the mean POA scores across each section and overall were compared to both Martineau and Corey's (2008) sexual assault scenario results and Snook et al.'s (2012) results. The mean PNOA scores across each section and overall were also compared to those found in Martineau and Corey's (2008) sexual assault scenario, and the number of variables reaching the 80% acceptability threshold were compared to those found in Snook et al.'s (2012) study.

## Results

### Numbers of variables used in each of the cases

Table 1 shows the amount of information that was available in each case. A variable was included in the calculation of the POA if at least one analyst entered information for that variable. A variable was included in the calculation of the PNOA if at least one analyst had entered no information for that variable.

The average number of variables coded by at least one analyst was 87 out of a possible 144 variables (or out of 146 in the case of case four where the apparent age variables were relevant).<sup>3</sup>

*Table 1. The number of variables used in POA and PNOA calculations in all four cases*

<b>Case number</b>	<b>Number of variables used – POA</b>	<b>Number of variables used – PNOA</b>
<b>1</b>	66.00	138.00
<b>2</b>	87.00	139.00
<b>3</b>	103.00	137.00
<b>4</b>	92.00	139.00
<b>MEAN</b>	<b>87.00</b>	<b>138.25</b>

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<sup>3</sup> While there are officially 156 questions in ViCLAS 4.0, it became apparent during analyses that the numbering of some of these questions (using a, b, c etc. as opposed to numerical values) meant that some numerical values were ‘missing’ and as such, for the purposes of this study only 146 variables were counted.

### Average interrater reliability across the four cases, by POA and PNOA

The POA and PNOA scores found in each of the four cases were combined to create overall mean POA and PNOA scores for each section and in total. The range and mean percentage of variables reaching the 70% and 80% reliability thresholds were also calculated for each section and in total. The mean total POA and PNOA scores and the mean numbers of variables reaching the acceptability thresholds were calculated using the individual variable totals, not the mean of section totals. Tables 2 and 3 outline the overall calculations; the individual case results can be found in Appendix 2.

The total POA score across all four cases was 55.80%, with section POA scores ranging from 10.71% for the additional names section to 78.50% for the administration section. The POA scores ranged from 0.00% to 100.00%. The percentage of variables reaching the 80% reliability threshold was 31.90%; a higher proportion of variables, 40.23%, reached the 70% threshold. The total PNOA score across all four cases was 88.99%, with section PNOA scores ranging from 57.92% for the additional information section to 100.00% for the if victim died section. The PNOA scores also ranged from 0.00% to 100.00%. The percentage of variables reaching the 80% reliability threshold was 79.02%; again, a higher proportion of variables, 86.08%, reached the 70% threshold.

In terms of the individual cases, the total POA scores ranged from 51.60% (case three) to 64.80% (case one). The highest POA score of 89.02% was found in case two for the administration section. The lowest POA score of 7.54% was found for case four in the vehicle section. In terms of the number of variables reaching the 70% acceptability threshold, 46.97% of variables reached this threshold in case one, 40.23% in case two, 33.98% in case

three, and 42.39% in case four. Looking in more detail, the greatest number of variables reaching this threshold were found in the administration section of case two (87.50%), while no variables reached this threshold in the weapon sections of cases two and four, the additional names and vehicle section of case four, and all of the additional information sections. It is worth noting that the additional names, weapon, and additional information sections only contain one variable each.

The total PNOA scores for the individual cases ranged from 87.02% (case two) to 92.25% (case one). The highest PNOA score of 100.00% was found for 13 sections across the four cases, with the lowest PNOA score of 37.67% found for the additional information section of case four. In terms of the number of variables reaching the 70% acceptability threshold, 89.86% of variables reached this threshold in case one, 82.73% in case two, 83.21% in case three, and 88.49% in case four. All variables reached the 70% threshold for 19 of the individual sections, while no variables reached this threshold in the additional information sections of cases three and four. Again, however, it is worth noting that this section only contains one variable.

*Table 2. The mean POA scores and mean number of variables reaching 70% and 80% agreement across all four cases*

<b>Section</b>	<b>Mean number of variables</b>	<b>Mean POA</b>	<b>Range of POA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	7.75	78.50	24.50-100.00	5.25	67.74	4.75	61.29
<b>Victim</b>	17.25	51.52	0.00-100.00	6.25	36.23	5.75	33.33
<b>Offender</b>	21.75	61.08	0.00-100.00	10.50	48.27	7.25	33.33
<b>Add. Names</b>	0.25	10.71	10.71	0.00	0.00	0.00	0.00
<b>Vehicle</b>	9.25	34.22	0.00-100.00	2.67	28.86	2.00	21.62
<b>Scene</b>	7.00	60.34	0.00-100.00	3.00	42.86	2.00	28.57
<b>Add. Locations</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	22.25	54.60	0.00-100.00	8.00	35.96	6.50	29.21
<b>If victim died</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	0.50	58.20	49.50-66.89	0.00	0.00	0.00	0.00
<b>Add. Information</b>	1.00	43.31	31.50-69.33	0.00	0.00	0.00	0.00
<b>TOTAL</b>	<b>87.00</b>	<b>55.80</b>	<b>0.00-100.00</b>	<b>35.00</b>	<b>40.23</b>	<b>27.75</b>	<b>31.90</b>

*Table 3. The mean PNOA scores and mean number of variables reaching 70% and 80% agreement across all four cases*

<b>Section</b>	<b>Mean number of variables</b>	<b>Mean PNOA</b>	<b>Range of PNOA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	6.25	75.14	8.00-100.00	3.75	60.00	3.75	60.00
<b>Victim</b>	22.00	89.33	0.00-100.00	19.25	87.50	18.25	82.95
<b>Offender</b>	36.50	91.51	0.00-100.00	33.25	91.10	30.75	84.25
<b>Add. Names</b>	1.00	93.41	73.63-100.00	1.00	100.00	0.75	75.00
<b>Vehicle</b>	14.50	83.99	8.00-100.00	10.75	74.14	10.25	70.69
<b>Scene</b>	7.25	77.55	19.00-100.00	4.75	65.52	4.00	55.17
<b>Add. Locations</b>	1.00	97.05	88.19-100.00	1.00	100.00	1.00	100.00
<b>Offence</b>	38.75	90.07	2.00-100.00	34.75	89.68	30.50	78.71
<b>If victim died</b>	9.00	100.00	100.00	9.00	100.00	9.00	100.00
<b>Weapon</b>	1.00	97.11	93.51-100.00	1.00	100.00	1.00	100.00
<b>Add. Information</b>	1.00	57.92	37.67-78.00	0.50	50.00	0.00	0.00
<b>TOTAL</b>	<b>138.25</b>	<b>88.99</b>	<b>0.00-100.00</b>	<b>119.00</b>	<b>86.08</b>	<b>109.25</b>	<b>79.02</b>

*Table 4. Number of variables' POA scores reaching the 70% threshold across all four cases*

<b>Section</b>	<b>Total number of variables</b>	<b>No. variables with high levels of consistency</b>	<b>% variables with high levels of consistency*</b>	<b>No. variables with mixed levels of consistency</b>	<b>% variables with mixed levels of consistency*</b>	<b>No. variables with low levels of consistency</b>	<b>% variables with low levels of consistency*</b>
<b>Administration</b>	8.00	3.00	37.50	4.00	50.00	1.00	12.50
<b>Victim</b>	19.00	3.00	15.79	9.00	47.37	7.00	36.84
<b>Offender</b>	27.00	6.00	22.22	13.00	48.15	8.00	29.63
<b>Add. Names</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Vehicle</b>	12.00	0.00	0.00	6.00	50.00	6.00	50.00
<b>Scene</b>	7.00	1.00	14.29	4.00	57.14	2.00	28.57
<b>Add. Locations</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	24.00	0.00	00.00	16.00	66.67	8.00	33.33
<b>If victim died</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	1.00	0.00	0.00	0.00	0.00	1.00	100.00
<b>Add. Information</b>	1.00	0.00	0.00	0.00	0.00	1.00	100.00
<b>TOTAL</b>	<b>99.00</b>	<b>13.00</b>	<b>13.13</b>	<b>55.00</b>	<b>55.56</b>	<b>34.00</b>	<b>34.34</b>

\* Due to rounding up/down percentage totals may not equal 100.

*Table 5. Number of variables' PNOA scores reaching the 70% threshold across all four cases*

<b>Section</b>	<b>Total number of variables</b>	<b>No. variables with high levels of consistency</b>	<b>% variables with high levels of consistency*</b>	<b>No. variables with mixed levels of consistency</b>	<b>% variables with mixed levels of consistency*</b>	<b>No. variables with low levels of consistency</b>	<b>% variables with low levels of consistency*</b>
<b>Administration</b>	6.00	3.00	50.00	1.00	16.67	2.00	33.33
<b>Victim</b>	22.00	16.00	72.73	5.00	22.73	1.00	4.55
<b>Offender</b>	37.00	31.00	83.78	4.00	10.81	2.00	5.41
<b>Add. Names</b>	1.00	1.00	100.00	0.00	0.00	0.00	0.00
<b>Vehicle</b>	15.00	7.00	46.67	8.00	53.33	0.00	0.00
<b>Scene</b>	7.00	3.00	42.86	3.00	42.86	1.00	14.29
<b>Add. Locations</b>	1.00	1.00	100.00	0.00	0.00	0.00	0.00
<b>Offence</b>	39.00	31.00	79.49	7.00	17.95	1.00	2.56
<b>If victim died</b>	9.00	9.00	100.00	0.00	0.00	0.00	0.00
<b>Weapon</b>	1.00	1.00	100.00	0.00	0.00	0.00	0.00
<b>Add. Information</b>	1.00	0.00	0.00	1.00	100.00	0.00	0.00
<b>TOTAL</b>	<b>139.00</b>	<b>103.00</b>	<b>74.10</b>	<b>29.00</b>	<b>20.86</b>	<b>7.00</b>	<b>5.04</b>

\* Due to rounding up/down percentage totals may not equal 100.

### The consistency of coding across the four cases

Tables 4 and 5 highlight the number of variables in each section that consistently reached the 70% acceptability threshold. Overall in terms of POA scores, 13.13% of variables consistently reached the 70% threshold, with the highest level of consistency of 37.50% found in the administration section. Looking at the PNOA scores, 74.10% of variables consistently reached the 70% threshold. All variables consistently reached this threshold in the additional names, additional locations, if victim died, and weapon sections.

### A comparison of the POA and PNOA results with previous research

Tables 6, 7, and 8 directly compare the POA and PNOA scores found in this study, for both individual cases and the mean across all four cases, to previous ViCLAS interrater reliability studies where available. The number of variables in this study that reached the 80% acceptability threshold were also compared to the number of variables reaching this threshold in Snook et al.'s (2012) study.

All POA scores were higher in this study in comparison to both previous studies, with the exception of the vehicle section score in case four (7.54%; although the mean score across all four cases was higher at 34.22% compared to Snook et al.'s (2012) study at 11.21%), and all of the weapon section scores in comparison to Martineau and Corey's (2008) study (93.93%), but not Snook et al.'s (2012) study (2.36%). The majority of the PNOA scores were also higher than in previous research, with the exception of the administration section score in case one (61.10%; although again, the mean score across all four cases was higher at

75.14% compared to Martineau and Corey's (2008) study at 68.97%), and all of the scene section and additional information section scores. In terms of the percentage of variables reaching the 80% threshold, no variables in the vehicle section in case four, the weapon sections, or additional information sections achieved this, as in Snook et al.'s (2012) study, nor did the variables in the additional names section of case four. No variables reached the 80% threshold in the scene section of case three, which was lower than the 22.22% of variables reaching this in Snook et al.'s (2012) study, although the mean percentage of variables reaching this threshold in the scene section in this study was higher at 28.57%. All other percentages of variables reaching the 80% threshold were higher in this study than in previous research.

*Table 6. The mean POA scores of the individual cases and the mean across all four cases, compared to previous studies*

<b>Section</b>	<b>Martineau and Corey (2008)<sup>x</sup> mean POA results</b>	<b>Snook et al. (2012) mean POA results</b>	<b>Mean POA results across cases</b>	<b>Case 1 mean POA results</b>	<b>Case 2 mean POA results</b>	<b>Case 3 mean POA results</b>	<b>Case 4 mean POA results</b>
<b>Administration</b>	24.50 (7.00)	62.87 (5.00)	78.50	66.77	89.02	84.39	72.33
<b>Victim</b>	17.96 (22.00)	40.86 (14.00)	51.52	48.54	47.80	45.64	61.24
<b>Offender</b>	13.28 (39.00)	37.93 (30.00)	61.08	73.45	53.35	52.65	76.39
<b>Add. Names</b>	<i>n/a</i>	<i>n/a</i>	10.71	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	10.71
<b>Vehicle</b>	<i>n/a</i>	11.21 (6.00)	34.22	<i>n/a</i>	35.90	57.30	7.54
<b>Scene</b>	10.08 (8.00)	40.19 (9.00)	60.34	68.50	66.95	53.39	54.67
<b>Add. Locations</b>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	12.85 (36.00)	21.78 (36.00)	54.60	71.24	51.91	41.81	57.54
<b>If victim died</b>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	93.93 (5.00)	2.36 (5.00)	58.20	<i>n/a</i>	49.50	<i>n/a</i>	66.89
<b>Add. Information</b>	5.09 (1.00)	12.50 (1.00)	43.31	69.33	31.50	32.40	40.00
<b>TOTAL</b>	<b>25.38 (118.00)</b>	<b>30.77 (106.00)</b>	<b>55.80 (87.00)</b>	<b>64.80 (66.00)</b>	<b>53.93 (87.00)</b>	<b>51.60 (103.00)</b>	<b>55.82 (92.00)</b>

<sup>x</sup> Martineau and Corey's (2008) sexual assault scenario results used.

The number of variables used by previous studies and the total number of variables are shown in brackets.

*Table 7. The mean PNOA scores of the individual cases and the mean across all four cases, compared to previous studies*

<b>Section</b>	<b>Martineau and Corey (2008)<sup>x</sup> mean PNOA results</b>	<b>Mean PNOA results across cases</b>	<b>Case 1 mean PNOA results</b>	<b>Case 2 mean PNOA results</b>	<b>Case 3 mean PNOA results</b>	<b>Case 4 mean PNOA results</b>
<b>Administration</b>	68.97 (7.00)	75.14	61.10	77.31	84.63	79.89
<b>Victim</b>	79.63 (22.00)	89.33	87.59	93.41	92.86	83.45
<b>Offender</b>	83.41 (39.00)	91.51	95.84	87.59	88.99	93.68
<b>Add. Names</b>	<i>n/a</i>	93.41	100.00	100.00	100.00	73.63
<b>Vehicle</b>	<i>n/a</i>	83.99	100.00	74.05	75.51	85.26
<b>Scene</b>	87.18 (8.00)	77.55	77.32	80.40	74.70	78.19
<b>Add. Locations</b>	<i>n/a</i>	97.05	88.19	100.00	100.00	100.00
<b>Offence</b>	79.80 (36.00)	90.07	95.21	87.07	86.71	91.41
<b>If victim died</b>	<i>n/a</i>	100.00	100.00	100.00	100.00	100.00
<b>Weapon</b>	1.19 (5.00)	97.11	100.00	93.51	100.00	94.94
<b>Add. Information</b>	81.45 (1.00)	57.92	78.00	73.33	42.67	37.67
<b>TOTAL</b>	<b>68.80 (118.00)</b>	<b>88.99 (138.25)</b>	<b>92.25 (138.00)</b>	<b>87.02 (139.00)</b>	<b>87.65 (137.00)</b>	<b>89.03 (139.00)</b>

<sup>x</sup> Martineau's sexual assault scenario results used.

The number of variables used by previous studies and the total number of variables are shown in brackets.

*Table 8. The percentage of POA scores reaching 80% thresholds, compared to previous studies*

<b>Section</b>	<b>Snook et al. (2012) % variables at 80%</b>	<b>Mean % variables at 80%</b>	<b>% case 1 variables at 80%</b>	<b>% case 2 variables at 80%</b>	<b>% case 3 variables at 80%</b>	<b>% case 4 variables at 80%</b>
<b>Administration</b>	20.00 (1.00)	61.29 (4.75)	42.86 (3.00)	87.50 (7.00)	75.00 (6.00)	37.50 (3.00)
<b>Victim</b>	21.43 (3.00)	33.33 (5.75)	33.33 (6.00)	33.33 (4.00)	33.33 (6.00)	33.33 (7.00)
<b>Offender</b>	13.33 (4.00)	33.33 (7.25)	60.00 (9.00)	19.23 (5.00)	27.59 (8.00)	41.18 (7.00)
<b>Add. Names</b>	<i>n/a</i>	0.00 (0.00)	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	0.00 (0.00)
<b>Vehicle</b>	0.00 (0.00)	21.62 (2.00)	<i>n/a</i>	16.67 (2.00)	30.77 (4.00)	0.00 (0.00)
<b>Scene</b>	22.22 (2.00)	28.57 (2.00)	50.00 (3.00)	28.57 (2.00)	0.00 (0.00)	42.86 (3.00)
<b>Add. Locations</b>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	2.78 (1.00)	29.21 (6.50)	42.11 (8.00)	30.00 (6.00)	11.54 (3.00)	37.50 (9.00)
<b>If victim died</b>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	0.00 (0.00)	0.00 (0.00)	<i>n/a</i>	0.00 (0.00)	<i>n/a</i>	0.00 (0.00)
<b>Add. information</b>	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
<b>TOTAL</b>	<b>10.38 (11.00)</b>	<b>31.90 (27.75)</b>	<b>43.94 (29.00)</b>	<b>29.89 (26.00)</b>	<b>26.21 (27.00)</b>	<b>31.52 (29.00)</b>

## Discussion

The purpose of this study was to assess the interrater reliability of ViCLAS coding in Belgium. It was designed to replicate previous research in order to investigate any potential differences in results found in Belgium, compared to results found in previous studies conducted in Canada. Crucially, however, this study was novel in that analysts coded four cases, thus enabling assessment of the consistency of coding reliability across a number of different cases and with regards to different sections of ViCLAS.

### An explanation of the results

The overall results show a relatively reliable level of coding across cases in terms of both the POA scores (from an overall score of 51.60% to 64.80%) and the PNOA scores (from an overall score of 87.02% to 92.25%). Just over 40.00% of variables reached the 70% reliability threshold in terms of the POA scores, and this figure was just over 86.00% for the PNOA scores. While the overall level of reliability appeared relatively consistent across the four cases, the POA scores were much more variable from one ViCLAS section to the next. It is worth noting here that the POA can be quite a strict measure of interrater reliability, because if one person erroneously adds information to a question that should have been left blank, this represents 0.00% interrater reliability (the same is true of the PNOA for questions where one analyst has not entered data). This could explain why the percentages are so variable, many of them ranging from 0.00% to 100.00% for both the POA and the PNOA.

In terms of coding consistency across sections, the POA results were quite varied. The administration section, for example, seemed to be coded quite consistently well, with 37.50% of its variables coded consistently at the 70% threshold, and 50.00% coded at least partially at or above this level. By contrast, the weapon and additional information sections contained no variables that were coded consistently highly (although as noted above, both of these sections contain only one variable each). For the PNOA results, the additional names, additional locations, if victim died, and weapon sections were all coded consistently at 70% or above, with more than 70.00% of the variables in the victim, offender, and offence sections consistently reaching this threshold. While this increased coding reliability for the PNOA results is no surprise given there are typically more occasions when ViCLAS questions will be left blank as opposed to being filled in, incorrectly including information has already been suggested as problematic in terms of affecting analysts' searches for potential links, so the fact that good PNOA levels are seen here should not be overlooked. While calculated, further details of where the coding of each variable was consistently good or poor couldn't be reported in this study due to the sensitivity surrounding the disclosure of particular ViCLAS questions.

The vast majority of the results across all four cases, overall and across sections, were higher than in previous research. This is true of both the POA results in comparison to Martineau and Corey's (2008) study and Snook et al.'s (2012) study, the PNOA results in comparison to Martineau and Corey's (2008) study, and the percentage of variables reaching the 80% acceptability threshold in comparison to Snook et al.'s (2012) study. These results were found under more ecologically valid conditions, with potentially more complexities in the coding process than in previous studies, such as the participants balancing other workloads with the coding required by the study, and the sourcing of extra information from

other police databases. (While it could be argued that this last factor may lead to increased agreement if different analysts refer to the same external sources, the additional workload that this demands of the analyst was considered in this instance as a hindrance to the coding process, rather than a help.)

It is vital to note that much of the coding falls short of the 70% acceptability threshold, although the results in general give a more positive impression of the interrater reliability of ViCLAS coding, at least in Belgium. The reasons for the discrepancies seen in this coding are discussed below, but crucially, as noted above, these results represent the interrater reliability at the end of only the first part of the coding process. In Belgium, there is a quality control process which is designed expressly to combat any coding discrepancies, and it is reasonable to expect that at the end of the whole coding process (i.e. after quality control), even more of these variables may reach an acceptable level of interrater reliability. This, however, has yet to be empirically tested.

Snook et al. (2012) outlined a number of reasons why the interrater reliability of ViCLAS may have been so low in their study. By referring to these explanations, it is possible to speculate as to why an improvement has been observed in this study's results, and how further improvements could be made. First, participant boredom or perceived unimportance of the task was suggested as impacting on performance. While it could be argued that academic studies will never generate the same level of importance and motivation found in 'real life' tasks, it is likely that the participants' motivation in this study may have been higher which may have had a positive impact on the results. First, real cases were used that would subsequently need to be coded into ViCLAS by one of the participating analysts, perhaps motivating them to consider how they would code these cases in 'real life'. Second,

as analysts working on a daily basis with ViCLAS, it may have been easier for them to see a personal benefit and impact on their working lives in research designed to understand and evaluate the system. On the other hand, analysts were not asked to devote a set amount of time to coding the cases for this study, and other work may have served as a distraction which could have contributed to lowering interrater reliability scores.

The second explanation that Snook et al. (2012) gave was a lack of familiarity with the case materials. This explanation seems unlikely to provide an account for the difference in results, as the analysts in this study were similarly unfamiliar with the case materials (with the exception of the analyst who would have originally read the case to see if it was suitable for ViCLAS entry). In the current study the analysts may have had longer with the case materials, however, participants in Martineau and Corey's (2008) study were given 10 days to code their case materials, and participants in Snook et al. (2012) were also allowed to work at their own pace, with continued access to the case papers.

Another potential explanation Snook et al. (2012) gave for the low interrater reliability results found was that coding such a large amount of information is naturally difficult. The analysts working within a centralised ViCLAS unit will have more familiarity with the task of coding ViCLAS, and this may help to explain the improved results found in this study. There is evidence to suggest that participants more effectively deal with tasks with a high cognitive load when their expertise in the task increases (van Merriënboer & Sweller, 2005). This factor may go some way to explaining why analysts working with ViCLAS on a daily basis within a centralised unit may demonstrate better interrater reliability than officers unused to coding information into ViCLAS.

Snook et al.'s (2012) fourth point is that participants in their study may have performed poorly because of their unfamiliarity with ViCLAS itself. They reported that many of their participants had not used ViCLAS since they undertook an initial ViCLAS training course, and some reported having not received any ViCLAS training at all. Given the Belgian analysts' daily exposure to the system and their consequent expertise with ViCLAS, it seems reasonable to suggest that this may well be a major contributing factor as to why they demonstrated better interrater reliability than previous studies. It is important to note that Martineau and Corey (2008) found no significant impact of training on interrater reliability performance, although their sample did not include participants that worked with ViCLAS to the same extent that participants in the current study do. An effect of training may be found if a sample compared those not familiar with using ViCLAS to analysts with the expertise of working within a centralised unit.

The final explanation posited by Snook et al. (2012) is that the coding task itself is difficult. ViCLAS requires the coder to consider, not only the logistical information of a crime, but also the complexities of human behaviour and of the behavioural interaction between the parties involved in the crime. The analysts in this study who work with ViCLAS daily did not achieve 100% interrater reliability, demonstrating just how difficult this task may be. The improved interrater reliability demonstrated in this study would seem to suggest that utilising ViCLAS is a complex process and requires a high level of expertise. The analysts in Belgium not only receive extensive training (De Sterck, personal communication, 2015), but also work consistently side by side, debating and discussing issues surrounding the consistency of ViCLAS coding, as evidenced by the production and use of the QC guide. These analysts have much more experience with the task, and how to combat any difficulties

that may arise. They are also much more familiar with how their colleagues may tackle the same task, which is particularly important in terms of consistent coding.

### How the interrater reliability of ViCLAS can be improved

Both the creation of the QC guide and the use of a quality control process demonstrate the crucial point that there is a recognition by both the analysts and management of the unit that the coding system can be complex, and that the analysts often need additional rules and guidelines in order to help them make decisions about how to code information in a consistent manner. Indeed, as the results demonstrated, many variables did not reach the 70% acceptability threshold, so it is perhaps encouraging to know that the information analysed in this study would not be the final information entered into ViCLAS. The quality control process designed in Belgium works with the express purpose of attaining better interrater reliability levels, although as mentioned above, its efficacy is yet to be empirically tested. As well as both the QC guide and quality control process, the analysts in Belgium hold regular meetings to discuss discrepancies in coding and the best way to deal with them (De Sterck, personal communication, 2015).

In terms of the results of this study, the second author has suggested that there are three possible reasons for finding less than acceptable interrater reliability. First, there is analyst error. An analyst, when coding information into ViCLAS, may either overlook information that should have been coded, or incorrectly code something as present when it is not. Second, there may be discrepancies within the case files themselves. The victim may describe the offence as having lasted an hour, for example, while the officer in their police

report describes it as lasting for half an hour. Thus, two analysts may enter different information, both of which are present in the case papers. Without a discussion with both the victim and officer involved in the case it would be difficult to suggest which is definitively the 'correct' information. Third, there are differences in behavioural interpretation. One analyst's description of the anger demonstrated by the offender, for example, may be different to another's; both of these opinions may be equally valid depending on the definitions of anger used to form their behavioural interpretations. This factor, as alluded to above, also speaks to the difficulty of determining objectively what the 'correct' answer should be. Given the level of behavioural interpretation required in order to use ViCLAS, this third point may be the most relevant in terms of understanding coding discrepancies. Although looking at eliminating discrepancies due to analyst or officer errors is important, it seems logical to suggest that by looking at the variables which were consistently coded below the 70% threshold in this study, it may be possible to ascertain which variables require a complex level of behavioural interpretation on the part of the analyst in order to answer them satisfactorily. The variables with poor consistency of coding may denote ViCLAS questions which would benefit from slightly greater focus or clarity of wording to assist with this issue. Clarifying what is meant by 'anger', for example, may assist analysts with providing more consistent responses. Focus groups could also be run to start to ascertain why some of the differences in behavioural interpretation exist.

### Limitations

The current study improved on previous studies' designs by asking analysts to code four cases, rather than just one. This enabled consideration to be given to specific variables

that consistently cause coding issues. What is missing in this study, however, is the representation of other scenarios that the analysts code; for instance, there were no murders or attempted rapes present in the cases coded. It may be that murders are easier to code because less information is generally available, or conversely coding a murder may be more difficult because the lack of a victim account makes the behavioural interpretation harder (second author, personal communication, 2016). This warrants further investigation.

In this study there was no investigation of whether discrepancies arose due to differences in the first languages of the analysts. Anecdotally, these differences were sometimes apparent ('brosse' in French means short hair that is sticking up, and 'bros' in Dutch means a shaved head; this was a discrepancy that had not been discovered before the coding of the study's cases) but, especially in countries where multiple languages are used, this area of investigation should be a consideration for the future. This study also did not assess the impact on coding that using the English version of ViCLAS may have had on the analysts' performances (while ViCLAS is available in other languages, these analysts have only used an English version of ViCLAS; second author, personal communication, 2016); analysts in this study will at some point have been reading in their second language, writing in their first, and coding into ViCLAS in their third. Further, while not officially measured, anecdotally there appeared to be differences in participants' language competency (e.g. some had qualifications certifying their second language proficiency, while others did not). While it was logical in this study to ask participants to code in both French and Dutch as was reflective of their daily duties, these differences in language competency may have had an effect on the results found.

Finally, this study did not measure the diversity of experience as a factor potentially mediating interrater reliability, as did Martineau and Corey (2008). That the effect of experience on performance as suggested here has not been found in previous research is an aspect that requires further consideration. Testing this using participants from such units, however, may be problematic; due to the more structured manner of their training and their regular exposure to the system it is likely their levels of experience of using ViCLAS will be much less variable than previous participant samples. It may be that including trainees (that were excluded from participation in this study) may be a way to test this premise. The potential differences in coding between civilian and police (or ex-police) staff would also be an interesting area of investigation.

#### Future research

One of the most important questions for future research to explore is whether certain types of ViCLAS questions, such as those that ask about the emotional state of the offender, or perhaps open-ended as opposed to multiple choice questions, are easier or more difficult to code more uniformly. In situations where information is ambiguous, it would also be interesting to see whether analysts prefer to code more or less information and, if any between-analyst differences exist, why this may be.

Analyst familiarity with certain questions may also have an impact on the reliability of coding, and this is important to investigate as the questions that analysts use more often in their analysis process to search for potential links are those that should be given priority in terms of ensuring uniform coding, especially if familiarity is not an indicator of increased

interrater reliability. To give an anecdotal example of questions that maybe affected by more than one of these factors, in this study, the free text questions designed to capture victim and offender descriptions were often coded less uniformly than the free text questions designed to capture offender speech. This may be due to the analysts' awareness that a) descriptive information is also captured elsewhere, and therefore may be deemed less crucial to capture it accurately in these free text questions (based on the premise that analysts would search through both questions if looking for details of victim and offender descriptions; second author, personal communication, 2016); and b) the free text speech question was more routinely used during the analysis process than victim and offender description details (second author, personal communication, 2016).

Variables may also be less uniformly coded if they ask for information rarely available in Belgian cases. As intimated above, there are several ViCLAS variables that are rarely completed in Belgium; in fact, the number of variables coded in general in this study were fewer than in previous studies (from 66 to 103 in this study, compared to 145 and 118 variables in the homicide and sexual assault scenarios of Martineau and Corey's (2008) study, and 106 variables in Snook et al.'s (2012) case file). The cases used in this study, however, were perceived, at least by the analysts, to be representative of the cases the ZAM unit routinely receive (second author, personal communication, 2016). The larger number of uncoded variables compared to previous studies is perhaps explained by the number of questions in ViCLAS that are rarely used in Belgium. Of the 144 possible variables (excluding the one instance where offender and victim apparent ages were used), 32 questions were not used across all four cases, or in other words, there was no information for 22.22% of the possible variables. ViCLAS was queried in order to see how often these 32 questions were used. For the 8,407 completed cases on ViCLAS at the time of enquiry, half

of these questions were used in less than two percent of all coded cases, and more than three-quarters (78.13%;  $n=25$ ) were used in less than five percent of cases. This may demonstrate questions that analysts are naturally more unfamiliar with which may cause coding issues if, in rare cases, the information is present. It may also be indicative of cultural differences between Canada and Belgium or that some questions are not routinely asked during victim police interviews. Both of these theories require further examination, as identifying sections or variables that are routinely problematic to code and the reasons for this provides useful information for the analysts and management of the unit, in order to implement a way of more uniformly coding these questions. The identification of these variables has implications, not only for further evaluative work within the unit, but also for the improvement of ViCLAS itself, and is especially important when considering the potential impact differences in coding may have on the subsequent analysis process.

While this study has extended the research of the reliability of ViCLAS coding from Canada to Belgium, there is a real need for more research with other units using ViCLAS across Europe and in other parts of the world. While the results of this study may generalise to other European countries that operate a broadly similar coding process to Belgium, any differences in process may mean that different results are found. If these improved results are consistently demonstrated across countries using centralised ViCLAS units, however, it would suggest that this manner of coding may, at least in part, explain these improvements. It would also be important to replicate this study in a country where only one language is used to read, write, and code into ViCLAS, in order to better understand how important the language differences in Belgium are in the interpretation of the findings, as well as further investigate just how coding is affected by the use of first, second, and even third languages during the coding process.

Crucially, the second part of the coding process in Belgium, the quality control procedure, needs to be investigated in order to assess its efficacy. It has been posited in this paper that this process may help to minimise coding discrepancies, but whether it effectively achieves this goal is, currently, yet to be empirically established. Whether coding decisions made during the quality control process are effectively noted in the QC guide, for example, in order that the same decision is taken the next time the same discrepancy arises, has not been investigated. All of the results of future research could be built into analyst training programmes to improve coding reliability.

## Conclusion

An acceptable level of interrater reliability of coding is crucial for ViCLAS to work as an effective tool for assisting analysts with conducting crime linkage. The results shown in this study suggest a much more encouraging level of interrater reliability than previous research has shown, results that are indicative of the benefits of the day to day operation of the unit in Belgium, and potentially in other European countries as well. In Belgium, the role of ViCLAS analyst is considered to be an expert role (De Sterck, personal communication, 2015), and perhaps the results may also have started to highlight the ramifications of the crucial differences in the way that information is entered into ViCLAS. Despite many of the POA scores falling below the 70% acceptability threshold, the fact that this study represents only the first part of the coding process cannot be stressed enough. The next step is to analyse the effect of the quality control process on the interrater reliability of ViCLAS, in order to

understand the standard of the interrater reliability at the end of the coding process as a whole.

## CONCLUSION

This thesis has explored some of the considerations associated with the practice of crime linkage. Ultimately, crime linkage is a tool designed to be used by those working in the criminal justice system to assist in the swifter and more efficient apprehension (and in some countries conviction) of offenders. From the existing research identified in the literature review in Chapter 1 and from the research conducted with analysts in Chapters 3 and 4, it is apparent that there are broader considerations when researching the *practice* of crime linkage that go beyond the notion of finding empirical support for behavioural consistency and distinctiveness. While these theoretical principles are essential to the process of crime linkage, attention equally needs to be given to these more practical considerations, as they too have the potential to significantly impact on linkage efficacy.

### A summary of the thesis findings

Chapter 1 made a novel contribution to the scientific knowledge about crime linkage by providing the first comprehensive review of the academic research and practitioners' writings related to the practice of crime linkage. Several different approaches to and methodologies for conducting crime linkage were identified. Research regarding the accuracy of practitioners of crime linkage, and factors affecting this accuracy, were discussed, as was the use of computerised databases. Where practitioners had made suggestions for future research that needed to be conducted, this was also highlighted. The review also identified gaps in the existing research, suggesting that future research is required into different

permutations of crime linkage practice, the different behaviours used during the linking process, and how behaviour is conceptualised. While the focus of academic study to date on the principles of crime linkage may well reflect the need to establish a strong theoretical grounding for the practice, the review suggests that many of the research gaps exist because of a historic lack of communication between practitioners and academics. It discusses the advantages and challenges associated with collaboration, and proposes that greater co-design and co-production of research would not only advance theory but also ensure ecologically valid research that meets practitioner need.

It is always important that research is conducted thoroughly and responsibly, and Chapter 2 highlighted the ramifications of when these principles are not adhered to. It addressed specific concerns with the reviewed article, but also went some way to exploring what a proper evaluation of a system like ViCLAS should involve. As in Chapter 1, practitioner-academic collaboration was outlined as something that would be of great benefit to research in this area, and further, that collaborative working between academics in different countries would also assist. In the absence of collaboration and an open dialogue, there is the danger of ignoring aspects of the practice of crime linkage, missing relevant documentation, and neglecting important cultural differences in crime linkage practice. Even if not peer-reviewed, the publication of erroneous conclusions can have serious consequences for those working within the field and, as such, there is a need to challenge and correct them. Further, as was noted in Chapter 1, crime linkage is practiced internationally, therefore this Chapter reiterates the need to consider nuances in practice between countries and to consider sources written in languages other than English. All this is aided through international collaboration.

Given the overarching theme identified in Chapters 1 and 2 of the benefits of collaborative working between academics and practitioners, Chapters 3 and 4 were an attempt to conduct more ecologically valid research by working in-house alongside analysts. The benefits of partnering with community organisations for access to hard-to-reach populations has already been documented (e.g. Benoit, Jansson, Millar, & Phillips, 2005; see Denner, Cooper, Lopez, & Dunbar, 1999, for a comprehensive list of the steps important to collaborative working). While research into the practice of crime linkage does not involve trying to access to hard-to-reach populations *per se*, there are parallels in the challenges associated with researching hard-to-reach communities and gaining access to sensitive police data, their personnel and their procedures. For example, time constraints will always be an issue for both parties, and it is difficult for practitioners to justify prioritising research over operational duties. Both in this thesis and in previous research (Denner et al., 1999), having clearly outlined common goals was of great important in overcoming this obstacle. The advantages highlighted by Benoit et al. (2005) were certainly equally experienced by the current author during the research for this thesis. The positive opportunity for practitioners to help shape research goals and assist with data collection, for instance, is unquestionable. It was this author's experience that practitioners find great value in accumulating a research profile to support the organisation, along with the potential for evidence-based evaluation of services leading to their subsequent improvement. It was also this author's experience that continuous contact with practitioners as the research progressed and the dissemination of findings in both academic and practitioner settings helped to further advance the collaboration and ensure the continuation of a good working relationship.

Chapter 3 was the first of the projects that called for in-house working, with the author visiting the Serious Crime Analysis Section (SCAS) analysts' place of work to

document the heuristics and processes they use to link crimes. A qualitative methodology was used in this Chapter as it was anticipated that the flexible nature of such a design would allow for the documentation of the complexity of the decision making process behind linking crimes and any individual differences between analysts. The Chapter highlights the factors considered relevant during the linkage process by the analysts, the importance placed on different types or combinations of behaviours, the different levels at which behaviours are operationalised, how the academic research is used, and the analysts' interaction with ViCLAS. While this study was largely descriptive in nature, it generated a large amount of pertinent information about the practice of CCA in the United Kingdom (UK), as well as a number of avenues for future research suggested not only by the authors but by practitioners themselves. The Chapter also highlighted some issues with the practice of CCA not considered in academic literature, for example, the practical difficulties associated with linking crimes where the victimology differs considerably, or where there are differing numbers of offenders in each case. This demonstrates the potential of this type of research to generate new research ideas that have not been prioritised by the academic community but that would be of great importance to practitioners. It was also an effective way of exploring how the process of CCA could be standardised and, as a consequence, more easily evaluated in future academic research.

As with Chapter 3, Chapter 4 was written while the author was embedded within the sex offence analysis (*Zeden-Analyse-Moeurs*, or ZAM) unit of the Belgian Federal Police. This Chapter was borne out of a need to replicate and extend previous research, but with consideration of the differences that may exist in practice between different countries. As with Chapter 2, the difficulties of not considering such variations in practice may mean that any results found are inappropriately generalised to practitioners who operate differently.

This study investigated the interrater reliability of ViCLAS coding by ZAM analysts, comparing it to previous results found using samples of Canadian law enforcement personnel. These previous studies had found a low level of interrater reliability of ViCLAS coding, although the differences in operation between the Canadians and their European counterparts was largely unexplored. The coding completed by the Belgian analysts demonstrated a higher level of interrater reliability than shown in previous research, although much of it still fell short of the 70% acceptability threshold. This study also extended previous research by asking analysts to code several cases; in doing so, it was possible to ascertain exactly where interrater reliability was consistently poor, and start to hypothesise as to why this might be. The fact that analysts have to conduct a large amount of complex behavioural interpretation may well be the reason why coding questions uniformly proved difficult for certain variables, and these results have implications for both the training of analysts and for the developers of systems such as ViCLAS. What this study did demonstrate was that there is variation in practice between countries, in at least a part of the crime linkage process, and that the context in which linkage is conducted needs to be considered when investigating linkage efficacy.

### The impact of the results found

The impact that the research in this thesis has had can already start to be measured through its use by practitioners, especially in terms of the use of crime linkage as an investigative tool. Chapter 2 has been used to dispel some of the unsubstantiated negative opinions of ViCLAS that had the potential to jeopardise analysts' work in certain law enforcement departments. The process maps created in Chapter 3 are being used in official National Crime Agency (NCA) documents to explain SCAS' purpose to the wider law

enforcement community and to non-analytical staff within the NCA. The report itself is now used as part of the training new SCAS employees undertake. The results from Chapter 4 have led to the creation of focus groups in ZAM to discuss coding issues as they emerge, in order that such discrepancies can be resolved. Further, an invitation was extended to both the primary author and her supervisor to organise a seminar for members of all the European units using ViCLAS in order to further disseminate the results found here; subsequently, several of the attendees have asked for copies of the research as they believe it to be relevant to their own practice (despite being from other countries). In this way, it is hoped that this thesis has demonstrated how research can be relevant from both an academic and practitioner perspective and that it has encouraged future academic-practitioner collaboration.

The implications of this research on the use of crime linkage in court was not a primary focus of this thesis, although this potential impact can still be considered. Documentation of the process is a first step towards there being a documented and standardised way of conducting crime linkage (Daubert v. Merrell Dow Pharmaceuticals, Inc., 1993). Some legal standards of admissibility also require the practice of crime linkage, as with the theory, to have been subject to peer review and publication, and in this way the research findings reported here can inform the Courts. It should be noted, however, that the nature of crime linkage may mean that it is not possible to fulfil all of the stipulations of some countries' court regulations, in which case crime linkage will remain an investigative tool.

### Limitations

One of the limitations of the research in this thesis is that the results are only directly applicable to the units that supplied the data or participants. While the practice of CCA may be similar in other countries, for example, it is impossible to make such assertions without conducting similar research with other groups of participants, and while this thesis attempted to be mindful of this by expanding the research to Belgium as well as the UK, there are large parts of the world that conduct crime linkage that have not been included in the research here. What is positive about the research in this thesis, however, is that by highlighting the specifics of one process, the differences between this and other processes may be more easily identified. It is also hoped that the differences in practice are not prohibitive to other practitioners finding this research useful, as evidenced by analysts from other countries' interest in this work.

By virtue of the analysts worked with during this thesis, most of the research referred to here, and all of the studies conducted, are focused on the crime linkage of sexual assault. This means that, as with the difficulties of applying the results of this research to different groups of analysts, it is difficult to know whether the results found here will generalise to the practice of linking other types of crimes. The different behaviours found in other types of crimes may mean that the coding of certain offences is handled differently to the coding of sex offences. While it is possible that data about the practice of linking sexual assaults may be more readily available, due to the specific units established to conduct this type of work, this does not mean that the linkage of other types of crimes should be overlooked.

#### Future research

Given that the results of the literature review highlighted scarcity of research conducted in this area, a wealth of future research ideas have already been suggested during the course of this thesis. One of the biggest questions yet to be comprehensively tackled is how the results of theoretical research could be used by practitioners. Answering such questions may only be possible when a more comprehensive analysis of the process itself has been undertaken. Because of this, as was stated in Chapter 1, mapping the crime linkage process may be the most pressing type of research to be conducted. Chapter 3 made a start in understanding the crime linkage process, and this research needs to be repeated with particular emphasis on exploring the different approaches to and methodologies employed to conduct crime linkage. That so many different approaches and methodologies are used in practice (as was identified in Chapter 1) is not something recognised in much of the academic literature, but each require consideration in order to identify where any similarities and differences exist.

As part of the investigation into the actual process of conducting linkage it was clear that analysts consider behavioural consistency and distinctiveness at multiples levels of abstraction. While academic research has studied behavioural consistency at the specific, domain, and thematic level, it has yet to replicated how analysts interchange between levels during the analytical process (studies of taxonomic similarity would be an exception to this; e.g. Woodhams, Grant, & Price, 2007). This is something that warrants further consideration by academics. The notion of relative consistency is also something that is used by analysts in order to look for links between crimes, and this also warrants attention in academia.

While a comprehensive mapping of the processes and decision making in crime linkage is arguably the most pressing research aim, next would be studies of the efficacy of

crime linkage, given the real world ramifications of linkage decisions. It has been recognised throughout this thesis that the consequences of incorrect linkage can be serious and wide ranging, including the improper allocation of resources or the incorrect attribution of crimes to a suspect. While studies on linkage efficacy have been conducted, they have yet to faithfully represent the real world task of crime linkage, nor have they given explicit consideration to how variations in practice might affect efficacy. By advancing academic understanding of the process of crime linkage, studies can be designed to better reflect the reality of the linkage task and thus have greater ecological validity.

Factors that might affect the efficacy of crime linkage have started to be explored (e.g. expertise and the impact of training). Such factors have been found to affect performance in other circumstances (van Merriënboer & Sweller, 2005). Other factors that have the potential to affect the efficacy of crime linkage should also be considered; practitioners' inherent biases, for example, may affect efficacy (such as the base rate fallacy, the representativeness heuristic, the clustering illusion, and the availability heuristic; see Rainbow, Almond, & Alison, 2011 for a more in-depth discussion of these and other factors), as may the time that analysts are allowed to devote to the task. Similarly, expertise with computerised systems associated with linkage may affect efficacy, and practitioners' efficacy with and without the support of such databases should also be considered. The effects of stress and fatigue are important factors to consider as crime linkage practitioners are exposed to sensitive and distressing material (Lavis, 2012). These factors are important in terms of efficacy; the negative impact of emotive content and stress on performance is discussed in other areas of law enforcement analysis (Kloess, Woodhams, Whittle, Grant, & Hamilton-Giachritsis, 2017), with some research exploring the link between certain types of stress and its negative affect on aspects of memory (Oei, Everaerd, Elzinga, van Well, & Bermond, 2006). It has

been documented that practitioners in forensic contexts can suffer from internal conflicts borne of the responsibility of making decisions that can have a significant impact on victims of crime (Kloess et al., 2017) and that this may affect the decisions they come to.

Finally, practitioners' own suggestions for future research should be considered by academics, as practitioners may well suggest those research questions which are most pertinent to their role, and merit most urgent attention in this field of research. Appendix 3 in Chapter 3 provides some good examples of research that SCAS analysts have suggested.

## Conclusion

This thesis has explored the practice of crime linkage from an academic perspective. Importantly, the inclusion of practitioners' expertise and the consideration of how crime linkage practice may differ from studies of its theoretical underpinnings have been instigative in creating research that is of both academic and practical value. The exploratory nature of the thesis and the breadth of content covered demonstrates how much research in this area there is yet to complete, but it is hoped that the research here provides a starting point from which to explore new avenues. This research is greatly needed, given that crime linkage is currently used by many different law enforcement organisations worldwide.

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## APPENDICES

### CHAPTER 3 – Appendix 1: The interview schedule

#### PART 1

1. Outline the index offence or series
2. Understanding of why case was chosen for analysis
3. First things done when case received
4. First behaviours looked at to start search process
5. Searches conducted
6. Reasons for inclusion/exclusion of cases
7. Cases potentially linked and which searches brought the cases back
8. Summary of potentially linked cases and reasons for inclusion
9. Further information on progress of report

#### PART 2

1. Any behaviours not discussed above that are believed to be important for linking process
2. Any changes in analysis process as experience gained
3. Any differences in analysis process from other analysts
4. Any ViCLAS improvements that could be made to assist with linking process
5. Research that you currently find useful to linking process
6. Any further research you feel would be useful to linking process
7. Any other comments

CHAPTER 3 – Appendix 2: A list of challenges that analysts highlighted relating to specific behaviours

1. Functional speech is difficult to search for and is not covered by the verbal themes section (P002, p. 11), although the term ‘functional’ may itself be subjective and context dependent;
2. Speech in general can be difficult to search for, and ViCLAS can ‘time out’ if the analyst is searching for a common word (P009, p. 21);
3. While violence is coded, it is difficult to conceptualise (P011, p. 11), and whether the violence is deemed to be purely functional to the commission of the crime is not coded (P002, p. 46; again, the notion of what is ‘functional’ may be prohibitively subjective);
4. Similar to functional violence, aggressive handling of the victim is difficult to search for because it is behaviour that would constitute aggression but is not coded as violence (P002, p. 11; although this notion may also be subject to inherent subjectivity which may make it difficult to conceptualise);
5. Victim resistance is difficult to code (P011, p. 11);
6. Unusual body positioning of the victim is difficult to search for (P002, p. 45);
7. The exit strategy of the offender is only coded within the verbal themes and precautions, although this behaviour is not always verbal (P002, p46). The fact that the closing stage of an offence is not adequately catered for on ViCLAS is something that has been highlighted as an issue in academic research using ViCLAS data (Slater, 2016);
8. The length of time a victim has been held by the offender cannot be searched for, which is deemed to be important given that the victim being held for a long period is

rare (P005, p. 34). It may be problematic to rely on this behaviour, however, due to research suggesting some victims are not able to accurately recall lengths of time (Thomas et al., 2004);

9. Abduction is difficult to conceptualise (e.g. an arbitrary distance needs to be set, over which moving the victim can be classed as abduction; P009, p. 14).

### CHAPTER 3 – Appendix 3: Analysts’ suggestions for future research

1. \*Updates to research studies already found useful by analysts; in particular the research that informs decision making regarding geography. Analysts also wanted studies to be updated with the current data held on ViCLAS, and to utilise larger sample sizes (P001, p. 29; P003, p. 12; P004, p. 65; P007, p. 57; P008, p. 76). The way searches currently work on ViCLAS means that analysts are faced with difficult decisions of how to make their searches manageable in terms of the number of cases returned. It was suggested that such research may also want to account for any other variables that might mediate the results, for example, whether offenders’ travels patterns are significantly different if a vehicle is involved;
2. While it was acknowledged that research supporting the general premise of behavioural consistency exists, further research was wanted regarding exactly what behaviours offenders demonstrate consistency in (P007, p. 54). Similar to Grubin et al.’s (2001) and Woodhams’ crime linkage research, investigating which behaviours are more consistent, including any thematic consistency (P007, p. 54), and what (if any) sex acts are consistent (P004, p. 66), was also suggested as being useful. Analysts said that ideally this type of research would be conducted every year (P011, p. 41);
3. Similar to Thomas et al.’s (2004) research, an investigation into the reliability of victims’ recall of offender ethnicity (P008, p. 76);
4. \*More geographical research was asked for (P011, p. 42), for example, how offenders’ geography differs when in an urban area compared to a rural area (P007, p. 57). The number of crimes committed in London in particular means that the distances searched across in London can be quite small, yet with the transport system

in London, offenders may travel further than in other locations. Looking at how the use of public transport affects offenders' geography would also be useful (P007, p. 58);

5. Research into how rare or common behaviours are (P004, p. 66);
6. \*Comparisons of behaviour demonstrated in lone perpetrator and multiple perpetrator offences (P002, p. 44), including investigating what behaviour may be relatively similar across these different conditions (P009, p. 41). This needs to be investigated in terms of whether lone offenders commit multiple perpetrator offences as well. Further, an assessment of behavioural consistency for serial multiple perpetrators was suggested;
7. Research into behaviour exhibited by ringleaders of group sex offences (P011, p. 7);
8. #Comparisons of behaviour demonstrated in apparent one-off and serial offences (P003, p. 47);
9. \*Comparisons of behaviour committed in offences against sex workers and non-sex workers (P011, p. 41);
10. Research into the consistency displayed between non-lethal sex offences and sexual murders (P005, p. 31);
11. Research to support the consistency of approach behaviours (P006, p. 43);
12. Considering the utility of including 'online contact/grooming' as an approach type in its own right, given the number of offenders known to use this as a way of instigating contact sex offences, and the differences associated with approaching someone online as opposed to in person (P011, p. 42);
13. Research into offender behaviour exhibited during child offences (P002, p. 44);
14. Which behaviours are more likely to co-occur (P008, p. 77);

15. What the more common aspects of certain offences are, for instance, what is more common in an indoors offence (P007, p. 64);
16. \*How anal offending in relation to domestic sexual practices have changed (P002, p. 44/45);
17. \*Research into the geography of offenders committing offences against sex workers (P003, p. 47);
18. Testing the premises on which familial DNA work is based, i.e. that criminality runs in families, and that families tend to reside close together (P005, p. 31);
19. Work conducted with offenders to better understand their recognition of victims' vulnerability (P011, p. 42);
20. Research to examine crossover offending. Several analysts expressed the belief that offenders are consistent in their choice of victim type (e.g. targeting sex workers, children etc.); existing research indicates already that many offenders are not consistent in this way (e.g. Heil et al., 2003);
21. Conducting focus groups with officers in order to ascertain their level of expectation from SCAS and the reports they generate, and to discuss with them any discrepancies in their perception of behaviours that may be important (or not) in behaviourally linking cases, compared with the analysts' expertise (P008, p. 31/32).

N.B. An asterisk (\*) denotes any suggestions of research that the unit is either already undertaking or instigating. A hash sign (#) denotes any suggestions where published research already exists. Further investigation is warranted here to understand why such research is either not known about, or alternatively not considered useful, by practitioners.

### CHAPTER 3 – Appendix 4: A list of behavioural trends noted by analysts

The following is a list of points made by analysts that fell outside the scope of this article's aims, but are nevertheless worth preserving, as they give an insight into the anecdotal trends that analysts said they had noticed during the course of their analyses. This information may be of use to researchers in the field as potential suggestions for new research hypotheses. As far as the authors are aware there are currently no published studies which confirm or negate these ideas. (It is important to note that 'offences' as mentioned here specifically pertain to those held on ViCLAS, i.e. sex offences and sexual murders.)

1. There appears to be a correlation between multiple offender offences and gun use (P001, p. 15);
2. Pseudo-intimate behaviours in offences against sex workers are rare (P001, p. 15);
3. More violence is used in offences committed against sex workers (this could be due to these victims being more resistant, or potentially that they are more frequently sexually assaulted and only report the particularly violent offences; P001, p. 16);
4. Offender masturbation and forcing the victim to perform fellatio do not commonly co-occur (P001, p. 18);
5. Anal intercourse is becoming more common (P002, p. 22);
6. Anal digital penetration (including using a hand or fist as well as a finger or fingers) is a more salient behaviour than was anticipated when searched for (P003, p. 13);
7. Binding and gagging occur together frequently (P003, p. 30);
8. Changes in offending over time can be seen, e.g. the increase in internet-related offences (P005, p. 29).

CHAPTER 3 – Appendix 5: Additional quotations

*Table 1: An outline of the themes found with illustrative quotations*

<b>SECTION 1: The analysis process mapped</b>	
<b>Themes</b>	<b>Quotations</b>
a) Pre-analysis process	
<i>i) Case triage</i>	‘So if you've got a, an offence with violence and a weapon, as, if there are precautions, forensic precautions, sighting precautions, if he puts his hand over his, her mouth, the victim's mouth, these things all add points on to the priority score’ (P011)
<i>ii) Coding of cases</i>	‘so it’s coded by the assistant, the assistant themselves will go through and check it’ (P001) ‘if there’s any discrepancies we have a team that deal with data interpret-y issues[...] So they can, they can search through previous questions and also obviously the database itself and make sure that we’re always coding things as consistently as possible.’ (P006)
<i>iii) Analyst preparation</i>	‘I’m also checking that the coding’s correct in terms of quality purposes.’ (P001) ‘jot down notes on what I think would be searchable and relevant to search and then I’d give the OIC a call just to see if it’s still accurate.’ (P002) ‘basically to be able to understand what behaviours happened in the offence, to be able to interpret the situation, so to be able to understand the other factors that affect your behaviour, so it, you may have an intention of how you’re going to behave, but the timing of it, the location, how that victim is behaving, it’s all going to have an impact on how you’re able to behave. So you need to be able to interpret what’s happening within an offence to be able to then compare it to other offences.’ (P006)
<i>iv) Conducting initial searches</i>	‘Sometimes I have a play around before I set terms of reference, just give me an idea if it's worth, what analysis, you know, if it’s worth doing the analysis on it.’ (P001)

	‘Sometimes I might do that before I phone the OIC, so when I phone the OIC I know that actually, did you know this happened last week down the road etc. etc., and just see if they know about it.’ (P001)
b) Analysis process	
i) <i>Running the searches</i>	‘So I’ll have all my single behaviours down one side and merge them then I can see how it’s going, but it’s not necessarily how everybody works. Some people will put in all of the behaviours just into one query and then just run it and then just read through those.’ (P001) ‘I like doing lots of singular searches, and then playing with them together.’ (P007) ‘I tend to always go for geography first’ (P009)
ii) <i>The inclusion/exclusion process</i>	‘generally if something is coming back and coming back and coming back I, you sort of notice it and I think hang on a second it keeps coming back, why does it keep coming back, let me just have another check at that’ (P001) ‘Rather than you’re not looking for one, one reason to exclude it, you’ve got to have a few good reasons to not include, to not include it.’ (P004) ‘you never exclude on one thing’ (P011)
c) Post-analysis process	‘you put things in and they come back and say, why have you done that, and sometimes[...] there’s a load of good reasons why and that’s fine, and you can justify it but, you know, you’ve got to, in the same way you know, manage their expectations at the beginning[...] You’ve got to kind of give them something that reflects that, otherwise, you know, you want them to believe in you’ (P004) ‘Yeah context is huge, so if I’ve got some context that can actually help with that dissimilarity so that it’s not just disregarded by the police, I’d definitely be putting that in’ (P006)
<b>SECTION 2: Main topics of discussion about the analysis process</b>	
<b>Themes</b>	<b>Quotations</b>
a) What behaviours are selected	
i) <i>Consistent behaviours</i>	‘the knife, we know from this, he didn’t take it from the scene, it was his knife, he took it there. So again that’s something that he’s chosen to do so that’s more interesting to me than, you know, perhaps if he picked it up from the scene that would be interesting too, he’s chosen to go armed with a knife to this offence’ (P002) ‘the offender is sort of beating her or punching her when it’s unnecessary so that again indicates something I’d be interested in in other similar cases to be honest, it’s, it’s kind of, there is no need for him to do that, he’s getting what he wants, so he’s doing it for another reason perhaps, so would this be exhibited in another case. So it would be something more interesting to me, I think, yeah.’ (P002)

	<p>'you've got other convictions on PNC and then you can incorporate different things but, yeah, it is quite a tricky when you've had other cases where the offending behaviour is so different.' (P002)</p> <p>'So think this one in particular, because of all that kind of element of preplanning if you like[...] It sounds like something he would do, it feels to me like something that would be consistent, it's a bit more sophisticated in that sense than just someone, someone grabbing her off the street.' (P003)</p> <p>'personally I think speech is a really important, and yeah it's quite a, consistent' (P003)</p> <p>'Offender led stuff is what we're all about, really. If you've got something that's offender, absolutely offender led, then that is, you know, generally you'd think that is what would be consistent because that is what they can choose to do' (P004)</p> <p>'Certainly, approach is something we would look at, because it's the offender's first action before, mainly before there's any influence on him, so before the victim or a situation has been able to influence his behaviour and him potentially adapt his behaviour.' (P005)</p> <p>'with this analysis you have to assume there's some degree of consistency in order to conduct this in the first place, because if you're looking for everything that's different you could include anything so, you'll need to rely on there some consistency, yeah, but not to the level of, there are some factors that we would assume are more consistent than others, based on the knowledge that we have of the database' (P006)</p> <p>'when the victim walks off he repeats that approach again, so then that's almost able to see, you're able to see that consistency within the same offence[...] that's showing you that consistency within that one offence, so I can then be more reliant on it when I'm looking at other offences so I'll definitely, I did look into the approach, the fact that he has repeatedly done that[...] If he's done that three times in an offence you can be even more sure' (P006)</p> <p>'if you've only got one case to look at you can't really look at, is what's consistent, other than if it's persistent through an offence you can look at that' (P008)</p> <p>'I've only done a few abductions in this sense, but they do tend to be relatively consistent.' (P009)</p>
<p>ii) <i>Distinctive and unnecessary behaviours</i></p>	<p>'I think, if you get something really weird, that is really unusual, you always think, if I find that in another offence, and it's that weird, what are the chances that it's somebody else?' (P004)</p> <p>'so you can have ones where it's unusual, that might be a standard behaviour that's unusual in a rape offence, so to tell someone where you work[...] Is not necessarily unusual behaviour, but in a rape offence that could be considered unusual and obviously in this situation I know it's looking at that location, the occupation itself but that is, that was obviously unusual so I looked at it. And yes you do have cases where, within a sexual offence, an actual sex act maybe very unusual, bizarre, and in which case again, just quickly running to see the kind of numbers you're looking at[...] Can then add weight to the fact as to whether that was unusual or not, yeah.' (P006)</p> <p>'Well I searched it on its own[...] Because it was so unusual.' (P008)</p>

	<p>‘Sometimes you get a very aggressive offender that will use, the control strategy would be to use violence rather than trying to persuade them, so then you might not necessarily see what we describe as a sort of pseudo-intimate acts, like kissing and things like that, might be rarer, so you wouldn't very often search on kissing as it is so common across the database but if you've got a very violent offender and then you've got that kissing, maybe putting those two together would give you an interesting results set to have a look at.’ (P010)</p>
<p>iii) <i>Geography</i></p>	<p>‘It could be if you've got a taxi driver or a lorry driver, or if you've just got someone who has lived in loads and loads of different locations then it could, then it could become so difficult, so irrelevant, that you would rule it out. I'm not going to, I'm not going to whittle anything down on geography, I'm just going look nationally because I know he has been transient, I know he's part of the travelling community, I know he lives over the country, I know he hasn't got any ties, I'm going to look at the whole country if I can. So automatically you would be taking into account any travel, or occupation.’ (P001)</p> <p>‘where possible I'll always try and look at the geography ones independently if I can.’ (P003)</p> <p>‘you also want to look at behaviour nationally, because we are a national unit, so you are always looking for those kind of slightly more unusual things that you can keep the searches national[...] And look for proper, you know, serial offenders across the land, as it were.’ (P005)</p> <p>‘Fundamentally, and what's really key I think for analysis, and what is really impressed upon all of us and obviously based on research is geography.’ (P008)</p> <p>‘You've got to weigh that up in terms of, you might have a very, very similar case behaviourally, but is it enough of a significant to include if you've got a case in Devon and Cornwall and you're including something from Scotland, is that going to be useful for the investigation as well, or are they just going to immediately look at that and think it's very unlikely it is the same one even though, you know, they've got similarities, so you've got to bring geography in.’ (P010)</p>
<p>iv) <i>Solved/unsolved offences</i></p>	<p>‘so this one I'd go straight to unsolved, I'm only considering unsolved cases, we've got him, we know he did it, so I'll run my unsolved query we've got that there’ (P001)</p> <p>‘when we found out it was he, found out who the offender was, that obviously helped me because I could, across my searches I could just narrow them down just to looking at unsolved offences, and rather than looking at the whole database, because that's a conversation you have with the OIC, checking that they're happy that that is their offender, and they're not looking for anyone else, and they only want us to bring back unsolved offences rather than offences involving suspects and things like that.’ (P003)</p> <p>‘My index is solved so I'm only bringing back unsolved cases so you're probably, pretty much halving it by doing that anyway, there or thereabouts’ (P004)</p>
<p>v) <i>Logistical considerations</i></p>	<p>‘if I've got an 18-year-old or a 16-year-old offender I know there's no point in me looking at offences that happened 10 years ago, I can get rid of them straightaway’ (P001)</p>

	<p>‘if it’s someone that’s in a nightclub I think that can help whether, I think someone who's driving a car, they’re unlikely to be 10 doing that sort of stuff so, but you, I normally, that's normally very much in agreement with what the investigating team want.’ (P003)</p> <p>‘it helps very much more from the, you’ve got far more intelligence gathered yeah, so you’ve got all his, yeah all his pre-cons, you know what he's, yeah you know, yeah you know where he’s lived before, you know where he's worked, and so all that sort of stuff and you’ve also got access to other databases that we can look at and try and gather even more intelligence on him so, it does help’ (P003)</p> <p>‘quite often if I’ve written that it means that they were similar enough that I would have contacted prison location services and checked VISOR and checked PNC.’ (P011)</p>
<p>b) How the database is searched</p>	
<p>i) <i>Thematic, general, and individual behaviour searching</i></p>	<p>‘what I will generally do is pick out what my key behaviours are and run an individual search on them’ (P001)</p> <p>‘You can do however you want to do it so you can do it that way, or you can do individual queries and then merge your individual queries together.’ (P001)</p> <p>‘I tend to start my analysis by doing a real general MO search’ (P002)</p> <p>‘So I do try and keep it more generalised which becomes problematic when the database is like nearly 26,000 but I feel more happier that I'm going through the really relevant things and then excluding it on other reasons rather than narrowly sort of excluding cases before I've even looked at them.’ (P002)</p> <p>‘sometimes I do, I do a basic MO and I do a specific MO’ (P002)</p> <p>‘it might not be that he'll say exactly the same words[...] that's where, like working out the thematics of behaviours so it might be someone that’s threatened, if you don't do this I'll stab you, or in another way he's kind of used a different type of threat, it’s like, oh yeah I’ll take your kids away or something about the, the kind of, the fact he's still threatening the victim, it doesn't have to be specifics.’ (P003)</p> <p>‘I think, again for logic reasoning I need, you need, I, I need to have something that makes sense as to why I’ve put them together’ (P003)</p> <p>‘We’ve got a database of well over 20,000 offences now so if, if the offence is quite generic and, it’s still horrendous but generic, it’s very difficult to be able to go through the inclusion exclusion process because you could include thousands of cases, but that’s not going to help anyone, so you have to be quite bold with your decision making’ (P005)</p> <p>‘if he'd said something really specific in there, like a specific phrase that was distinctive, I would search that, and then I’d broaden it out and look at the curiosity as well so, always try and broaden out’ (P009)</p> <p>‘Yeah because occasionally you do get the ones where they’re really, really consistent and they use the exact same speech, but we have to remember that even if they've use the exact same speech it doesn't mean the victim’s remembered it exactly as the offender’s said it, or it’s been written down as the victim’s said it, and it can just be a little bit like Chinese whispers</p>

	in that things can just get lost in translation as well so, even if the offender is really mega consistent we have to remember all these kind of coding errors that we can do, that the police can do, that the victim can't recall things, so we have to broaden it out to incorporate all these.' (P009)
<i>ii) Issues with the search process</i>	'if it's something quite distinctive that you're looking for, quite often it's free text and then it's easy enough to do it, you've just got to think of all the different alternatives that somebody may have called it.' (P001) 'we've just got so many cases on the database now that you, you're left without much of a, an option.' (P011)
c) The inclusion/exclusion process – how cases are 'linked'	
<i>i) Context</i>	'I could have an offence that's not violent at all but he's got previous convictions for violence against women, I've got to bear in mind there's a tendency there that he could be violent.' (P001) 'You know they can escalate, you know and it is stuff, some of it you do pick up, sort of forensics back, like older offences, perhaps offenders aren't as bothered about the sort of being forensically aware and using condoms because, you know, the forensic techniques weren't as good as they are today and stuff like that. So that's the kind of thing you consider' (P002) 'you do have to be a little bit wary of kind of preparation and learning and things, so if I'd had an offence that happened after this, that the offender had come with a balaclava to, it might be because he's realised he's been seen in the previous offence, and therefore he doesn't want to make that mistake again.' (P005) 'I mean for this kind of case you, you wouldn't want to exclude outdoor offences, but what would they look like, and what would you expect in an outdoor offence' (P007) 'victim offender interaction is, is, is massive in analysis' (P011)
<i>ii) Offender description</i>	'I've done things like just looked at, you can do the odd search, so say someone's got a really distinctive piece of clothing on and you can just do a quick search on it and it's only do, bring back 10 cases you might as well just do it as why not' (P001) 'Like I said unless it's sort of IC1 versus IC3 and you've really got nothing else, or because the database is so big and you need to manage numbers somehow, but you'd always get the sort of consent of the OIC of just sort of run that past and say we are going to do that.' (P002) 'sometimes victims might describe someone as IC4, when in fact actually they're IC3 heritage. Sometimes we've had, victim's described someone as a tanned IC1, and they're actually IC2' (P008)
<i>iii) Victimology</i>	'it's quite unusual for an offender to cuddle or hug the victim anyway but it does happen, but a prostitute victim, it normally just doesn't happen as often.' (P001) 'behaviour could be quite different between a child victim and an adult victim. Just because a) the way that the victim might be able to recall exactly what's happened or explain exactly what's happened, but also the way an adult might interact with the offender could be very different to the way a child might interact with the offender, the control strategies

	<p>that the offender might need to use against a child and an adult might be quite different, so you might see quite different behaviour because of the victimology' (P005)</p> <p>'the research would certainly suggest that you really shouldn't focus too much on[...] Really on one [gender], you know because, at, at that age level, you might not get the distinction or the preference necessarily.' (P007)</p> <p>'I guess the assumption could, believe that the victim's 12, a prepubescent female, that perhaps other victims would be similar, but I didn't want to exclude other vulnerable adults as well. So perhaps somebody that was more likely to get into a vehicle, and by that I mean somebody that perhaps might have had learning disabilities or, I guess my thinking was that an adult is less likely to get into a vehicle using that approach[...] Where, with the victim it's the vulnerability, perhaps, rather than the age' (P009)</p> <p>'I'd be less inclined to exclude because of multiple victims in this case because, I, I guess there's no good reason except for like, it's common sense as such in that the younger children might be more likely to be out together, they're easier to coerce and get into a vehicle, two children rather than two adults.' (P009)</p>
<p>iv) <i>Absence of behaviour</i></p>	<p>'I just feel, [searching for absence of behaviour] it's just a bit risky in terms of, it's probably more my own opinion and personal to me, it could, you know if I was searching for an offence where there was no weapon, that's not to say he wouldn't use a weapon in another offence' (P002)</p> <p>'I think the absence of behaviours are just as much, just as important as, I find the absence, quite often a lot of my exclusionary[...] when I'm looking at two cases, is down to if something's not there as much as if it is.' (P003)</p> <p>'the absence of information became more significant then because you can rely on it a little bit more because it was present in a lot, lot more of the cases.' (P009)</p>
<p>v) <i>Single versus multiple perpetrator offences</i></p>	<p>'it's really, really difficult to compare the two' (P001)</p> <p>'it just really varies, it just really, I guess what their control, what their role is within the multiple offender case, if they're sort of taking a back seat or if they're sort of instigating things and encouraging people, so it can depend on their role in that multiple offender case, how you kind of see it and single offender cases' (P002)</p> <p>'I appreciate that there's research that suggests that people do go on to commit in, in sort multiple offender cases as well as single' (P003)</p> <p>'we know offenders that offend on their own might also offend with others' (P004)</p> <p>'like if you've got a group of offenders they can all, well a) the victim might not know who's done what for starters, and b) they can just, they can egg each other on really and get people doing different things, so someone on their own might not have as much control over the victim than if he had two of his mates holding her down, might not have someone egging him on to do certain acts or, might be less interaction because you've got less people to engage, but, so yeah you might just, it might just be quite difficult to understand how that offender might perform.' (P005)</p>

	<p>‘I think it's because it's really tricky when it's multiple offenders because the behaviour changes so much because of your interaction because of the two offenders, and especially if there's two offenders and more victims, so although I know that multiple offenders do go off and offend on their own, sometimes you just can't pick apart that behaviour’ (P009)</p>
<p>vi) <i>Geographical proximity, temporal proximity, and temporal ordering</i></p>	<p>‘the more geographically similar they are, or sorry geographically close they are, the less similar they necessarily have to be behaviourally.’ (P003)</p> <p>‘we don’t have the capability being able to search for that, to look at how many times something has happened’ (P006)</p> <p>‘there’s no way of looking for the use of disguise at the end of a offence, there’s no way of searching that on ViCLAS.[...] You can only look, yeah, you can’t look at when it’s happened’ (P008)</p>
<p>vii) <i>Sex acts</i></p>	<p>‘something that probably we thought was a distinctive sex act or something was not that common on the database a few years ago, now becoming quite common.’ (P001)</p> <p>‘there’s no point me searching for offences with vaginal penetration in, because I’ve got a database full of them, that’s not helpful to me.’ (P004)</p>
<p>viii) <i>Risk-taking</i></p>	<p>‘So obviously in the index offence we had in, a massive high risk going into a house where the victim’s parents were there. In this one, massive high risk because he’s in a public changing room.’ (P005)</p> <p>‘the amount of risk or perseverance or determination the offender takes in performing anything, if they’ve taken a lot of risk and really persevering despite whatever it may be being thrown at them then they probably really want to do it, and therefore going to really want to do that in other offences, probably.’ (P005)</p> <p>‘in this series it [the level of risk] was, it was consistent.’ (P009)</p> <p>‘Is at a rural location, is it in a nightclub where there’s potentially CCTV, yeah, you talk about the risk-taking and the behaviour that’s, he’s using to reduce that level of risk maybe.’ (P010)</p>
<p>ix) <i>Offence type</i></p>	<p>‘it's hard because you're looking at other murders but then other sort of violent rapes or attempted murders, and you can only, well this could have been present in the murder but we'll never know so it's all very, yeah it's hard to judge and you don't want to rule something out just because it's not present in the murder because we don't know, so yeah they're tricky, yeah.’ (P002)</p> <p>‘we know that people that murder people don’t just murder people, there tends to be a build up, and in that build up there, you know, you would expect to, potentially see some other sexual, like lesser sexual assaults or rapes, or attempt rapes’ (P004)</p> <p>‘But if there was no violence in an offence with a rape, there’s no indication that it could lead to a murder potentially and you would, you would probably exclude on that.’ (P010)</p>
<p>d) <i>Analysts’ experiences and</i></p>	<p>‘I probably don't have loads of inclusions but there are some analysts, and I’ll peer review their work, that do have lots of inclusions, and I think it generally is experience and confidence, and just the personality of that person.’ (P001)</p>

differences in practice	<p>‘It really varies, some people sort of do just really broad searches and do a few of them, whereas some other people will do just really specific searches on everything, and then perhaps merge those. So our techniques across the unit does really vary I think, from what I've seen and peer reviews and stuff. I think there's a happy medium, who am I to say what's right and wrong but in my eyes I think it's a bit of both, you wouldn't want to go too streamlined or too broad, but yeah, but there is, yeah variations.’ (P002)</p> <p>‘there’s certainly some analysts that will do that and that’s absolutely fine and that, that’s, that’s their way[...]there’s millions of different ways to construct searches, and some people can use really complex ways doing it, and as I said to you I just break it down in the most simplest because that works for me but, ultimately you get to the same, you get the same results out of it’ (P003)</p> <p>‘I guess it’s just simple things in the process, like some people will write their behavioural interpretation before they start constructing their searches, some people will construct their searches and then do their BI. Some people will use the SSA, the BadMan SSA, some people won’t.’ (P005)</p> <p>‘if you’re reading hundreds of cases one after the other you need to make sure that you’re still focussing on each one in relation to your index one as well so it’s, it’s a very high level of concentration is required, it’s not just a case of reading it, yeah, then yes or no, you really have to think about each one that you’re interpreting so it just, I think it’s just the level of concentration that it requires for sustained, long periods of time where that’s solely what you’re doing.’ (P006)</p> <p>‘It’s experience and it’s, it’s, it’s, it’s being more comfortable with the risk element, of me being wrong.[...] I’m happier with that these days.’ (P007)</p>
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**SECTION 3: Challenges and future work**

<b>Themes</b>	<b>Quotations</b>
a) Challenges	<p>‘it might be that [FORCE NAME] will just write off and say they didn't look enough like each other to go and interview him. It might be that they request to go and interview him.’ (P001)</p> <p>‘it’s human error isn't it, and it's also it's on somebody's perspective of something.’ (P001)</p> <p>‘in fact sometimes if you include sort of a slightly different ethnicity they just dismiss it straight away[...] Which is frustrating.’ (P002)</p> <p>‘feedback is our biggest problem.’ (P003)</p> <p>‘quite often you’ll get OICs who’ll say this seems really unusual or uncommon, but actually we can help them, actually change that opinion, because obviously a lot of them might not have seen as many as we do.’ (P003)</p> <p>‘So actually a lot of my exclusion reasons are just not enough similarities to include.’ (P005)</p>

<p>b) Suggestions for improvements to ViCLAS</p>	<p>‘yeah you can’t search repetition.’ (P001)  ‘no option to change the order so that would be quite good, or if you could just do something where, yeah you kind of just, or you, not get rid of them, just kind of grey them out. So they’re not the ones that I really want to look at first, these are the ones I want to look at first, or you can, so you can look at like the geography and merge it.’ (P001)  ‘to be fair, ViCLAS is pretty flexible, for most things you can, you can get something, you can get it to almost work how you want it, just not always exactly.’ (P003)  ‘he goes on quite a bit at the end of the offence, but it’s just really not that helpful, because it’s, that is coded in exactly the same way as an offender saying, oh don’t tell anyone.’ (P004)  ‘‘Things like that’d be handy, or if actually if you’ve got an offender that he offends on a certain day or something like that, it would be really nice to be able to filter results like that. You’d still look through 200 cases, but you could just change the order in which you look at them, that’d be helpful.’ (P009)</p>
<p>c) Suggestions for new academic research</p>	<p>‘trying to find these consistencies, I think that’s the key, so for me saying like approach I find is a, that’s my personal preference as one thing to find that’s quite good at it, anything that backs those sort of, sort of arguments up is always, is always quite helpful.’ (P003)  ‘offenders who cross over between sexual offending and homicides.[...] And, not entirely sure what aspect at the moment, but you know, how we find link, how we link those because they, you know, they’re very difficult, if you’ve got a homicide and a rape, that you might have no behaviours similar really.[...] So if there’s anything that can be found around consistency around those types of offenders, but we’ve done stuff around, like internal stuff around multiple offenders and how multiple offender, how, how offenders may be different in multiple offender offences and individual.’ (P005)</p>

## CHAPTER 4 – Appendix 1: Coding guidelines

You have chosen to participate voluntarily in this interrater reliability study. This document outlines some guidelines for the coding process:

1. You are asked to enter four cases into ViCLAS, two in French and two in Dutch. If you experience difficulties coding in your second language, please do not hesitate to use a dictionary. If you are still experiencing issues, please speak to the researchers.
2. You will be asked to write some of the free text questions in a separate Word document; these questions will be marked \*SEE WORD DOCUMENT\*. You can find the document saved in: [FILE LOCATION HAS BEEN REMOVED FOR SECURITY REASONS]. Please save documents under your unique reference number – e.g. IRR.BE.15.001, 002, 003 etc., followed by case1, case2, case3, or case4. When answering the free text questions, please write in your native language. In this way, the influence of language issues on the results should be minimised.
3. For technical reasons, the coding will be conducted on a paper ViCLAS questionnaire. Since this is different from the usual method of input, you are asked to keep an empty copy of the computerised ViCLAS open, in order that you can refer to it while coding. You will sometimes be asked to refer to the computerised version for full options of behaviours not listed on the paper ViCLAS questionnaire. These questions are marked \*SEE COMPUTERISED VICLAS\*.

4. From the time you are given the first case, you will have three weeks to complete the coding. Once you have completed coding the cases, please make sure all Word documents are saved and return the paper questionnaires to the researchers.
  
5. Please do not discuss the coding of the cases with your colleagues while you are participating in this study; it is vital that coding is done independently.

CHAPTER 4 – Appendix 2: The interrater reliability results of the individual cases

*Table 9. The mean POA scores and number of variables reaching 70% and 80% thresholds in case one*

<b>Section</b>	<b>Number of variables</b>	<b>Mean POA</b>	<b>Range of POA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	7.00	66.77	35.00-100.00	3.00	42.86	3.00	42.86
<b>Victim</b>	18.00	48.54	0.00-100.00	6.00	33.33	6.00	33.33
<b>Offender</b>	15.00	73.45	13.50-100.00	9.00	60.00	9.00	60.00
<b>Add. Names</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Vehicle</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Scene</b>	6.00	68.50	33.33-100.00	3.00	50.00	3.00	50.00
<b>Add. Locations</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	19.00	71.24	20.75-100.00	10.00	52.63	8.00	42.11
<b>If victim died</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Add. information</b>	1.00	69.33	69.33	0.00	0.00	0.00	0.00
<b>TOTAL</b>	<b>66.00</b>	<b>64.80</b>	<b>0.00-100.00</b>	<b>31.00</b>	<b>46.97</b>	<b>29.00</b>	<b>43.94</b>

*Table 10. The mean PNOA scores and number of variables reaching 70% and 80% thresholds in case one*

<b>Section</b>	<b>Number of variables</b>	<b>Mean PNOA</b>	<b>Range of PNOA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	7.00	61.10	8.00-100.00	3.00	42.86	3.00	42.86
<b>Victim</b>	22.00	87.59	27.00-100.00	19.00	86.36	18.00	81.82
<b>Offender</b>	36.00	95.84	27.70-100.00	34.00	94.44	33.00	91.67
<b>Add. Names</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Vehicle</b>	15.00	100.00	100.00	15.00	100.00	15.00	100.00
<b>Scene</b>	7.00	77.32	20.33-100.00	4.00	57.14	4.00	57.14
<b>Add. Locations</b>	1.00	88.19	88.19	1.00	100.00	1.00	100.00
<b>Offence</b>	38.00	95.21	54.00-100.00	36.00	92.31	35.00	92.11
<b>If victim died</b>	9.00	100.00	100.00	9.00	100.00	9.00	100.00
<b>Weapon</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Add. information</b>	1.00	78.00	78.00	1.00	100.00	0.00	0.00
<b>TOTAL</b>	<b>138.00</b>	<b>92.25</b>	<b>8.00-100.00</b>	<b>124.00</b>	<b>89.86</b>	<b>120.00</b>	<b>86.96</b>

*Table 11. The mean POA scores and number of variables reaching 70% and 80% thresholds in case two*

<b>Section</b>	<b>Number of variables</b>	<b>Mean POA</b>	<b>Range of POA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	8.00	89.02	29.25-100.00	7.00	87.50	7.00	87.50
<b>Victim</b>	12.00	47.80	0.00-100.00	4.00	33.33	4.00	33.33
<b>Offender</b>	26.00	53.35	0.00-100.00	10.00	38.46	5.00	19.23
<b>Add. Names</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Vehicle</b>	12.00	35.90	0.00-100.00	2.00	16.67	2.00	16.67
<b>Scene</b>	7.00	66.95	0.00-100.00	5.00	71.43	2.00	28.57
<b>Add. Locations</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	20.00	51.91	0.00-100.00	7.00	35.00	6.00	30.00
<b>If victim died</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	1.00	49.50	49.50	0.00	0.00	0.00	0.00
<b>Add. information</b>	1.00	31.50	31.50	0.00	0.00	0.00	0.00
<b>TOTAL</b>	<b>87.00</b>	<b>53.93</b>	<b>0.00-100.00</b>	<b>35.00</b>	<b>40.23</b>	<b>26.00</b>	<b>29.89</b>

*Table 12. The mean PNOA scores and number of variables reaching 70% and 80% thresholds in case two*

<b>Section</b>	<b>Number of variables</b>	<b>Mean PNOA</b>	<b>Range of PNOA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	6.00	77.31	31.83-100.00	4.00	66.67	4.00	66.67
<b>Victim</b>	22.00	93.41	51.06-100.00	20.00	90.91	20.00	90.91
<b>Offender</b>	37.00	87.59	0.00-100.00	32.00	86.49	27.00	72.97
<b>Add. Names</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Vehicle</b>	15.00	74.05	27.00-100.00	8.00	53.33	8.00	53.33
<b>Scene</b>	7.00	80.40	31.67-100.00	5.00	71.43	5.00	71.43
<b>Add. Locations</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Offence</b>	39.00	87.07	2.67-100.00	33.00	84.62	29.00	84.36
<b>If victim died</b>	9.00	100.00	100.00	9.00	100.00	9.00	100.00
<b>Weapon</b>	1.00	93.51	93.51	1.00	100.00	1.00	100.00
<b>Add. information</b>	1.00	73.33	73.33	1.00	100.00	0.00	0.00
<b>TOTAL</b>	<b>139.00</b>	<b>87.02</b>	<b>0.00-100.00</b>	<b>115.00</b>	<b>82.73</b>	<b>105.00</b>	<b>75.54</b>

*Table 13. The mean POA scores and number of variables reaching 70% and 80% thresholds in case three*

<b>Section</b>	<b>Number of variables</b>	<b>Mean POA</b>	<b>Range of POA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	8.00	84.39	24.50-100.00	6.00	75.00	6.00	75.00
<b>Victim</b>	18.00	45.64	0.00-100.00	6.00	33.33	6.00	33.33
<b>Offender</b>	29.00	52.65	0.00-100.00	12.00	41.38	8.00	27.59
<b>Add. Names</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Vehicle</b>	13.00	57.30	6.00-100.00	6.00	46.15	4.00	30.77
<b>Scene</b>	8.00	53.39	22.00-75.67	1.00	12.50	0.00	0.00
<b>Add. Locations</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	26.00	41.81	0.00-100.00	4.00	15.38	3.00	11.54
<b>If victim died</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Add. information</b>	1.00	32.40	32.40	0.00	0.00	0.00	0.00
<b>TOTAL</b>	<b>103.00</b>	<b>51.60</b>	<b>0.00-100.00</b>	<b>35.00</b>	<b>33.98</b>	<b>27.00</b>	<b>26.21</b>

*Table 14. The mean PNOA scores and number of variables reaching 70% and 80% thresholds in case three*

<b>Section</b>	<b>Number of variables</b>	<b>Mean PNOA</b>	<b>Range of PNOA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	6.00	84.63	53.50-100.00	4.00	66.67	4.00	66.67
<b>Victim</b>	22.00	92.86	47.57-100.00	20.00	90.91	19.00	86.36
<b>Offender</b>	36.00	88.99	38.33-100.00	32.00	88.89	28.00	77.78
<b>Add. Names</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Vehicle</b>	13.00	75.51	8.00-100.00	8.00	61.54	8.00	61.54
<b>Scene</b>	8.00	74.70	39.79-99.00	5.00	62.50	3.00	37.50
<b>Add. Locations</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Offence</b>	39.00	86.71	27.96-100.00	33.00	84.62	26.00	66.67
<b>If victim died</b>	9.00	100.00	100.00	9.00	100.00	9.00	100.00
<b>Weapon</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Add. information</b>	1.00	42.67	42.67	0.00	0.00	0.00	0.00
<b>TOTAL</b>	<b>137.00</b>	<b>87.65</b>	<b>8.00-100.00</b>	<b>114.00</b>	<b>83.21</b>	<b>100.00</b>	<b>72.99</b>

*Table 15. The mean POA scores and number of variables reaching 70% and 80% thresholds in case four*

<b>Section</b>	<b>Number of variables</b>	<b>Mean POA</b>	<b>Range of POA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	8.00	72.33	24.60-100.00	5.00	62.50	3.00	37.50
<b>Victim</b>	21.00	61.24	0.00-100.00	9.00	42.86	7.00	33.33
<b>Offender</b>	17.00	76.39	17.00-100.00	11.00	64.71	7.00	41.18
<b>Add. Names</b>	1.00	10.71	10.71	0.00	0.00	0.00	0.00
<b>Vehicle</b>	12.00	7.54	0.00-17.00	0.00	0.00	0.00	0.00
<b>Scene</b>	7.00	54.67	0.00-100.00	3.00	42.86	3.00	42.86
<b>Add. Locations</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Offence</b>	24.00	57.54	0.00-100.00	11.00	45.83	9.00	37.50
<b>If victim died</b>	0.00	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<b>Weapon</b>	1.00	66.89	66.89	0.00	0.00	0.00	0.00
<b>Add. information</b>	1.00	40.00	40.00	0.00	0.00	0.00	0.00
<b>TOTAL</b>	<b>92.00</b>	<b>55.82</b>	<b>0.00-100.00</b>	<b>39.00</b>	<b>42.39</b>	<b>29.00</b>	<b>31.52</b>

*Table 16. The mean PNOA scores and number of variables reaching 70% and 80% thresholds in case four*

<b>Section</b>	<b>Number of variables</b>	<b>Mean PNOA</b>	<b>Range of PNOA</b>	<b>No. variables at 70%</b>	<b>% variables at 70%</b>	<b>No. variables at 80%</b>	<b>% variables at 80%</b>
<b>Administration</b>	6.00	79.89	41.83-100.00	4.00	66.67	4.00	66.67
<b>Victim</b>	22.00	83.45	0.00-100.00	18.00	81.82	16.00	72.73
<b>Offender</b>	37.00	93.68	0.00-100.00	35.00	94.59	35.00	94.59
<b>Add. Names</b>	1.00	73.63	73.63	1.00	100.00	0.00	0.00
<b>Vehicle</b>	15.00	85.26	56.00-100.00	12.00	80.00	10.00	66.67
<b>Scene</b>	7.00	78.19	19.00-100.00	5.00	71.43	4.00	57.14
<b>Add. Locations</b>	1.00	100.00	100.00	1.00	100.00	1.00	100.00
<b>Offence</b>	39.00	91.41	2.00-100.00	37.00	94.87	32.00	82.05
<b>If victim died</b>	9.00	100.00	100.00	9.00	100.00	9.00	100.00
<b>Weapon</b>	1.00	94.94	94.94	1.00	100.00	1.00	100.00
<b>Add. information</b>	1.00	37.67	37.67	0.00	0.00	0.00	0.00
<b>TOTAL</b>	<b>139.00</b>	<b>89.03</b>	<b>0.00-100.00</b>	<b>123.00</b>	<b>88.49</b>	<b>112.00</b>	<b>80.58</b>