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Author(s):	**Rachel E. Lovell, Ph.D., Danielle Sabo, Ph.D., Joanna Klingenstein, M.A., Daniel J. Flannery, Ph.D., Jiaxin Du, MS, Xinyue Ye, Ph.D., Laura Overman, M.A., MEd**
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Using Sentiment Analysis and Topic Modeling in Assessing the Impact of Police Signaling on Investigative and Prosecutorial Outcomes in Sexual Assault Reports

Authors

Rachel E. Lovell, PhD
Assistant Professor of Criminology
Department of Criminology and Sociology
Cleveland State University
2121 Euclid Ave
Cleveland, OH 44115
(216) 687-4526 | r.e.lovell@csuohio.edu

Danielle Sabo, PhD
Research Associate
Department of Criminology and Sociology
Cleveland State University
2121 Euclid Ave
Cleveland, OH 44115
(330) 720-2753 | d.n.sabo@csuohio.edu

Joanna Klingenstein, MA
Research Consultant
Scribe & Scholar Consulting, LLC
scribescholarconsulting@gmail.com
(609) 969-9425

Daniel J. Flannery, PhD
Dr. Semi J. and Ruth W. Begun Professor
Jack, Joseph and Morton Mandel School of Applied Social Sciences
Case Western Reserve University
10900 Euclid Ave
Cleveland, OH 44106
(216) 368-0109 | Djf6@case.edu

Jiaxin Du, MS
PhD student
Urban Data Science Lab
Texas A&M University, College Station
(973) 489-3129 | Jiaxin.Du@tamu.edu

Xinyue Ye, PhD
Harold L. Adams Endowed Associate Professor
Dept. of Landscape Architecture & Urban Planning & Dept. of Multidisciplinary Engineering
Texas A&M University, College Station
(419) 494-7825 | Xinyue.Ye@tamu.edu

Laura Overman, MA, MEd
Research Associate
Jack, Joseph and Morton Mandel School of Applied Social Sciences, Case Western Reserve University
10900 Euclid Ave , Cleveland, OH 44106
(216) 368-0155 | lto3@case.edu

Grantee's Contact Information
Case Western Reserve University
10900 Euclid Avenue
Cleveland, Ohio 44106
Phone +1-216-368-4510
Email spadocs@case.edu

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Summary

This study seeks to better understand if and how responding officers' written reports in a rape case impact case progression in the criminal justice process. Specifically, we aim to identify signaling in the narratives of police officers' rape reports that affect subsequent attrition. We specifically focus on the first step in the investigative process to elucidate facilitators and barriers to rape cases reaching a successful disposition.

Using a methodologically advanced approach to the issue of understanding the criminal justice response to rape, we employ machine learning methods—specifically natural language processing—and advanced statistical analyses to evaluate the narratives of over 5,600 police reports of rapes, where victims had SAKs collected in one large, urban jurisdiction over nearly two decades (primarily from 1993 to 2011). These reports contain large amounts of data that are analyzed using two computational methods. First, we conduct *sentiment analysis*, which involves identifying the direction and predictiveness (on case outcomes) of opinion and subjectivity in the text. Second, we conduct *text classification*, a statistical approach to identifying predictive (of case outcomes) phrases in the text.

This study addresses three Aims. Aim 1 assesses the presence and type of sentiment (positive versus negative, subjective versus objective) specific to rape in the responding officers' incident reports and, if sentiment is detected, how sentiment varies by the characteristics of the case, victim and suspect. Aim 2 assesses whether sentiments in the responding officers' reports are different in cases with increased investigative activity, and how the phrases contained in the incident reports vary depending on the level of investigative activity. Finally, Aim 3 is similar to Aim 2, except we focus on the most successful cases—whether sentiments in the responding officers' reports are different in cases that proceeded to

prosecution (the most successful cases in our study)—and how the phrases contained in the incident reports vary depending on whether the cases proceeded to prosecution.

Regarding Aim 1, we detected sentiment in the reports, which tended to skew near neutral/slightly negative and more subjective. The detected sentiment was also predictive across several victim and suspect characteristics and case outcomes.

Regarding Aim 2, incident reports connected to *Investigation Stalled* were more negative (as predicted) and less subjective words (not as predicted). Incident reports connected to cases with more investigative activity, *Investigation Forwarded for Prosecutorial Review*, were more negative (as predicted) and non-significant subjectivity (not as predicted). We also found that the phrases were different in reports where the cases stalled earlier in the process. The most predictive phrases for the *Investigations Not Stalled* and *Investigations Not Forwarded for Prosecutorial Review* cases mentioned the actions of the victims and the assigned detective, followed by phrases related to investigative leads, or lack thereof.

Regarding Aim 3, the most successful cases were more positive (as predicted) and more subjective (not as predicted). We also found that the phrases were different in reports where the cases were the most successful. The most predictive phrases in the cases that *Did Not Proceed to Prosecution* heavily emphasized actions that stall or stop a case from moving forward, such as prosecutorial decline, lack of investigative leads and negatively worded victim references/preferences.

In addition to the findings discussed in connection to the above Aims, we provide several additional products from this study including: (a) a protocol detailing the information extraction process for police reports (Appendix A); (b) an open-source, adaptable sentiment lexicon (Appendix B); (c) a pre-trained classifier based on statistical algorithms that flag

instances of signaling in police reports (Appendix B); (d) a list of signals that predict less successful investigations and prosecutions (Appendix B); and (e) a training protocol(s) for officers and detectives for how they respond to and report on rapes (Appendix C)—all of which can be adopted, adapted and implemented by other jurisdictions. We also provide a summary of the artifacts from this study in Appendix D.

These findings inform best practices related to investigating and prosecuting rapes. Law enforcement can use the findings to develop technological advancements/software and training protocol(s) for officers to improve their report writing and (by extension) their interactions with victims of sexual violence, and guide supervisors in identifying possible "red flags" in police reports that could affect victim engagement and investigations. An improved response to rape also increases victim engagement in the process, improving the likelihood of successful investigations and prosecutions that result in greater accountability for offenders, and improved community safety.

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Introduction

Despite police officers spending a significant amount of their time writing reports (Kanable, 2005) with little training, supervision (Carr et al., 1980; Gregory et al., 2011), glamour (Archambault et al., 2020) or enthusiasm (Kanable, 2005), police reports serve as the official record of a crime by documenting what an officer experienced and observed. Furthermore, police reports function as a vital evidentiary component of the criminal justice system for numerous entities, including investigators, prosecutors, defense attorneys, judges and jurors (Yu & Monas, 2020). The recommendations for report writing are often general, such as needing "accuracy, brevity, completeness; objectivity; a step-by-step account of the events that occurred; [and] details about the people and places involved" (Reynolds, 2012, p. 17). Less is known about if and how these recommendations are achieved (Yu & Monas, 2020) and the consequences of poorly- or well-crafted reports. Readers' perceptions and interpretations of text are strongly shaped by wording and syntax choice (Ask, 2018), which implies that how police report narratives are crafted is likely predictive of the cases' outcomes. Thus, might the way that information is expressed in police reports influence all that comes after it in the criminal justice process?

Among other outcomes, a successful police report also aids the court in prosecuting a case by capturing the statutory elements of the crime. Research using machine learning technology to analyze police reports suggests that for some types of crime, these statutory elements are often nuanced and not accurately described in the narrative (Kuang et al., 2017). Thus, the narrative should be tailored to the type of crime. Specifically for the crime of rape—a particularly difficult crime to investigate and prosecute (Long et al., 2022) with an extremely low conviction rate (Morabito, Williams, et al., 2019)—thorough incident and investigative reports are needed to support the statutory elements of the crime (e.g., force/non-consent,

penetration) for obtaining a successful prosecution (Archambault et al., 2020). Yet, rape reports are often poorly written (Archambault et al., 2020), and rape is unlike many other types of crimes due to the high and persistent levels of victim-blaming, victim disbelief and rape myth acceptance (Archambault et al., 2020) among the general population (Langhinrichsen-Rohling, Jules, et al., 2022), and within law enforcement (O'Neal & Hayes, 2019; Shaw et al., 2017). Moreover, experimental research indicates that the language used in narratives of fictitious rape reports influences how victims and their actions/inactions are interpreted by those not in law enforcement (Ask, 2018; Byrman, 2013; Niemi & Young, 2016). Little is known about how the language contained in the narratives of actual rape reports is interpreted by those *in* law enforcement, especially as it relates to victims and their actions/inactions. Thus, how should or could police reports specifically for rape be written to improve criminal justice outcomes?

After a rape, a responding officer—also known as a reporting officer—is the officer who first responds to the call, often a patrol officer who is frequently the victim's first contact with the criminal justice system. Thus, the officer's report is the first step in the reporting process. Besides attending to the victim's immediate needs, the responding officer is responsible for carrying out an initial investigation and gathering the most pertinent facts and evidence for an investigator follow up. Therefore, an investigator's first contact with a case often is not with the victim, but with the content of the initial report. Research indicates that police expend more effort on investigating cases where they believe the victim, or believe their case is worthy of investigation (R. Campbell & Fehler-Cabral, 2018; Kerstetter & Van Winkle, 1990). Thus, might the way that information is expressed *specifically in an incident report of rape* influence all that comes after it in the criminal justice process?

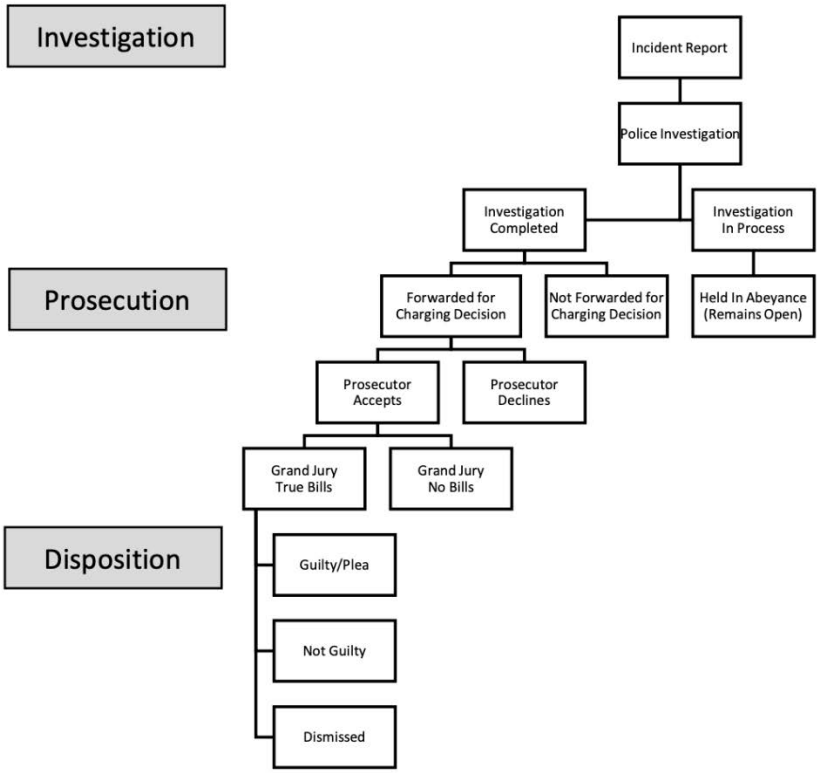
Using a particularly robust and methodologically novel approach to systematically and empirically examine a large number of reports—machine learning technology—this study fills a knowledge gap in the literature by exploring the nature of the information articulated in responding officers' incident reports of rape and how (whether intentionally or not) the expression of that information influences decision making, case flow and attrition. More specifically, do responding officers express negative opinions and subjective statements in documents that are supposed to be factual? If so, what do those opinions and subjective statements look like? Do those negative opinions and subjective statements signal information about the (lack of) credibility of the victim or the worthiness of a case to investigators and prosecutors? If so, do they impact how much activity is expended in the investigation and whether the case leads to a successful prosecution?

Review of Relevant Literature

Case Flow and Attrition in the Criminal Justice Process

The below summary of the criminal justice process is particularly relevant for this study's investigative and prosecutorial outcomes. The process for investigating and prosecuting rape is typically denoted by three key sequential phases: *Investigation*, *Prosecution* and *Disposition*. Police investigate rapes and then forward some of these cases to prosecutors for review. Prosecutors review for possible prosecution and then decide whether to file charges or not. If charges are filed, the case proceeds to grand jury, pre-trial and ultimately (if not dismissed), a final disposition. Thus, there is a "handing off" of a case as it proceeds through the criminal justice system. Figure 1 illustrates the *typical* decision-making process regarding case flow and attrition in a reported rape.

Figure 1: Process of Case Flow and Attrition for Reported Rape Cases



The *Investigation Phase* begins when an incident report is taken by a responding officer, who is responsible for gathering the most pertinent facts and evidence. This report is then forwarded for investigative follow-up. The investigator opens an investigation by obtaining and reviewing the necessary documentation (e.g., the incident report by the responding officer) and then makes decisions about what investigative activities should be completed. This typically includes contacting and interviewing (when applicable) the victim, witnesses and suspect; collecting and submitting applicable evidence (e.g., a sexual assault kit); and writing an investigative report that details the completed activities (Archambault et al., 2020; Lovell et al., 2018).

The *Prosecution Phase* begins when completed investigations are forwarded to prosecutors for a charging decision. Completed investigations that do not proceed are typically

closed out ("cleared") and classified as *Unfounded* or *Exceptional Clearance.* According to the FBI's definition, cases should only be closed by exceptional clearance if an offender has been identified (Federal Bureau of Investigation, 2018). However, in practice, exceptional clearance often includes cases that are closed due to lack of victim "cooperation" or engagement (at times, without identifying an offender), a prosecutor declining to charge or other reasons outside of law enforcement's control (Lovell, Overman, et al., 2020). *Unfounded* cases are those where an investigation was completed, and it was determined that a crime did not occur, according to the FBI's definition (Federal Bureau of Investigation, 2019). Investigations in progress but not closed are *Held in Abeyance*, meaning they are open pending further investigative leads. While the processes described here imply a firm hand-off of cases from police to prosecutor, the hand-off is often pliable in practice. Prosecutors frequently conduct pre-arrest screenings or confer with investigators informally prior to making an arrest or issuing a warrant, especially in potentially "problematic" or difficult cases. If prosecutors express reservations about the case, police do not proceed (Spohn & Tellis, 2011).

Once formally forwarded for a charging decision, prosecutors can decide to accept or decline to charge. Charged cases are then presented to the *grand jury*. The grand jury can either *No Bill (not indict)* or *True Bill (indict)*, meaning in the latter that they determined there was probable cause to believe the defendant committed the crime. Once indicted, the case proceeds to pre-trial and if not dismissed, to the Disposition Phase, which results in a *guilty verdict or plea, a not guilty verdict or a dismissal* (Ohio Prosecuting Attorneys Association, 2012).

Factors Influencing Case Flow and Attrition for Rape in the Criminal Justice Process

Regarding the outcomes of this study, below we summarize the research on case flow and attrition for rape. An estimated one in five women in the U.S. will be the victim of rape in their

lifetime (Smith et al., 2015). Even when reported to law enforcement, arrests and convictions are rare. Out of every 100 rapes, approximately a third are reported to law enforcement (Morgan & Thompson, 2020), 19 lead to arrest and five lead to a conviction (plea or guilty verdict) (Morabito, Williams, et al., 2019). As indicated in these statistics and as reported in other studies, the majority languish in the Investigative Phase, never reaching Prosecution (Lovell, Overman, et al., 2020; Morabito, Williams, et al., 2019).

As discussed in Lovell, Overman, et al. (2020) and summarized extensively in McGill et al. (2022), the research on the factors that predict rape attrition in the criminal justice process is expansive, but in general, these factors are frequently categorized as either "legal" factors (evidentiary facts and/or strength of the evidence) or "extra-legal" factors ("beyond" legal factors). Legal factors include whether the rape charge is one of several charges (Addington & Rennison, 2008); criminal severity, such as the presence of a weapon (Bouffard, 2000; Spohn & Tellis, 2018; Walfield, 2016), gratuitous injuries to the victim (Johnson et al., 2012; Morabito, Pattavina, et al., 2019; Spohn & Tellis, 2018; Walfield, 2016); delayed reporting (Morabito, Williams, et al., 2019; Spohn & Tellis, 2014); the presence of eyewitnesses (Morabito, Pattavina, et al., 2019; Spohn & Tellis, 2018); and whether or not a kit was collected (Johnson et al., 2012; Kelley & Campbell, 2013; Morabito, Pattavina, et al., 2019; Tasca et al., 2013).

Extra-legal factors often include actual or perceived victim cooperation (Craig, 2016; Kaiser et al., 2017; Kelley & Campbell, 2013; Murphy et al., 2014; Walfield, 2016); the victim-offender relationship (Beichner & Spohn, 2012; Du Mont & Myhr, 2000; Spohn & Holleran, 2001); race and age of the victim (Bouffard, 2000; O'Neal et al., 2015; Pattavina et al., 2016; Spohn & Holleran, 2001; Spohn & Tellis, 2012; Tellis & Spohn, 2008; Walfield, 2016); the location of the rape (Addington & Rennison, 2008; Bouffard, 2000); and victim credibility

(Alderden & Ullman, 2012; Beichner & Spohn, 2005; Hohl & Stanko, 2015; Jordan, 2004; Lievore, 2004; Morabito, Pattavina, et al., 2019; O'Neal et al., 2015; Quinlan, 2016; Spohn & Tellis, 2018). However, in practice, legal and extra-legal factors can, and often do, intersect. For example, should whether a victim defends themselves against their attacker(s) speak to the facts of the case, to the credibility of the victim or both?

Studies that examine extra-legal influences on cases come to conflicting conclusions, but mostly point to the fact that victim credibility, often influenced by rape myth acceptance, plays a significant role in case attrition (Shaw et al., 2017). Researchers are beginning to evaluate the effectiveness of interventions to address this, including how training influences their beliefs in rape myths (B. Campbell, 2022) and how changes in interviewing techniques impact victim engagement (Westera et al., 2011). To the best of our knowledge, no one has examined on a large scale the role of the responding officer in predicting case flow and attrition. Responding officers play a critical first step in effectively addressing rape and engaging victims. The lack of knowledge about how information from this initial encounter is conveyed to investigators and prosecutors limits possibilities for intervention.

Also discussed in Lovell, Overman et al. (2020) and Lovell and Langhinrichsen-Rohling (2022), the system heavily depends on victims' cooperation, but navigating the criminal justice system is notoriously difficult for victims of rape. Victims frequently report negative interactions (e.g., victim-blaming, insensitive behaviors and attitudes) with individuals within the criminal justice system—termed secondary victimization—which can lead to retraumatization and negative health impacts (R. Campbell, 1998). For example, R. Campbell and Fehler-Cabral (2018) found that in an attempt to manage an unmanageable workload, police in Detroit pushed victims to disengage with the process "by being jaded, by

being rude, by questioning them aggressively, by threatening them—and in the end, they blamed victims for the fact that no action had been taken in their case due to their 'lack of cooperation'" (pp. 96-97). However, victim cooperation is one of the strongest predictive factors in successfully prosecuting rape cases (Lovell, Overman et al., 2020; Morabito, Williams et al). Outcomes for victims are improved when they are perceived as credible, which is often a deciding factor in prosecuting rape cases (Beichner & Spohn, 2005; Bouffard, 2000; Kingsnorth & Macintosh, 2004). Victim advocates aid victims in communicating and cooperating with criminal justice officials, which prosecutors have noted positively affects their credibility (Gaines & Wells, 2017; Luminais et al., 2020). In addition to secondary victimization, victims may also experience institutional betrayal, which is the harm caused to victims of interpersonal violence by institutions through the institution's actions or inactions, often occurring in institutions that elicit strong feelings of trust and/or dependency among its citizenry, like law enforcement (C. P. Smith & Freyd, 2014).

In a study based on a subsample of the data presented here, Lovell, Overman et al. (2020) found that the two strongest predictors of a case proceeding to prosecution were whether a suspect was fully named (a legal factor) and whether the victim was engaged in the process (an extra-legal factor). The former is a common factor in all criminal justice adjudications in that cases cannot logistically proceed to prosecution without a named suspect (with a notable exception being when DNA profiles are indicted [Lovell, 2022]). The latter has already been discussed in the extra-legal factors section above.

Then, there are factors beyond both legal and extra-legal, such as those pertaining to departmental culture and decision-making, such as the prevalence of rape myth acceptance in police departments (Shaw et al., 2017; Sleath & Bull, 2017) and downstream orientation, which

is when police officers tend to pursue cases they believe prosecutors will accept, which has been shown to impact a case's likelihood of progression (Morabito et al., 2017; Pattavina et al., 2016). Decision-making by investigators (Addington & Rennison, 2008; Bouffard, 2000) and prosecutors (Beichner & Spohn, 2005, 2012) has also been found to impact case attrition, with some work focusing on the interaction between the two groups (Pattavina et al., 2016; Spohn & Tellis, 2014, 2018).

Methodological Limitations and Advancements

Since the perception of credibility by police, investigators and prosecutors is not easily assessed, in this section we summarize the variety of methods that have been employed to evaluate the factors that influence case flow and attrition in rape cases, including: mixed methods that perform quantitative analysis on large samples in conjunction with qualitative analysis of a more limited sample (Kelly et al., 2005; Spohn et al., 2014; Spohn & Tellis, 2012); relatively large scale projects that rely on logistic regression (Spohn et al., 2014; Spohn & Tellis, 2014; Stafford, 2022; Walfield, 2016); projects with smaller samples using logistic regression (Gray-Eurom et al., 2002); qualitative studies based on official documentation (Beichner & Spohn, 2012; Kelley & Campbell, 2013; O'Neal et al., 2014; Shaw et al., 2017; Soulliere, 2005; Spohn & Tellis, 2018; Tasca et al., 2013); qualitative studies that include contemporaneous interviews (Jordan, 2004; Kelly et al., 2005; Quinlan, 2016); statistical analyses of relatively small samples based on qualitative coding of police files, including multidimensional scaling (Brown et al., 2007) and multivariate modeling (Beichner & Spohn, 2012); and ethnographic methods, such as participant observation (Frohmann, 1997). These data collection methods and analyses are important to highlight because they reflect the double-bind of qualitative/quantitative methodology—large samples provide more robust statistical

analyses but cannot capture the nuance required to identify investigators' sentiments—yet, qualitative work is labor intensive and results in smaller samples.

Machine learning techniques offer potential solutions to this quandary, but as this technology has developed so rapidly, it has not been applied in this realm of research thus far. In general, it is difficult for researchers to obtain access to very large numbers of police reports, which is needed to "train" the models in machine learning (Güss et al., 2020). Kuang et al. (2017) applied machine learning to short police narratives to produce "ecologically more meaningful latent crime classes" that could be the starting point for "optimal crime prevention" (p. 1), demonstrating how machine learning can generate new leads for research and practice (holding similar promise for case flow and attrition). Karystianis et al. (2019) explore text mining techniques to identify abuse types and injuries in domestic violence narratives. Finally, Güss et al. (2020) summarize the challenges and lessons learned in using machine learning technology to analyze police reports as data, such as the difficulty in gaining access to reports or case files as researchers, lack of uniformity in reports, inconsistencies in report content, individual writing variations and biases, lack of suspect information and unqualified statements (e.g., if witness was not cooperative, why?). This is the first National Institute of Justice funded study exploring the social science implications of machine learning concerning case flow and attrition.

Signaling

Regarding the predictors in this study, this section defines signaling and summarizes the research on how language might influence decision-making and case flow and attrition. A signal is any information conveyed by the sender and received and interpreted correctly by the receiver, usually through language (Benz, 2011; Shannon & Weaver, 1949). Language is

framed by who we are and what we have experienced. Since the first point of contact in the criminal justice system for a victim is the responding officer (R. Campbell, 1998), they potentially have a strong influence on how the case proceeds via what we term *signaling*. Police reports provide insight into the "mental models" of police officers (for example, their heuristic decision-making process), as well as how they understand their task environment (the external environment of an organization that affects its ability to meet its goals) and how they communicate with peers. If framing bias is detected via language analysis in the mental model of officers (e.g., adherence to rape myths), it may help explain why cases fail to proceed. In short, this framing may unintentionally influence investigators or prosecutors to reduce the effort expended on a case.

Moreover, the language used by police officers in their rape incident reports creates a "word picture," communicating a specific image, which may or may not reflect reality (Renner, 2002). For example, a "word picture" describing two people voluntarily taking off their clothing depicts a consensual act ("She said they each took their clothes off by themselves"). While this might be technically accurate, it does not convey the involuntary nature of rape ("He threw her on the bed, took his shirt off and ordered her to take her clothes off") (Archambault et al., 2020). The habit of describing rape in terms of consensual sexual contact is not limited to law enforcement. Media reports of rape often describe rape in terms of "the victim had sex with" (Attenborough, 2014), or employ rape myths to describe the victim and the offender (O'Hara, 2012).

Research suggests that *rape myths* and *gender bias* can be detected in the organizational language of police (Shaw et al., 2017). Overt signaling—using disparaging language or stating outright doubt in the victim's credibility—is obvious in reports, although

sometimes inaccessible, as it is buried in figurative mountains of unstructured text. For example, in Detroit, researchers found extremely offensive language in police reports from rape cases that included an unsubmitted SAK (Shaw et al., 2017). In a shocking example of this, an officer wrote this about a 14-year-old victim who had been abducted raped, "This heffer [sic] is trippin" (Kaffer, 2015, para. 3). Thus, if signaling is present and detected in any police reports, it would most likely be in rape reports, especially in victims with specific vulnerabilities, such as prostitution (Shaw et al., 2017) and juvenile victims (O'Neal & Hayes, 2020). In contrast, with machine learning techniques in this study, we search for subtler language clues in the form of negative opinions and subjective statements about victims that can derail justice proceedings, in some cases, absent any intentionality.

Research on the first interaction between rape victims and police have zeroed in on the neurobiology of trauma and how it impacts victims' ability to recall events and why victims' emotional responses seldom mirror what police officers expect if they are not aware of this important research (R. Campbell, 2006; R. Campbell et al., 2008). This sets the stage for doubts about a victim's credibility to enter into the language contained in the report.

The content of the initial police report and the semantic signals being relayed to the investigating officer are interpreted by the investigator, influencing how they prioritize the case considering their numerous other cases. It can potentially direct the decisions they make in the investigation regarding the amount of investigative activity that is expended. Given officers' downstream orientation, the amount of investigative activity impacts prosecutorial outcomes. Furthermore, prosecutors know that police reports will be available to the defense and may take the tone of the report into account, as victim credibility also plays a role in their decision-making process (Archambault et al., 2020; Beichner & Spohn, 2012; Shaw et al., 2016).

Signaling, in terms of game theory and socio-linguistics, is not a novel topic, but the introduction of computer simulations and machine learning have reinvigorated the field recently (Argiento et al., 2009; Benz, 2011; Mühlenbernd & Quinley, 2013; Zhou et al., 2004; Zollman, 2005). Others have shown that sentiment in reports, as determined by word choice and syntax, can at least reflect the acceptance of rape myths, and Shaw et al. (2017) state, "Findings suggest that future research should examine the extent to which such statements predict rape case progression" (p. 602). To our knowledge, no previous research has attempted to define, document and quantify signaling and its impact on investigative and prosecutorial outcomes. By researching this understudied topic with machine learning, we add to the traditional literature on case flow and attrition while expanding the methodological tools available to researchers. Machine learning allows us to leverage the nuance of qualitative research on a scale previously seen only in quantitative assessments of case flow and attrition.

Police Report Writing

Below we review the literature on best practices related to police report writing and more specifically, rape report writing. Prior research suggests how a police report is written might influence how officers think about (Ask, 2018) and engage (B. Campbell, 2022) with victims of rape. Therefore, officers are advised to balance the need to be concise with the need to be thorough in police reports. There is limited research on preferable report lengths, but prior research documents that longer police reports are associated with "truthful reports" (victims providing truthful statements to police) (Quijano-Sánchez et al., 2018), and might be an indicator of how much effort was expended by the officer (Yu & Monas, 2020). Thus, reports that err on the longer side (likely implying more detail) vs. shorter are potentially connected to cases deemed as being "worthy" of more investigative activity (which are also the

cases with fewer victim criminal justice credibility issues), and/or an indication of officers having more time to craft longer, more detailed narratives (R. Campbell & Fehler-Cabral, 2018; Kerstetter & Van Winkle, 1990).

Within the context of minimizing victim blaming by adopting a victim-centered and trauma-informed approach (Langhinrichsen-Rohling, Lathan, et al., 2022), rape reports are recommended to: document all evidence collected during the initial reporting of the incident and the investigation, provide a video and/or audiotaped account of the crime from the victim's perspective, include video and/or audiotaped witness statements (in particular for those that corroborate victim's statements) and include the suspect's video and/or audiotaped statements, (in particular for those that corroborate victim's statements) (Archambault et al., 2020). In addition, the reports should also be written to capture the statutory elements of the crime and respond to common strategies used by the defense in rape cases (Archambault et al., 2020; Long et al., 2022). Thus, more recent guidelines suggest that counter to what is often taught to officers, to help offset victim blaming in rape cases, officers should consider documenting the victim's perspective and providing a fair account of corroborating evidence to support the victim's statement (Archambault et al., 2020; Strom et al., 2022).

Human-Detected (Potentially) Signaling Language

Regarding how the Aims were developed, this study has been strongly informed by a seven-year (and counting) collaboration with the Cuyahoga County SAK Task Force, led by the Cuyahoga County Prosecutor's Office, as their research partner. A sexual assault kit (SAK), also known as a rape kit, is a set of items used by medical professionals for collecting and preserving evidence from a victim of rape for investigation and prosecution. The U.S. Department of Justice's (DOJ) SAK Initiative was launched in 2015 to provide jurisdictions

with funding to test and follow up on testing hundreds of thousands of previously untested SAKs. The Cuyahoga County SAK Task Force, which began in 2013, has received millions of dollars in funding from the DOJ's SAK initiative to address the County's untested SAKs for over 5,000 SAKs that had never been submitted for DNA testing ("unsubmitted") and almost 2,000 SAKs that had some prior forensic testing, but did not use current methods for DNA testing ("previously submitted") for a total of nearly 7,000 rapes that included SAKs.

One of the main activities related to the research from the Cuyahoga County SAK Task Force is the extensive coding of the case files. Our coded database consists of over 600 discrete variables about the assault, the offender, the victim, the SAK, the investigation (at the time and current) and any prosecutorial activity (at the time and current) for nearly 2,000 of these rapes. This database is unique in its depth and breadth, and produces findings that counter what we know about rape and the people who commit it (Lovell et al., 2017, 2018, 2019; Lovell, Huang, et al., 2020; Lovell & Langhinrichsen-Rohling, 2022). However, this activity is extremely labor intensive. The coding of these nearly 2,000 case files has taken many years to code, clean, manage and analyze, not to mention the amount of time spent supervising and advising. Machine learning technologies allow us to build on this expertise while leveraging the benefits of automation, including speed, scale and reproducibility.

This study's research questions are the direct result of observations made by the research team when reading these police reports. We noticed that responding officers sometimes appeared to be making comments doubting the victim's credibility in ways similar to those documented in Detroit's unsubmitted SAKs (Shaw et al., 2017), and consistent with current understandings of rape myths. The following are examples of possible signaling from the cases we have coded. The first case file, the lead researcher read a detailed report about the abduction, rape and extended

captivity (~24 hours) of a 13-year-old by two males, aged 15 and 19, while she was walking home from middle school in 1994. After describing this disturbing incident, the report stated, *"Victim is a habitual runaway and she has run away from home three times prior…."* In a 2000 rape, after a brief description of the circumstances leading up to the crime, the officer described the victim by stating in parentheses—*"(Female is a known prostitute and crack cocaine abuser)."* In a 1995 rape, the responding officer overtly discredited the victim by stating, *"…during interview victim was unable to keep eye contact, laughed during questioning, victim was obviously being deceptive."* In a 1995 rape of a juvenile, a responding officer included details that appear not to be pertinent (e.g., past sexual history) and described the rape in consensual terms (e.g., "full intercourse"), "*Juvenile has had sex in the past. Rape kit to be completed. Reporting person advised to obtain further information on [Suspect]. Full intercourse per juvenile."* In a 2005 police report, a responding officer's statement seemed to be, perhaps, inadvertently discrediting the victim's account of events or misinterpreting how trauma can impact behavior, *"We observed no bruises, contusions on the female nor were her clothes disheveled. At times during the interview she smirked as if it was funny, but she did show signs that she was in pain or discomfort."* As illustrated above, many of these statements are made without sufficient context as to why the seemingly problematic language is included. The research design employed here expands on predictive signaling language contained in these observations, but in a more theoretically and methodologically advanced way.

Aims and Significance of the Study

This study seeks to better understand if and how responding officers' written reports in a rape case impact case progression in the criminal justice process. Specifically, we aim to identify signaling in the narratives of police officers' rape reports that affect subsequent

attrition. We specifically focus on the first step in the investigative process to elucidate facilitators and barriers to rape cases reaching a successful disposition.

Using a methodologically advanced approach to the issue of understanding the criminal justice response to rape, we employ machine learning methods—specifically natural language processing—and advanced statistical analyses to evaluate the narratives of over 5,600 police reports of rapes, where victims had SAKs collected in one large, urban jurisdiction over nearly two decades (primarily from 1993 to 2011). These reports contain large amounts of data that are analyzed using two computational methods. First, we conduct *sentiment analysis*, which involves identifying the direction and predictiveness (on case outcomes) of opinion and subjectivity in the text. Second, we conduct *text classification*, a statistical approach to identifying predictive (of case outcomes) phrases in the text.

This study addresses three Aims. Aim 1 assesses the presence and type of sentiment (positive versus negative, subjective versus objective) specific to rape in the responding officers' incident reports and, if sentiment is detected, how sentiment varies by the characteristics of the case, victim and suspect. Aim 2 assesses whether sentiments in the responding officers' reports are different in cases with increased investigative activity, and how the phrases contained in the incident reports vary depending on the level of investigative activity. Finally, Aim 3 is similar to Aim 2, except we focus on the most successful cases—whether sentiments in the responding officers' reports are different in cases that proceeded to prosecution (the most successful cases in our study)—and how the phrases contained in the incident reports vary depending on whether the cases proceeded to prosecution.

In addition to the findings discussed in connection to the above Aims, we provide several additional products from this study including: (a) a protocol detailing the information

extraction process for police reports (Appendix A); (b) an open-source, adaptable sentiment lexicon (Appendix B); (c) a pre-trained classifier based on statistical algorithms that flag instances of signaling in police reports (Appendix B); (d) a list of signals that predict less successful investigations and prosecutions (Appendix B); and (e) a training protocol(s) for officers and detectives for how they respond to and report on rapes (Appendix C)—all of which can be adopted, adapted and implemented by other jurisdictions. We also provide a summary of the artifacts from this study in Appendix D.

These findings inform best practices related to investigating and prosecuting rapes. Law enforcement can use the findings to develop technological advancements/software and training protocol(s) for officers to improve their report writing and (by extension) their interactions with victims of sexual violence, and guide supervisors in identifying possible "red flags" in police reports that could affect victim engagement and investigations. An improved response to rape also increases victim engagement in the process, improving the likelihood of successful investigations and prosecutions that result in greater accountability for offenders, and improved community safety.

Data

Description of the Data

The analytical sample in this study consists of 5,638 police reports of rape from a population of 6,071 rape reports from the Cleveland Division of Police (CDP)—all of which have an associated sexual assault kit (SAKs), also known as a rape kit—that was recently forensically tested for DNA as a part of the Cuyahoga County SAK Initiative. As a research partner, and in collaboration with the Cuyahoga County SAK Initiative, we were given access to all rape reports with associated SAKs from CDP (n = 6,071).

These rape reports cover nearly a quarter century—from 1991 through 2015—although the vast majority (>99%) were between 1993 through 2011. While the initiative's focus is on previously untested kits from 1993 through 2011, in some instances, if an offender was linked to a rape outside of this time frame, they incorporated this rape with the untested SAK's investigation and prosecution. This explains why our sample includes some rape reports before 1993, and after 2011. While some other jurisdictions "chipped away" at their older, untested kits over time, very few kits were regularly submitted by CDP for forensic testing before the late 2000s (Luminais et al., 2017). This implies that our analytic sample is derived from untested SAKs representing almost all the SAKs collected in this jurisdiction during the time period. CDP rape reports not associated with a SAK were not available to the research team.

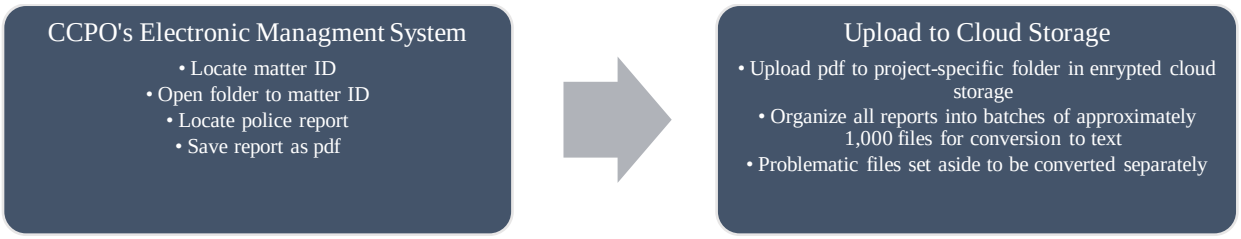
In terms of the information contained in the reports, these rape reports typically include: (a) an *incident report* taken by the responding officer(s) who is tasked with gathering the most pertinent facts and evidence, and then forwarding the report to an investigator (detective) for follow-up, and (b) a *summary of the investigative activity on the case as noted by the investigator*, which (if reviewed by a prosecutor) includes some information about the prosecutorial review of the case. If applicable, the reports often denote the *charging decision* of the prosecutor. If charges are filed, the reports often include details about the grand jury. Given that these are police files, information as to the final adjudication of the case (guilty, not guilty, plea, dismissed) is typically not included. Cuyahoga County has both a city and county prosecutor's office, where simplistically, felonies are prosecuted at the county level and misdemeanors at the city level; however, rapes are first reviewed by Cleveland prosecutors before being forwarded to County prosecutors, even though the city prosecutor's office does not

prosecute rape. The mention of prosecutorial involvement in the reports could indicate Cleveland and/or the County.

Extraction Process

Our team extracted the CDP rape reports (in pdf format) from the Cuyahoga County Prosecutor's Office's (CCPO) electronic management database. This electronic database is set up so that each police report is housed in a "folder" with an associated "matter ID," which is a unique ID assigned by the CCPO that corresponds to a previously untested SAK. Each folder contains numerous documents needed for potentially prosecuting rape. Thus, the police reports were not kept in one large extractable file that could be downloaded. To extract the police reports, the research team opened each folder, found the police report and saved it to a project-specific folder in an encrypted cloud platform for every single rape report. The team was provided a spreadsheet by the CCPO of all "matters" and access to these matters via their electronic management system. From this spreadsheet, we limited matters to only those labeled as CDP reports (over 90% of all the matters). Figure 2 illustrates the extraction process for the 6,353 potential reports to be located in the case management system.

Figure 2: The Extraction Process



During the extraction process, we noted in our tracking database if the police report was present, missing or if the report was completely unreadable. We also noted the police report number ("Records Management System [RMS] number") to further aid in identifying duplicate reports. Of the 6,353 reports potentially eligible for extraction, 6,071 (95.6%) were extracted,

and 282 (4.4%) were not. The reasons why reports were not extracted included: the matter folder did not contain a police or investigative report, the report was a duplicate, the matter was erroneously labeled as CDP rape but was not, the report was associated with a very small number of victims who reported a large number of rapes (determined to be unfounded and associated with the victim's severe mental illness) and problems extracting, or other anomalies in the report. Table 1 details the extraction process that resulted in a list of 6,071 CDP rape reports from the SAK Initiative—all in PDF format.

Table 1: Descriptive on Extracted Report Reports

	n
Extracted from electronic management database for analysis	*6,071*
Cleaned	5,638
Had investigative narrative in report	5,189
Had no investigative narrative in report	456
Not cleaned	433
Duplicate	70
No text file	110
No incident report narrative	229
Not CDP case	13
Not a rape	8
Unreadable	3
Not extracted from electronic management database for analysis	*282*
Total N	**6,353**

Conversion Process

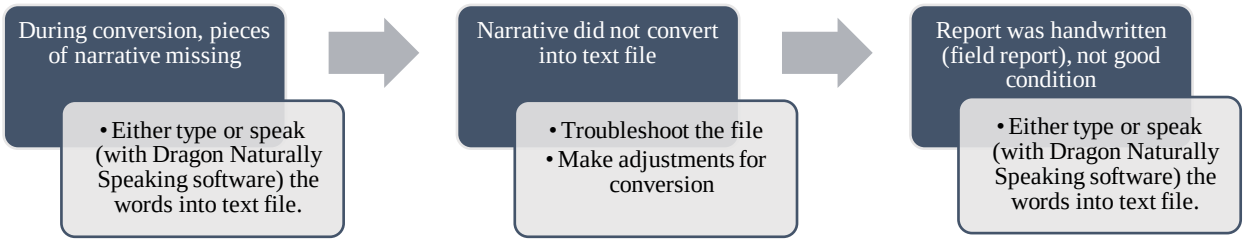
To better understand the most efficient and effective method for converting the files, the research team conducted a pilot conversion project using a commonly used and commercially available optical character recognition software, OmniPage, on a sample of 43 extracted files. OmniPage is designed to take pdfs or images and convert them into malleable documents. The process for conversion in this pilot included uploading a police report, asking the software to read it and copying and pasting the text out of the police report into a Word document. Researchers then reviewed the document for typos and misspellings. Of the 43 files in this pilot,

17 were used by a research team member to document how long this entire process took, and then compared OmniPage to the Adobe edit text function, or dictating the narrative into Word. OmniPage was clearly the fastest and most accurate, averaging around 5 minutes per document. Narrating ranged from 5 to 35 minutes per report while Adobe averaged around 8 minutes per report (this timing did not include coding information from the police report). Additionally, researchers recorded the quality of the text-reading conversion. Even in the best-case scenario (a pdf file that was clearly legible and in the most updated report version), OmniPage had difficulty reading the whole report. Adobe struggled to read the text as well and would often insert symbols or other characters, which created more editing work. As a result of this pilot, the research team developed an algorithm to automate the conversion process, as discussed below.

As described in Figure 2, once the 6,071 reports were extracted, they were saved in one of the seven batch's project-specific folders in the encrypted cloud platform for conversion from pdf to text. Of these, 5,638 were eligible to proceed to the quality control process (92%). The conversion process was automated separately for each batch. We utilized *pdfMiner* (Shinyama, 2015) and optical character recognition programs (Smith, 2007). Those python programs first extracted the text from the pdf. Once the reports were scanned and stored as images in the pdf, the optical character recognition was able to recognize the text and translate the image data to text data by recognizing the characteristics in the images.

During the extraction and conversion process, we identified several types of problematic files: (a) parts of the narrative were missing from the text file, (b) the narrative did not convert into text correctly and (c) the pdf was handwritten or not in good condition and needed to be processed manually. Of the 5,638 reports, 320 had to be converted to text files differently, as detailed in Figure 3.

Figure 3: The Conversion Process



Quality Control Process

Preparing the data for the text analysis required a lengthy quality control process. For the standard police report in our dataset, the narrative included numerous typos, abbreviations or words that did not convert correctly. These variations present significant difficulties for machine learning when trying to learn, read and understand the text. Therefore, we conducted a time-consuming quality control cleaning process for each now-converted file by having a member of the research team read each text file to correct inaccurate text conversions. This was accomplished via a three-step quality control procedure: (Step 1) During the automation process, researchers standardized date formats and edited common abbreviations in the reports into their full word or phrase (the common abbreviations list was developed by the research team, as detailed below). (Step 2) Upon automating a batch (~1,000 reports), research team members manually checked that in each report: (a) all the narratives from the police report were successfully transferred into text format, (b) typos, strange characters and errors in the text file (e.g., the text did not convert) were corrected, abbreviations had been converted to their full word or phrase and dates were in a standardized format. (Step 3) Once these tasks were completed, notify the team that the batch was cleaned and ready for analysis.

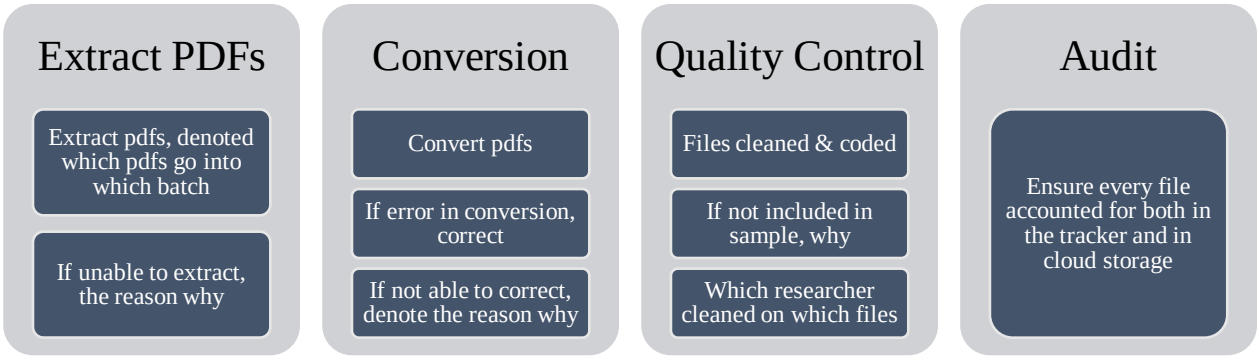
The research team generated a list of common abbreviations and what they stand for, which were spelled out during the automated conversion process. In some instances, one

abbreviation could mean multiple things. Therefore, during this process, the two main options were inserted into the narrative. During the quality control process, the research team chose, based on context, which abbreviation was correct and deleted the other. For example, Lt. can mean Lieutenant or Light, so for every Lt. in the reports, “Lieutenant or Light” was inserted in its place.

Tracking Method and Coding Details

Due to the large number of files in the dataset, all at different phases in the process, we developed a tracker that noted where each file was in the process—extraction, conversion and quality control (Figure 4). At the end of all these phases, the team conducted an audit to ensure all potential files in our sample were accounted for and had completed all the phases. The sum of all these activities resulted in a total analytical sample of 5,638 rape reports, which equates to 3,931,481 words and 9,157 pages of text.

Figure 4: Data Preparation



Coding Case Outcome

Since this study's main dependent variables pertain to what happened with the case—how far along it made it in the process (investigative activity) and how the case ended (case outcomes)—our team manually coded case outcomes while conducting quality control (both the *in vivo* text used in the closing reasons and categorical response options for the closing reasons).

This was the chosen method for coding after pilot analyses of reports indicated that the language used in the reports often varied across reports (see Figures 5 and 6); therefore, case outcomes could not be reliably automated from text files.

The closing language was found either in the incident report or in the investigative report. While also coding outcomes, the research team noted whether the police report mentioned a suspect or victim's criminal history, hypothesizing that this could be an indicator of signaling and might be useful for computer training. Lastly, we noted in the dataset if the police report lacked an incident report.

Figure 5: Example of In Vivo Closing Language

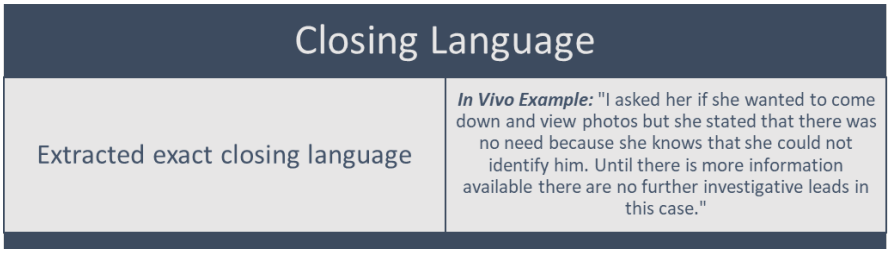
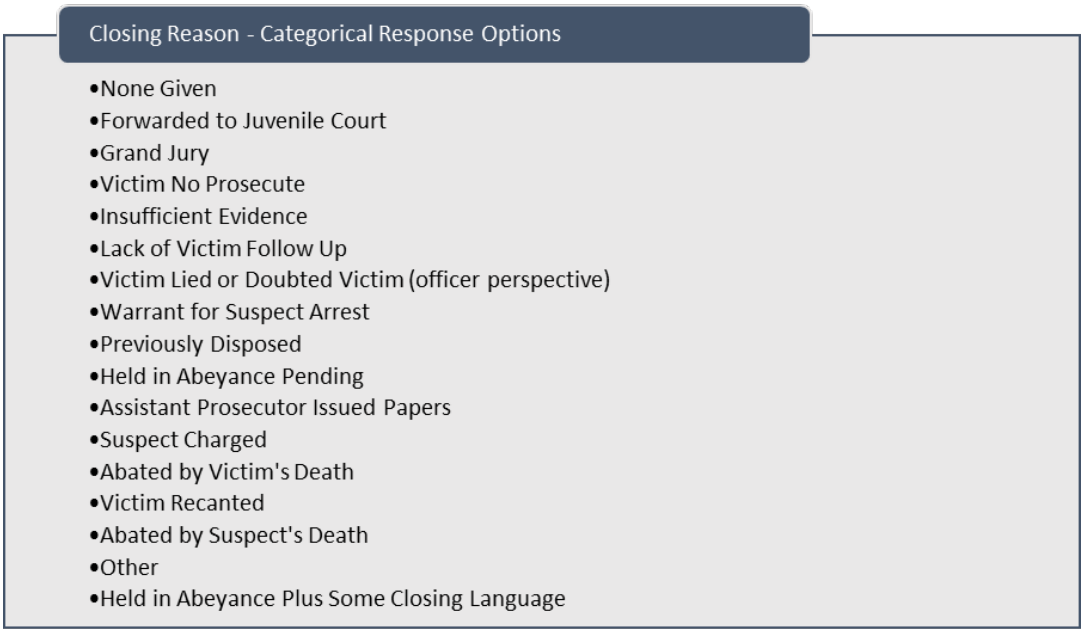


Figure 6: Closed-Ended Response Categories for Closing Reasons



Discrete Fields

Each police report has a section at the top of the report where responding officers enter data into discrete fields or use drop-down response options—often called a “front sheet.” These fields included information such as the date of the incident, the date of the report, the victim's name, the suspect's name, the address of the incident, weapon use, property recovered, arrest information, etc. Figure 7 is an example of a redacted CDP front sheet from the dataset.

Figure 7: Example of a Redacted CDP Front Sheet

CLEVELAND POLICE DEPARTMENT
OFFENSE/INCIDENT REPORT

Date: 07/02/2014
Page: 1

Case Description:
Rape

Case Number: [redacted]99

Primary Victim: NONE

Date/Time Reported: 10/03/94 6:11 Hrs.
Date/Time Occurred: 10/01/94 0:30 Hrs.
Date/Time Between : 10/01/94 0:30 Hrs.
Location Occurred : [redacted]
Cross Street . . :
Area: District 4 Section: Zone 413 Grid:

Dispatch Incident Type:
All Other

Case Status: Open Disposition: Disp. Date:

Offense Number: 1
Crime Code: 07020 RAPE
Statute . : 2907.02
Stat Desc : RAPE
Location Type . : Street
Statute ORI/Group . : S
Counts . . . . . : 001
NCIC Code . . . . . : Sex asslt
Offense Date . . . :
Abandoned Structure : NO

Attempted/Committed : Completed
Criminal Activity . :
Agg Aslt/Home Crcmst:
Larceny/Theft Offnse:
Scene/Location Type2:
Victim Drug Related :
Property Damage . .

SUBJECTS:

Complainant: Present Information
[redacted]
Phone: [redacted]
[redacted]
Race : Black Sex: FEMALE D.O.B [redacted] Age: 36
Dr Lic #: St:

Suspect . : Present Information
SUS #1
Phone:

In the grant application, we did not propose to collect data from the front sheets because it was unclear at that time whether this information could be extracted via an automated process. However, preliminary analyses of early batches indicated that the highly structured and

procedural way these reports were written presented problems in identifying potentially signaling words about a victim's credibility. We hypothesized that perhaps we could "get past" much of the procedural words/phrases and potentially identify "signaling" language by examining the characteristics of victims and/or suspects. Moreover, we hypothesized that the information contained in these discrete fields, specifically about the demographics of victims and whether a suspect was named at the time, were vital to better differentiating sentiment and predictive phrases in the reports. For example, the qualitative literature suggests that female juvenile victims often have some of the highest levels of disbelief from police officers. Thus, by comparing juvenile victims with non-juvenile victims, we might more effectively undercover signaling words or phrases.

The research team tried several different methods to automate this process. There are two popular ways in the natural language processing community to perform information extraction. The first is a rule-based method (often a complex set of rules)—meaning to define rules and keywords to locate the information, e.g., the beginning of the document is the report Record Management System (RMS) number. The second way is to use machine learning or artificial intelligences (AI). We did not find any model that effectively extracted information because the formatting in the reports was inconsistent, and there were not enough training data to inform the information extraction model. Additionally, these types of fields were difficult for the computer to extract due to significant variations in the spacing of this information, and the quality of the pdf (see Appendix A). While the information was extracted in a database, our research team's assessment of the accuracy of the extracts indicated that automated extraction was not reliable. Researchers reviewed 328 reports comparing the victim's date of birth extracted versus the original report. Only seven reports (or 2%) of 328 extracted the dates correctly. The computer

did not extract a date of birth for 291 (89%) of this sample (although there was a date of birth to extract). For 18 reports (5%), the date that was extracted and labeled as the victim's date of birth was not actually the victim's date of birth from the report. For the remaining 12 reports, there was no date of birth to extract. One report had multiple victims, which the computer was unable to discern.

Since the pdf-to-text conversion process was not able to accurately automate the extraction of the discrete fields, we determined that the information was important enough for the analysis to justify collection—even if that meant hand-entering these fields for all 5,638 reports. While police reports from CDP were mainly consistent in their format/structure, most of the reports were in one of four different formats (see Appendix A). Given the scale of the undertaking to enter data from the discrete fields, the team developed a coding procedure for the four major format types of the police reports to ensure consistency across multiple coders. Our guiding coding approach was to capture information as it was noted in the reports, even if the data in those fields appeared to be erroneously entered by police officers (e.g., the front sheet mentioned one victim, but the narrative mentioned two victims) (see Appendix A for more information). We selected variables from the front sheets that were most consistently captured across the four format types including: dates of report and crime, victim's name(s), dates of birth for the victim and suspect, location of the assault, address of the victim and suspect, race/ethnicity and gender of victim and suspect and the criminal charge information listed on the report. During this process, we identified and indicated any additional reports that lacked an incident report or had little narrative text in the incident report (e.g., procedural text, and not the victim's account of the assault to the patrol officer). These reports were either removed from the sample (Table 1) or flagged as such in the database. Lastly, to aid in de-identifying the reports,

we ran a name entity recognition model (implementation in python package *Spacy*) on the textual data to remove victims', suspects' and officers' names and addresses.

Given the novelty of using machine learning technology with criminal justice data, included as part of our deliverables for this project, Appendix A provides a summary protocol detailing the extraction, conversion and cleaning processes.

Measures

Predictors: Sentiment Analysis Scores

Sentiment analysis is an approach to text classification that assesses the degree of opinion or emotion in a given text, positive, negative or neutral (Ignatow & Mihalcea, 2018). Sentiment analysis can be conducted by referencing a prebuilt, open-source library of sentiments ("*sentiment lexicon*"), which are textual collections of positive or negative sentiment (e.g., OpinionFinder). The *sentiment score* indicates how positive, negative or neutral the words comprising the narrative are. It is a float that ranges from [-1.0, 1.0], where 0.0 is neutral, positive words are assigned a positive value and negative words a negative value, and the final sentiment score is the sum of positive and negative scores. This means that the higher the score, the greater the number of positive words making up the text.

Rule-based sentiment scoring and machine learning-based sentiment scoring are two commonly used methods in sentiment analysis. Given that we did not have training data for the machine learning method, and a machine learning-based sentiment tool trained on police reports does not exist, we applied the rule-based method. The rule-based method requires a dictionary or lexicon that defines the sentiment score on each word, with specific rules to handle negation and relationship in words such as adverbs (e.g., *very happy* is more positive than *happy*). We used the lexical-based approach to calculate the *sentiment score* for the entire report, the maximum

sentiment score for the paragraph and the maximum sentiment score for the sentence (Baccianella et al., 2010). There are multiple, open-access general sentiment lexicons or dictionaries. They vary slightly in their scoring calculations. The sentiment scores used here were derived from the *SentiWordNet 3.0* dictionary (Guerini, Gatti & Turchi, 2013).

To cross-check the quality of sentiment lexicon dictionaries, we used another lexicon, *TextBlob*, to derive polarity and subjectivity scores. Polarity scoring is conceptually the same as sentiment scoring in that it is a float within the range [-1.0, 1.0], where -1 is very negative, and +1 is very positive, so the higher the score, the more positive the sentiment is in the text. *Subjectivity* refers to personal feelings, views or beliefs. Subjective expressions come in many forms, e.g., opinions, allegations, desires, beliefs, suspicions and speculations (Liu & Zhang, 2012). *Subjectivity scores* in the report quantify the amount of personal opinion and factual information contained in the text. Subjectivity floats within the range [0.0, 1.0], where 0.0 is very objective, and 1.0 is very subjective. In other words, the higher the score, the more personal opinion rather than factual information is contained in the text.

While not a sentiment measure per se, we also measured the length of the report via a word count of the incident report. We used the default tokenizer in the python *nltk* package to calculate word count. Word counts can be an indicator of the amount of detail provided to responding officers by victims, and/or the level of effort expended in writing the report by the responding officer. In the proceeding sections, *sentiment analysis measures* refer to the three different sentiment analysis measures.

Predictors: Demographics and Other Characteristics of the Cases

In terms of the demographics, victims' and suspects' race/ethnicity are based on what was indicated in the discrete fields of the front sheet. The police reports did not include a "check

all that apply" racial categorization (e.g., no multi-racial options). On certain forms, Hispanic was listed as a race (e.g., a choice of White, Black, Asian or Hispanic). Other forms listed Hispanic as an ethnicity, allowing for the combination of race and ethnicity, such as Black Hispanic, White Hispanic or other Hispanic. However, given the inconsistency that race and ethnicity are documented in the different forms of the reports over time, if the reports indicated Hispanic (whether Black or White [no instances of Other Hispanic in the dataset]), the person was coded as Hispanic in these analyses. Thus, *Victim/Suspect Black* refers to victims/suspects who were identified in the police reports as African American, not Hispanic; *Victim/Suspect White* refers to victims/suspects who were identified in the police report as White, not Hispanic; *Victim/Suspect Hispanic* refers to victims/suspects who were identified on the police reports as Hispanic (race or ethnicity); *Victim/Suspect Other* refers to victims/suspects who were identified on the police report as a race other than White, Black or Hispanic.

Victim's/suspect's age (at the time of the assault) was determined based on their date of birth (if provided) and the date of the assault. Given the age demographics of victims and the Ohio criminal statutes related to rape and age (Ohio Revised Code, 2021), the victim's age was also grouped as *Victim less than 13 years of age, Victim 13-17 years of age or Victim 18 years of age or older. Runaway* defines a minor (less than 18 years of age) who was in the process of leaving their place of residence, be it their home or a residential setting, without custodial consent. Runaway cases are coded as such based on keywords searched in the narratives, such as "runaway" and "unruly"—while these two terms are not necessarily equivalent, they were the two commonly used words in reports to describe these types of cases. *Suspect fully named* indicates if the suspect (or in the case of multiple suspects, if at least one of the suspects) is fully named (first and last name) in the suspect section of the police report's front sheet. *Suspect*

criminal history mentioned in the report refers to any mention of a suspect's prior criminal history in the narrative of the police report, such as prior arrests and convictions. This was coded during the quality control process. *Victim criminal history mentioned in the report* refers to any mention of a victim's prior criminal history in the police report, such as prior arrests and convictions, also coded during the quality control process. *Victim not believed* refers to cases where there was investigative follow-up on the case, and the closing language indicates either the victim was lying/doubted, or the victim recanted. *Victim no engagement* refers to cases where there was investigative follow-up on the case and, per the closing language, the case was closed due to a lack of victim follow-up with investigators, or due to the victim declining prosecution. In terms of case outcomes, *Unfounded* refers to cases closed after a police investigation determined a crime did not occur, as defined by the Federal Bureau of Investigation's Uniform Crime Report (Federal Bureau of Investigation, 2013). A case is coded as unfounded if the term was mentioned in the narrative of the investigative follow-up, in the title or footer of the report. *Year of the report* was collected from the RMS number and information provided on the front sheet. *Number of victims, Gender of Victim/Suspect* and *Gender of Victim/Suspect* are derived from the front sheet.

Outcomes

Case outcomes are measured in two ways: (a) where the case stopped in the criminal justice system process—a measure of investigative activity—and (b) whether the case proceeded to prosecution—a measure of a "successful" case outcome in this study. In terms of investigative activity, we categorized cases as follows:

(a) *No Investigation*—cases with no indication in the police report of any investigative activity, but this could also mean cases where the investigative report is missing,

(b) *Investigation Stalled*—cases with an indication in the police report of investigative follow-up, but the case was closed without being forwarded to a prosecutor for review,

(c) *Investigation Forwarded for Prosecutorial Review (stopped after review)*—cases with an indication in the police report of investigative follow-up and the case being forwarded to a prosecutor for review, but the prosecutor declined to pursue the case further, and

(d) Proceeded to Prosecution—cases where there was an indication in the police report of investigative follow-up and the case being forwarded to a prosecutor, and the prosecutor accepted the case.

Given that approximately a quarter of the cases proceeded to prosecution (see Table 2), and the more limited information contained in the case files as to whether a case led to a successful adjudication (often defined as a guilty plea or conviction), we categorize the successful cases as those that *Proceeded to Prosecution*.

Methods

Machine learning techniques of textual data provide several important benefits to the more traditional social science methods of analyzing textual data (e.g., human manual qualitative and quantitative coding). Machine learning techniques can analyze large quantities of text and/or larger samples in much less labor- and time-intensive ways. Additionally, machine learning techniques or methods can also detect patterns in text that human analysis techniques are not able to discern (DiMaggio et al., 2013) .

There are numerous types of machine learning models for analyzing textual data. All machine learning models involve learnable parameters, as opposed to the pre-defined fixed

parameters, as is common in more traditional methods for analyzing textual data, which can be adjusted based on the data. Typically, in machine learning, several models are tested for fit and efficiency, and based upon information on those metrics ("performance"), the results from the best or better fitting methods are presented.

Preprocessing of Text

In this study, before the text could be analyzed using machine learning models, it had to be preprocessed via tokenization, which is the process of separating the text into pieces a machine can understand. This was done by treating white spaces and punctuation as explicit word boundaries. After chunking the police reports into word pieces, we then represented the police reports using the bag-of-words representation. It was equivalent to creating the dummy variables of the word count for each word in the documents. We removed capitalization in the text, as it did not carry extra explanatory information. We also removed punctuation and then put it back in, because we found the sentence mark helped us understand the context of the words. Lastly, we removed words that appeared less than five times because they were likely either typos or strange words and did not provide significant information on the case outcomes.

Since the goal of the study was to explore if and how responding officers' written reports in rape cases impact investigating officers' decision-making and how cases proceed (or fail to proceed) in the criminal justice process, we limited our textual analysis of the data to the incident reports taken by the responding officers. Responding officers are tasked with writing the incident report of the crime. The incident reports should document the most pertinent facts and evidence and then be forwarded to an investigator (detective) for follow-up. The case outcomes derive from primarily the investigative reports; however, in these analyses (e.g., sentiment analyses and

text classification), we did not include the text from the investigation or prosecution of the case (e.g., text connected to what occurred after being forwarded for investigative follow-up).

Sentiment Analysis

We present sentiment analyses on what should be objective text, as police reports should only contain pertinent facts, not opinions, and what is pertinent is often unclear, and is based upon details provided by the victim.

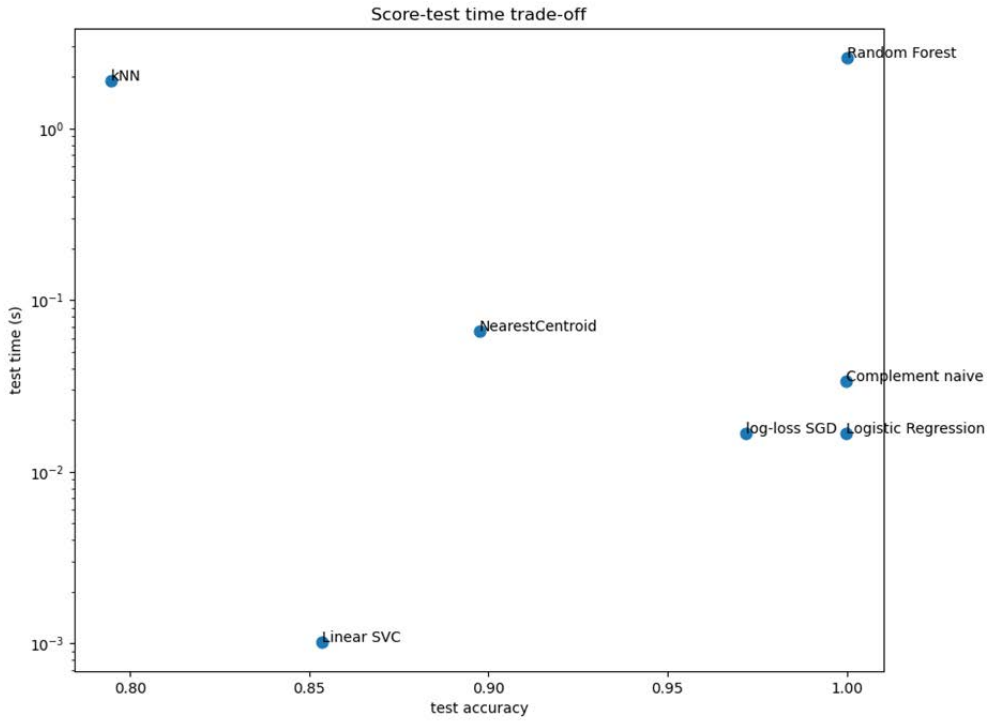
Text Classification: Trigrams

We originally proposed to use topic modeling using *Latent Dirichlet Allocation (LDA),* where "each topic is a distribution of all observed words in the texts such that words that are strongly associated with the text's dominant topics have a higher chance of being included" (Ignatow & Mihalcea, 2018, p. 210). Topic modeling is used for discovering abstract topics from a collection of documents. We conducted LDA in our preliminary analyses of these data; however, the results produced topics that were almost all procedural words and did not provide the more substantive phrases that might speak to signaling. Therefore, we instead employed a similar technique—discussed as *trigrams*—that produced more substantively interpretable phrases, as detailed below.

Within the text classification methods implemented in *scikit-learn* instead of single-word representations, we explored predictive phrases in the text via two words phrases (*bigrams*, e.g., "issued papers") and three words phrases (*trigrams*, e.g., "issued papers for"). Trigrams are the most informative, as they give more contextual information. Preliminary analyses resulted in trigrams that were almost exclusively procedural in nature and did not provide the more substantive phrases that might speak to signaling. In order to "get past" some the highly procedural phrases, we removed the trigrams that appeared in more than 50% of the text, as these

were procedural phrases that provided little signaling information. We then trained several supervised machine learning methods to classify the police reports. Figure 8 provides information on which of the employed machine learning methods best fit the data based on the score-test time trade-off, where the better fitting models are those with the highest level of accuracy and the lowest test time. Based upon these data, we present the trigrams for two methods—logistic and complement Naïve Bayes.

Figure 8: Score-Test Time Trade-Off for Text Classification Methods



The best fitting method was logistic regression (Method 1). Logistic regression is a linear model for classification, also known as logit regression, maximum-entropy classification (MaxEnt) or the log-linear classifier. The probabilities describing the possible outcomes of a single trial are modeled using a logistic function. For notational ease, we assumed that the target y_i took values in the set {0,1} for data point i. Once fitted, the method predicts the probability of the positive class $P(y_i=1|X_i)$ as

$$\hat{p}(X_i) = \operatorname{expit}(X_i w + w_0) = \frac{1}{1 + \exp(-X_i w - w_0)}.$$

As an optimization problem, binary class logistic regression with regularization term $r(w)$ minimizes the following cost function:

$$\min_w C \sum_{i=1}^{n} \left(-y_i \log(\hat{p}(X_i)) - (1 - y_i) \log(1 - \hat{p}(X_i))\right) + r(w).$$

The second best fitting method (Method 2) used the Complement Naive Bayes algorithm (ComplementNB or CNB), which is a Bayesian learning approach commonly used in Natural Language Processing (NLP). For example, the program guesses the tag of a text, such as an email or a newspaper story, using the Bayes theorem. CNB is an adaptation of the standard multinomial naive Bayes (MNB) algorithm that is particularly suited for imbalanced data sets. Specifically, CNB uses statistics from the *complement* of each class to compute the model's weights. The parameter estimates for CNB are more stable than those for MNB. Further, CNB regularly outperforms MNB (often by a considerable margin) on text classification tasks.

Assuming the conditional independence between every trigram appearing in the narratives, Naive Bayes (Rennie, Shih, Teevan, & Karger, 2003) was used to detect the most predictive trigrams in the reports. Bayes' theorem states the following relationship, given the case outcomes and dependent trigrams appearance x_1 through x_n:

$$P(y \mid x_1, \ldots, x_n) = \frac{P(x_1, \ldots, x_n)}{P(y)P(x_1, \ldots x_n \mid y)}$$

Using the naive conditional independence assumption that

$$P(x_i|y, x_1, \ldots, x_{i-1}, x_{i+1}, \ldots, x_n) = P(x_i|y),$$

for all *i*, this relationship is simplified to

$$P(y \mid x_1, \ldots, x_n) = \frac{P(y) \prod_{i=1}^{n} P(x_i \mid y)}{P(x_1, \ldots, x_n)}$$

Since $P(x_1, \ldots, x_n)$ is constant given the input, we used the following classification rule:

$$P(y \mid x_1, \ldots, x_n) \propto P(y) \prod_{i=1}^{n} P(x_i \mid y)$$

$$\Downarrow$$

$$\hat{y} = \arg\max_{y} P(y) \prod_{i=1}^{n} P(x_i \mid y),$$

and Maximum A Posteriori (MAP) estimation to estimate P(y) and $P(x_i \mid y)$. The former was then the relative frequency of the case outcome *y* in the training set. Laplace smoothing was used in the estimation of the probability distributions to avoid assigning a probability of zero when documents contained words never previously seen within a case outcome.

Human-Detected Sentiment and Themes

Given that the sentiment lexicon in these analyses is based on non-criminal justice text, and text classification frequently requires a qualitative exploration and interpretation (Ignatow & Mihalcea, 2018), we also conducted human-detected sentiment and thematic analyses on portions of the data. These human-detected analyses provided a contextual understanding and validation of the machine-detected findings. For example, what does it mean to have "negative" text? What is being described? How is it being described? And who is being described negatively (if applicable)?

Sentiment scores for polarity, subjectivity and overall sentiment were assigned to each report using methods detailed in the previous section. These scores were uploaded into an spreadsheet for each police report analyzed (N = 5,635). Two of the highest sentiment analysis scored reports were selected at random from a list of the top 20 police reports in the spreadsheet for each sentiment measure—subjectivity, polarity and overall sentiment. Additionally, two median sentiment analysis-scored police reports for each sentiment analysis measure were randomly selected from the middle of the data file between reports numbered 2,810 to 2,830. Finally, for each sentiment analysis measure, two randomly selected police reports were chosen from the bottom 20 of the sentiment-scored Excel data file. The original narratives for each of

these police reports (n = 18) were then qualitatively hand coded. The qualitative thematic codes were developed around a family of codes describing victim characteristics, perpetrator characteristics, the year in which the assault took place, total word count for the narrative and other thematic issues that arose in the case (e.g., how the case closed, levels of violence, alcohol/drug use). Each of these coded words were then imported into a free word cloud software that allows for visual customization of the thematic coding. Word clouds are a straightforward way to represent textual data visually. These visual designs highlight more frequently used words, codes or themes by allowing them to occupy more prominence (i.e., size) in the final representation (McNaught & Lam, 2010). Word clouds can be used for the preliminary analysis of text and validation of findings (McNaught & Lam, 2010). The larger or more prominent the coded word(s), the more frequently it occurred across the 18 sentiment analysis-scored police reports.

Results

Tables 2 and 3 provide the descriptive statistics for the discrete and continuous variables in our dataset. Table 4 indicates that the mean sentiment score is very close to zero in these data. Again, sentiment can be thought of as the degree of opinion (*general*)—positive, negative or neutral—in the text (Ignatow & Mihalcea, 2018). The near-zero mean for this measure is an indicator of the more neutral and formulaic nature of police reports. The polarity score can be interpreted similarly to sentiment score in our reports—just from a different open-source dictionary. The mean polarity score is slightly negative—the only negative mean among the three different types of sentiment measures. Subjectivity is a measure of the degree of *personal* opinion in the reports rather than factual information. The mean subjectivity score is positive and the highest of the three different types of sentiment analysis measures, which means the reports

are more subjective than objective in language overall. Taken together, the mean scores for these three different sentiment analysis measures demonstrate that these reports generally are not highly opinionated and/or tend to skew slightly negative and are more subjective. Lastly, word counts indicate that there are an average of 415 words in the incident reports.

Aim 1

Aim 1 assesses to what extent: (a) sentiment is present and, if present, the nature of the sentiment, and (b) sentiment varies by the characteristics of the case, victim and suspect—in particular for reports that are most likely to have negative opinions or statements about a victim's credibility.

Aim 1's hypotheses:

H_{1A}: Sentiment is present in the reports and skews negative and subjective.

H_{1B}: Sentiment is more negative and subjective in reports where victims: were not believed by officers, have traditionally been viewed more negatively by police officers and not engaged in the criminal justice process—lending support that negative, subjective sentiment might indicate signaling.

Preliminary analyses explored which sentiment analysis measures should be used—the maximum score for the entire incident *report*, the maximum score for the *paragraph* or the maximum score for the *sentence*. Sentiment analysis measures for the entire incident report were chosen for two reasons. First, there was a great deal of variation from report to report in the number of paragraphs contained in the incident report, and even more variation when examining by sentence. Second, the descriptive analyses on the distribution of the maximum paragraph and sentence scores indicated they were significantly skewed. Thus, the presented maximum sentiment analysis statistics are based on the entire incident report.

Table 2: Characteristics of the Reports for the Discrete Variables

Characteristics of report, victim and suspect	*n*	*f*
Incident report		
Has incident report	5,570	98.8
No or limited incident report	68	1.2
Decade of report		
1990s	2,280	41.0
2000s	2,931	52.6
2010s	356	6.4
Decade of (sexual) assault incident		
1980s	1	<0.1%
1990s	2,277	40.9
2000s	2,939	52.8
2010s	350	6.3
Number of victims		
One victim only	5,539	98.2
More than one victim	99	1.8
Gender of first victim		
Female	5,236	94.7
Male	291	5.3
Race/Ethnicity of first victim		
Black/African American	3,547	64.6
White/Caucasian	1,790	32.6
Hispanic (of any race)	138	2.5
Other race	16	0.3
Age of first victim		
Less than 13 years of age	654	11.9
Between 13 and 17 years of age	1,238	22.6
18 years of age or older	3,585	65.5
Gender of second victim		

Female	67	69.8
Male	29	30.2
Race/Ethnicity of second victim		
Black/African American	65	69.1
White/Caucasian	28	29.8
Hispanic (of any race)	1	1.1
Other race	0	0.0
Age of second victim		
Less than 13 years of age	31	34.8
Between 13 and 17 years of age	15	16.9
18 years of age or older	43	48.3
Suspect age		
Only non-minor(s) involved (at least 18 years old)	2,119	84.7
More than 1 suspect (at least one suspect is a minor & at least one suspect not a minor)	25	1.0
Only minor(s) involved (less than 18 years old)	359	14.3
Gender of first suspect		
Female	40	0.9
Male	4,640	99.1
Race/Ethnicity of first suspect		
Black/African American	3,472	77.2
White/Caucasian	854	19.0
Hispanic (of any race)	159	3.5
Other race	13	0.3
Gender of second suspect		
Female	39	6.8
Male	532	93.2
Race/Ethnicity of second suspect		
Black/African American	394	75.5
White/Caucasian	110	21.1

Hispanic (of any race)	15	2.9
Other race	3	0.6
Gender of third suspect		
Female	8	4.8
Male	158	95.2
Race/Ethnicity of third suspect		
Black/African American	114	75.0
White/Caucasian	35	23.0
Hispanic (of any race)	2	1.3
Other race	1	0.7
Gender of fourth suspect		
Female	3	5.2
Male	55	94.8
Race/Ethnicity of fourth suspect		
Black/African American	41	78.8
White/Caucasian	11	21.2
Hispanic (of any race)	0	0.0
Other race	0	0.0
Gender of fifth suspect		
Female	3	15.8
Male	16	84.2
Race/Ethnicity of fifth suspect		
Black/African American	12	66.7
White/Caucasian	6	33.3
Hispanic (of any race)	0	0.0
Other race	0	0.0
Gender of sixth suspect		
Female	3	30.0
Male	7	70.0
Race/Ethnicity of sixth suspect		

Black/African American	7	70.0
White/Caucasian	3	30.0
Hispanic (of any race)	0	0.0
Other race	0	0.0
Gender of seventh suspect		
Female	1	33.3
Male	2	66.7
Race/Ethnicity of seventh suspect		
Black/African American	1	33.3
White/Caucasian	2	66.7
Hispanic (of any race)	0	0.0
Other race	0	0.0
Any suspect fully named		
Fully named	3,124	55.3
Not fully named	2,514	44.7
First suspect named		
Fully named	3,106	62.6
Not fully named	1,816	37.4
Second suspect named		
Fully named	214	37.2
Not fully named	346	62.8
Third suspect named		
Fully named	48	28.1
Not fully named	120	71.9
Fourth suspect named		
Fully named	17	29.6
Not fully named	38	70.4
Fifth suspect named		
Fully named	6	30.0
Not fully named	14	70.0

Sixth suspect named		
Fully named	4	44.4
Not fully named	5	55.6
Seventh suspect named		
Fully named	2	66.7
Not fully named	1	33.3
Victim criminal history		
Mentioned in report	27	0.5
Not mentioned in report	5,611	99.5
Suspect criminal history		
Mentioned in report	287	5.1
Not mentioned in report	5,351	94.9
Case outcomes and characteristics		
Investigation		
No investigation indicated in report	474	8.4
Investigation occurred as indicated in the report	5,164	91.6
Of those with an investigation as indicated in the report		
Investigation stalled before being forwarded to prosecution	1,338	25.9
Investigation not stalled	3,826	74.1
Of those with an investigation and it did not stall (as indicated in the report)		
Investigation forwarded for (prosecutorial) review	2,307	60.3
Investigation not forwarded for (prosecutorial) review	1,519	39.7
Of all cases, did the case		
Proceeded to prosecution	1,519	26.9
Did not proceed to prosecution	4,119	73.1
Case stalled at investigation or prosecution		
Investigation stalled for reasons known or unknown	1,045	18.5
Investigation closed – all other closing reasons	4,119	73.1
No investigation	474	8.4
Victim not believed		

Indication victim not believed or lied	158	2.8
No indication victim not believed or lied	5,480	97.2
Victim engagement		
Case closed due to lack of victim engagement (lack of victim follow-up, or victim did not want to prosecute)	2,296	40.7
Case closed for all other reasons	3,342	59.3
Case was closed as unfounded		
Unfounded	386	6.8
Not unfounded	5,252	93.2
Victim identified as a runaway in the report		
Runaway	64	1.1
Not a runaway	5,574	98.9
Suspect arrested		
Suspect was arrested	1,186	21.4
Suspect was not arrested	4,352	78.6

Table 3: Characteristics of the Reports for the Continuous Variables

	n	*M (SD)*	*Min*	*Max*
Demographics				
Age of victims (years)				
Victim 1	5,477	23.85 (12.31)	0.00	95.00
Victim 2	89	21.14 (17.09)	0.00	83.00
Age of suspects (years)				
Suspect 1	2,478	29.37 (11.81)	6.00	89.00
Suspect 2	169	24.66 (10.83)	6.00	58.00
Suspect 3	38	20.40 (7.71)	9.00	46.00
Suspect 4	14	20.21 (5.86)	13.00	37.00
Suspect 5	3	16.00 (1.00)	15.00	17.00
Suspect 6	3	15.67 (2.52)	13.00	18.00
Suspect 7	2	15.00 (2.83)	13.00	17.00
Sentiment analysis scores				
Subjectivity	5,638	.2517 (.0554)	.1069	.5875
Subjectivity (standardized)	5,638	.0000 (1.0000)	-2.6111	6.0573
Polarity	5,638	-.0120 (.0373)	-.1394	.2147
Polarity (standardized)	5,638	.0000 (1.0000)	-3.4103	6.0691
Sentiment score	5,638	.0021 (.0080)	-.0246	.0336
Sentiment score (standardized)	5,638	.0000 (1.0000)	-3.3550	3.9528
Max sentence subjectivity	5,638	.8097 (.1946)	.1245	1.0000
Max sentence polarity	5,638	-.3299 (.1549)	-1.000	.0000
Max sentence sentiment score	5,638	-.1027 (.0693)	-.7693	.0000
Max paragraph subjectivity	5,638	.8564 (.1297)	.1341	1.0000
Max paragraph polarity	5,638	-.3020 (.1751)	-1.000	.0000
Max paragraph sentiment score	5,638	-.1185 (.0766)	-.7693	.0000
Word count of incident report	5,638	415.09 (251.53)	0.00	2694.00

Difference of Means Testing

To assess the presence and type of signaling, Tables 4 and 5 present the results for the difference of means for the three sentiment analysis measures plus word count by: (a) the characteristics of the victims and suspects, and (b) the reports most likely to have signaling language because they were closed as unfounded, had explicit statements about disbelieving the victim's account or were where victims were not engaged in the process according to the reports. The results provide insight into which reports might have the highest prevalence of signaling language and the nature of that signaling (e.g., more negative, subjective).

The mean number of words in the incident reports is higher in cases: with female victims, non-Black victims, White victims, Hispanic victims, victims 13-17 years of age (vs. victims younger than 13 or older than 17), victims less than 18 years of age, at least one suspect fully named, at least one suspect's criminal history mentioned in the report, not unfounded and victims engaged in the investigation. Cohen's d point estimates indicate that word count has a large effect on many of the variables of interest in the study. As a continuous variable, the younger the victim, the more words the incident report has. For the variables pertaining to victims (e.g., victim's age, gender, race/ethnicity), the presented analyses pertain to only the first victim listed in the report (more than 98% of the cases) because our manual coding of the data indicated that when there was more than one victim, the demographic information for the second victim was more prone to data entry errors by the officers. These errors frequently took the form of officers entering in information connected to witnesses or reporting persons who were not the victim into the field for victim 2 instead of in the fields for witnesses or reporting persons.

Subjectivity scores in the incident reports are higher (indicating more personally opinionated text/tone) in cases: with Black victims, non-White victims, victims younger than 13

years of age, at least one suspect fully named and at least one suspect's criminal history mentioned in the report.

Polarity scores in the incident report are higher (indicating more positive text/tone) in cases: with non-Black victims, White victims, victims younger than 13 years of age, at least one suspect fully named, not unfounded and victims engaged in the investigation. The correlation matrix indicates that the younger the suspect (presented as a continuous variable instead grouped), the lower the polarity score (more negative).

Sentiment scores in the incident report are higher (indicating more opinionated text/tone) in cases: where at least one suspect is fully named, at least one suspect's criminal history is mentioned in the report, not unfounded and there is no evidence in the report of victims not being believed by officers.

Table 4: Difference of Means Results for Sentiment Analysis Measures Including Word Count for Predictors and Case Outcomes

Sentiment Analysis Scores	Female victim (n = 5,150)		Male victim (n = 279)		p value	Cohen's d
	M	SD	M	SD		
Word count	415.65	247.84	380.13	246.64	**.020**	-.143
Subjectivity	.251	.055	.258	.052	.061	.115
Polarity	-.012	.037	-.008	.041	.091	.104
Sentiment	.002	.008	.002	.008	.573	-.035
	Black victim (n = 3,480)		Non-Black victim (n = 1,913)		p value	Cohen's d
	M	SD	M	SD		
Word count	405.46	240.06	430.92	260.30	< **.001**	.103
Subjectivity	.253	.056	.248	.053	**.002**	-.089
Polarity	-.013	.037	-.011	.036	**.021**	.066
Sentiment	.002	.008	.002	.008	.335	-.027
	White victim (n = 1,760)		Non-White victim (n = 3,633)		p value	Cohen's d
	M	SD	M	SD		
Word count	429.31	260.81	407.31	240.81	**.003**	-.089
Subjectivity	.248	.053	.253	.055	**.003**	.086
Polarity	-.011	.036	-.013	.037	**.031**	-.063
Sentiment	.002	.008	.002	.008	.381	-.025
	Hispanic victim (n = 137)		Non-Hispanic victim (n = 5,256)		p value	Cohen's d
	M	SD	M	SD		
Word count	457.11	248.44	413.38	247.61	**.041**	-.177
Subjectivity	.248	.052	.251	.055	.475	.062
Polarity	-.011	.036	-.012	.037	.745	-.028
Sentiment	.003	.008	.002	.008	.407	-.072
	Other race victim (n = 16)		Non-other race victim (n = 5,377)		p value	Cohen's d
	M	SD	M	SD		
Word count	383.50	302.43	414.58	247.55	.616	.125
Subjectivity	.252	.045	.251	.055	.989	-.003
Polarity	-.006	.028	-.012	.037	.499	-.169
Sentiment	-.001	.008	.002	.008	.142	.368

	Victim less than 13 years of age (n = 628)		Victim 13 years of age or greater (n = 4,751)		p value	Cohen's d
	M	SD	M	SD		
Word count	414.81	256.71	414.76	247.12	.996	.000
Subjectivity	.257	.054	.251	.055	**.013**	-.105
Polarity	-.008	.040	-.013	.037	**.002**	-.139
Sentiment	.002	.008	.002	.008	.248	-.049
	Victim 13-17 years of age (n = 1,214)		Victim younger than 13 or older than 17 (n = 4,165)		p value	Cohen's d
	M	SD	M	SD		
Word count	441.85	245.59	406.87	248.47	< **.001**	-.141
Subjectivity	.250	.055	.252	.055	.467	.024
Polarity	-.013	.038	-.012	.037	.286	.035
Sentiment	.002	.008	.002	.008	.323	.032
	Victim 18 years of age or older (n = 3,537)		Victim less than 18 years of age (n = 1,842)		p value	Cohen's d
	M	SD	M	SD		
Word count	405.46	246.99	432.63	249.70	< **.001**	.110
Subjectivity	.251	.055	.253	.055	.299	.030
Polarity	-.013	.036	-.011	.038	.211	.037
Sentiment	.002	.008	.002	.008	.930	-.003
	Suspect fully named (n = 3,063)		Suspect not fully named (n = 2,476)		p value	Cohen's d
	M	SD	M	SD		
Word count	455.08	268.82	357.90	205.58	< **.001**	-.338
Subjectivity	.249	.055	.255	.056	< **.001**	.190
Polarity	-.008	.038	-.018	.036	< **.001**	-.229
Sentiment	.004	.008	.000	.008	< **.001**	-.605
	Suspect criminal history mentioned (n = 281)		Suspect criminal history not mentioned (n = 5,258)		p value	Cohen's d
	M	SD	M	SD		
Word count	583.81	318.79	402.44	239.51	< **.001**	-.743
Subjectivity	.233	.049	.253	.056	< **.001**	.353
Polarity	-.013	.032	-.012	.037	.629	.026
Sentiment	.004	.007	.002	.008	< **.001**	-.244

	Victim criminal history mentioned (n = 26)		Victim criminal history not mentioned (n = 5,513)		p value	Cohen's d
	M	SD	M	SD		
Word count	417.12	342.21	411.61	246.85	.935	-.022
Subjectivity	.250	.065	.252	.055	.849	.038
Polarity	-.023	.034	-.012	.037	.141	.290
Sentiment	.005	.006	.002	.008	.107	-.317
	Unfounded (n = 382)		Not unfounded (n = 5,157)		p value	Cohen's d
	M	SD	M	SD		
Word count	373.27	220.49	414.48	249.00	**.002**	.167
Subjectivity	.252	.055	.252	.055	.982	.001
Polarity	-.020	.034	-.011	.037	< **.001**	.229
Sentiment	-.003	.008	.003	.008	< **.001**	.768
	Evidence victim not believed (n = 156)		No evidence victim not believed (n = 5,383)		p value	Cohen's d
	M	SD	M	SD		
Word count	394.21	240.42	412.15	247.54	.372	.073
Subjectivity	.251	.060	.252	.055	.860	.014
Polarity	-.016	.041	-.012	.037	.222	.099
Sentiment	-.001	.008	.002	.008	< **.001**	.361
	Lack of victim engagement (n = 2,278)		Victim engaged (n = 3,261)		p value	Cohen's d
	M	SD	M	SD		
Word count	371.75	211.87	439.51	265.87	< **.001**	.276
Subjectivity	.252	.055	.251	.056	.563	-.016
Polarity	-.014	.035	-.010	.038	< **.001**	.107
Sentiment	.001	.008	.003	.008	< **.001**	.180

Note: Victim variables only pertain to first victim listed in the report.

Table 5: Correlation Matrix for Continuous Measures

Continuous variables	n	1	2	3	4	5	6
1. Sentiment score		--					
2. Polarity score	5,539	.124***	--				
3. Subjectivity score	5,539	-.187***	.386***	--			
4. Word count	5,539	.068***	-.117***	-.148***	--		
5. Victim 1 age	5,379	-.027	-.018	-.013	-.046***	---	
6. Suspect 1 age	2,418	-.007	.113***	.018	.025	.464***[a]	---

Note: *** < .001. [a] n = 2,405

Sentiment Analysis Measures Across Time

Given that the reports cover nearly a quarter of a century, we explored variations in the sentiment analysis measures (plus word counts) across time. The results indicate all the sentiment analysis measures have remained consistent over the observation period. Figures 9 through 12 specify that for most of the 1990s through the 2010s, the word counts are stable (with the demonstrated variation in the word counts deriving from the smaller number of reports prior to 1993 and after 2011). Figure 10 shows that when examining word count by decade, the average incident report increases by an average of 13 words from the 1990s to the 2000s, and then stays constant through the 2010s. Sentiment, polarity and subjectivity are also stable over the years and even decades, with a small increase in subjectivity and a small decrease in polarity starting around 2002-2003.

Figure 9: Word Count by Year

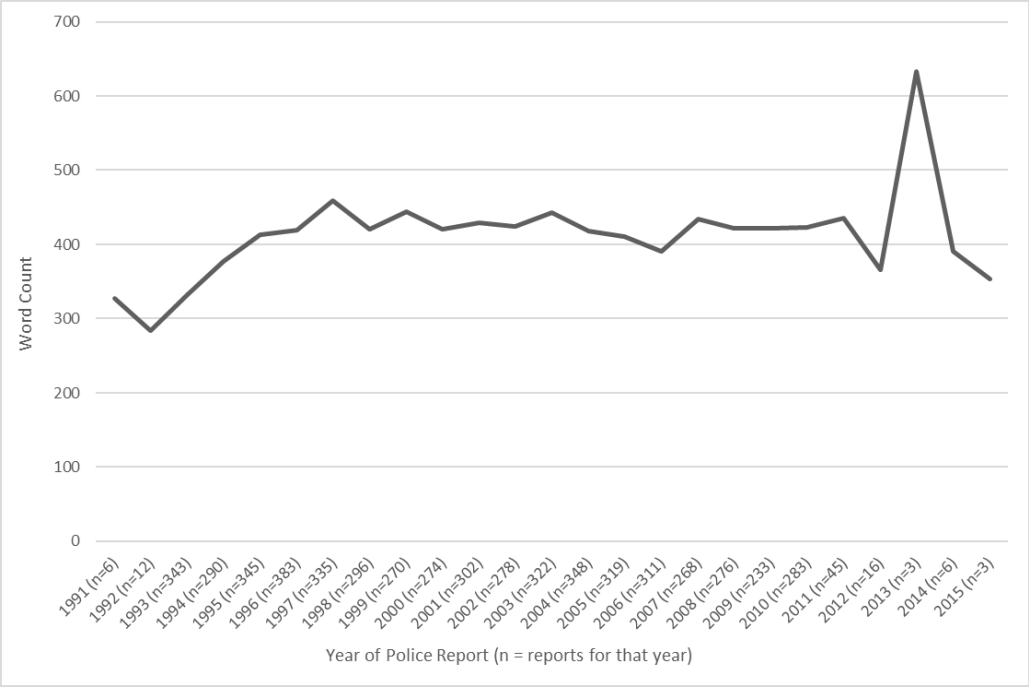


Figure 10: Word Count by Decade

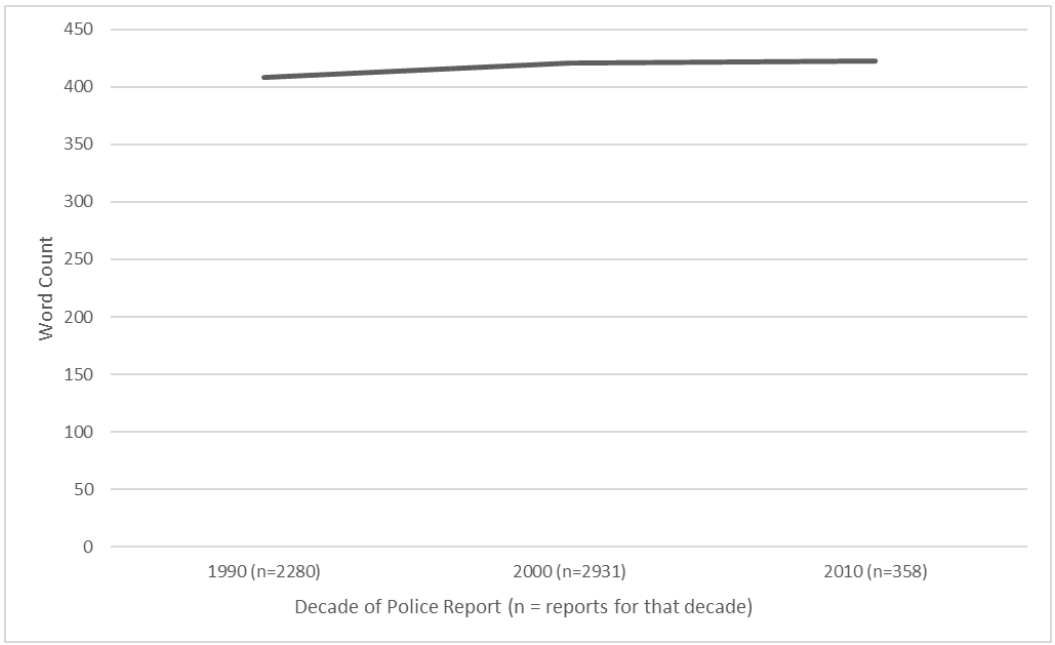


Figure 11: Sentiment Analysis Measures by Year

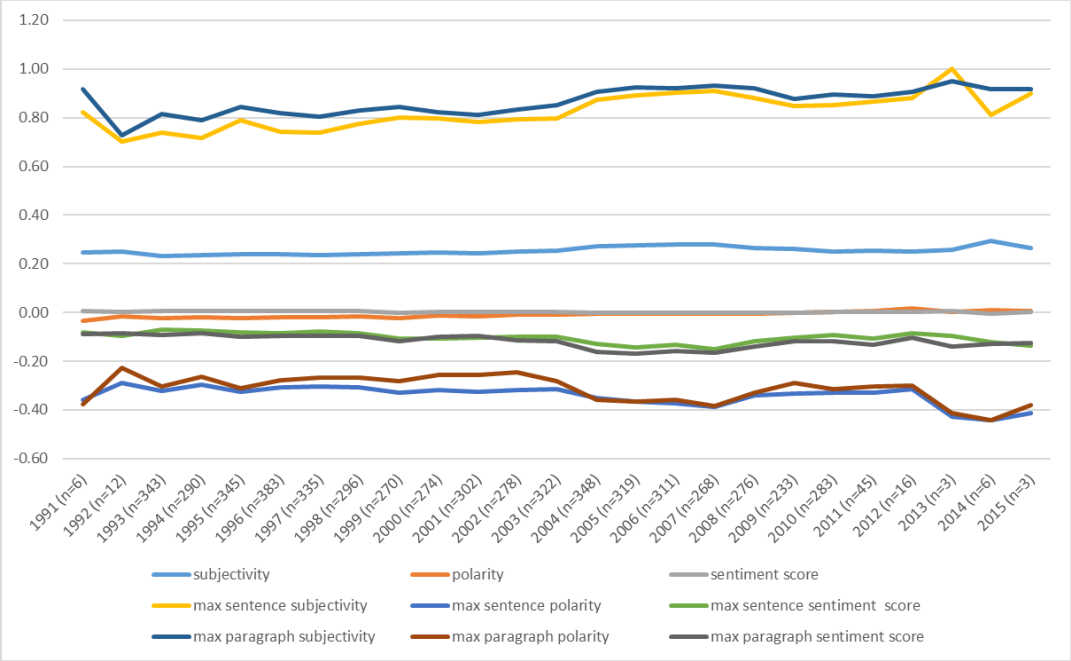
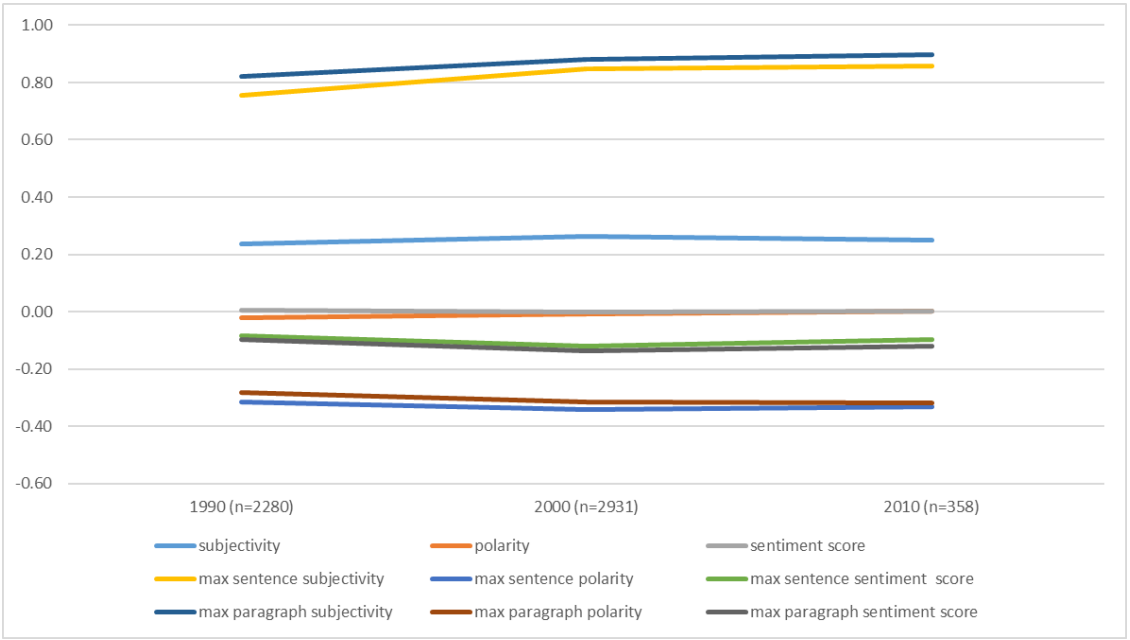


Figure 12: Sentiment Analysis Measures by Decade



Aim 2

Aim 2 assesses: (a) whether sentiments in the responding officers' narratives are different in cases with increased investigative activity compared to those with less, and (b) how phrases in the incident reports vary depending on the level of investigative activity. Investigative activity is

defined as—*Investigation Stalled* prior to prosecutorial review (0,1) and *Investigation Forwarded for [Prosecutorial] Review* (0,1).

Aim 2 hypotheses:

H_{2A}: Sentiment analysis measures predict the level of investigative activity—more specifically, shorter reports and those with more negative and subjective sentiment stalled earlier in the process.

H_{2B}: Phrases in the reports vary depending on the level of investigative activity—more specifically, reports stalled earlier in the investigative process have phrases that more negatively describe the victim, thus potentially indicating signaling.

Aim 2: Sentiment Analysis Findings

In support of H_{2A}, Table 6's differences of means tests indicate that the sentiment analysis measures vary for Investigation Stalled and Investigation Forward for Review cases.

Table 6: Difference of Means Results for Sentiment Analysis Measures Including Word Count for Activity Outcomes

Sentiment Analysis Scores	Investigation stalled (n = 3,747)		Investigation did not stall (n = 1,329)		p value	Cohen's d
	M	SD	M	SD		
Word count	368.64	210.97	429.31	257.88	< **.001**	.246
Subjectivity	.240	.051	.257	.055	< **.001**	.320
Polarity	-.025	.034	-.006	.037	< **.001**	.517
Sentiment	.003	.008	.001	.008	< **.001**	-.236

	Investigation forwarded for prosecutorial review (n = 2,274)		Investigation not forwarded for prosecutorial review (n = 1,473)		p value	Cohen's d
	M	SD	M	SD		
Word count	390.29	229.15	489.55	286.64	< **.001**	.392
Subjectivity	.261	.055	.252	.055	< **.001**	-.164
Polarity	-.009	.035	-.002	.039	< **.001**	.205
Sentiment	<-.000	.008	.004	.007	< **.001**	.518

Since the difference of means tests indicate a relationship between the sentiment analysis measures and investigative outcomes, we conducted logistic regression of these measures on investigative activity (Tables 7 through 8). We do not provide regressions for cases where there was no indication of any investigative activity, as prior research on these cases indicated that no investigative activity could mean that an investigation was never conducted, but could also mean the investigative report was missing (Lovell, Overman, et al., 2020). Each sentiment measure is regressed in separate models as multicollinearity diagnostics and a goodness of fit measure (Hosmer & Lemeshow test) indicate that separately regressing each measure produces better fitting models (results not shown).

In support of H_{2A}, Models 2 and 3 in Table 7 establish that the polarity and subjectivity scores predict *Investigation Stalled* or not, with sufficient to strong goodness of fit metrics (starting at the .05 level, the higher the value, the better the fit). However, in partial support of $H_{2A,}$ the stalled cases have more negative and less subjective text/tone. Additionally, reports with fewer words, older victims and cases without fully named suspects were more likely to be stalled in the investigation phase. Model 1 in Table 7 has a very large odds ratio indicating a potential lack of fit in this model.

Also in support of H_{2A}, Models 1 through 3 in Table 8 indicate that sentiment, polarity and subjective scores predict *Forwarded for Review* or not, with sufficient to moderate goodness

of fit metrics. However, in partial support of H_{2A}, cases that proceeded to this phase have more negative (although the mean polarity scores are near zero) and more subjective tone/text than those that stalled earlier in the process. The differences of means bivariate analyses indicate a negative, significant relationship, but the multivariate regression analyses in Model 3 indicate a non-significant relationship. Reports with fewer words, older victims, non-Hispanic victims for polarity (n = 87; White victims are the much larger reference group) and cases without fully named suspects are more likely to be stalled after being *Forwarded for Review*.

One major difference between these two outcomes is the change in the sign for subjectivity in cases that were forwarded, although the multivariate relationship is non-significant. Additionally, the other covariates in Models 2 and 3 for the sentiment variables have larger odds ratios and weaker goodness of fit statistics in the *Forwarded for Review* cases.

Table 7: Logistic Regression for Sentiment Scores on Investigation Stalled Outcome

	Model 1: Sentiment (N = 4446)				Model 2: Polarity (N = 4446)				Model 3: Subjectivity (N = 4446)			
Covariates	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**
Scores for Incident Reports												
Sentiment Score	4.489E+21	***	5.113	49.856								
Polarity Score					.000	***	1.211	-13.835				
Subjectivity Score									.001	***	.758	-6.625
Control Variables												
Word Count	.999	***	.000	-.001	.999	***	.000	-.001	.999	***	.000	-.001
Victim Black[a]	1.060		.083	.058	1.003		.084	.003	1.075		.083	.073
Victim Hispanic	1.393		.245	.331	1.437		.245	.362	1.407		.242	.341
Victim Race Other	1.834		.611	.607	1.671		.597	.514	1.552		.611	.439
Victim Female	1.313		.196	.272	1.340		.197	.292	1.326		.195	.282
Victim Under 13 Years of Age[b]	.647	**	.146	-.436	.619	**	.147	-.480	.647	**	.146	-.435
Victim 13-17 Years of Age	.854		.094	-.158	.817	*	.094	-.202	.841		.093	-.173
Suspect Fully Named in Report	.365	***	.084	-1.009	.522	***	.080	-.649	.440	***	.080	-.822
Suspect Criminal History Mentioned in Report	.804		.210	-.218	.780		.211	-.248	.738		.210	-.304
Victim Criminal History Mentioned in Report	.703		.662	-.352	.634		.679	-.456	.790		.669	-.235
Constant	.451	***	.212	-.795	.377	***	.214	-.976	2.494	**	.293	.914
Chi-square	265.080***				311.109***				247.395***			
Cox & Snell R-square	.058				.068				.054			
Hosmer & Lemeshow Test	.092				.635				.200			

Notes: ***p < .001; **p < .01; *p < .05. [a] White is reference category [b] Victim 18+ is reference group.

Table 8: Logistic Regression for Sentiment Scores on Investigation Forwarded for Prosecutorial Review Outcome

	Model 1: Sentiment (N = 3539)				Model 2: Polarity (N = 3539)				Model 3: Subjectivity (N = 3539)			
Covariates	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**
Scores for Incident Reports												
Sentiment Score	.000	***	5.475	-43.513								
Polarity Score					.001	***	1.140	-7.529				
Subjectivity Score									1.023		.752	.023
Control Variables												
Word Count	.999	***	.000	-.001	.999	***	.000	-.001	.999	***	.000	-.001
Victim Black[a]	1.045		.087	.044	1.018		.087	.018	1.046		.086	.045
Victim Hispanic	.422	**	.284	-.863	.423	**	.284	-.859	.418	**	.283	-.873
Victim Race Other	.716		.687	-.334	.856		.684	-.155	.857		.688	-.154
Victim Female	1.115		.191	.109	1.105		.189	.100	1.096		.189	.091
Victim Under 13 Years of Age[b]	.251	***	.129	-1.381	.256	***	.127	-1.363	.263	***	.126	-1.337
Victim 13-17 Years of Age	.516	***	.095	-.661	.517	***	.095	-.659	.527	***	.094	-.641
Suspect Fully Named in Report	.113	***	.116	-2.183	.097	***	.114	-2.330	.094	***	.114	-2.366
Suspect Criminal History Mentioned in Report	.866		.161	-.144	.827		.161	-.190	.850		.160	-.163
Victim Criminal History Mentioned in Report	2.471		.686	.904	2.105		.705	.744	2.154		.691	.767
Constant	17.528	***	.228	2.864	19.484	***	.226	2.970	18.543	***	.307	2.920
Chi-square	1063.768***				1043.912***				998.981***			
Cox & Snell R-square	.260				.255				.246			
Hosmer & Lemeshow Test	.373				.071				.063			

Notes: ***p < .001; **p < .01; *p < .05. [a] White is reference category [b] Victim 18+ is reference group.

Aim 2: Text Classification Findings

Investigation Stalled

The logistic regression method (Method 1) in text classification models generates both a predictively positive and negative cluster of trigrams. For the outcome *Investigation Stalled,* trigrams with predictive value (positive, 1) indicate heavy prosecutorial involvement ("prosecutor [person name]," "ruled no papers," "no papers issued") (see Figure 13 for raw results). While not formally forwarded for review, a sizable portion of the stalled cases included *conferment* with a prosecutor, or mention that a case *would be* forwarded (versus was forwarded) to a prosecutor, juvenile court or child welfare—thus, an intent to forward or perhaps a more

informal involvement of a prosecutor. These results suggest the prosecutor's pre-screening and/or conferment might serve as a gatekeeping process for these cases.

The inverse (negative, 0) of *Investigation Stalled* (i.e., those that proceeded forward) cases highlights the importance placed on victim involvement during investigations. The actions of the victim and the assigned sex crimes officer are in focus. Most trigrams involve the victim as the subject ("victim come forward," "victim has not," "until the victim"), or sex crimes officer names or assignments ("received an assignment," "lieutenant [name] officer," "in charge detective"). The next group of trigrams contain phrases in reference to leads, or lack thereof ("investigative leads at," "leads at this," "no further investigative"). (See Figure 14 for trigram categories).

Figure 13: Investigation Stalled Raw Results

Case Outcome: Investigation Stalled (Report Count, n = 1,338)

Raw Results: Analysis for Aim #2

Negative, 0

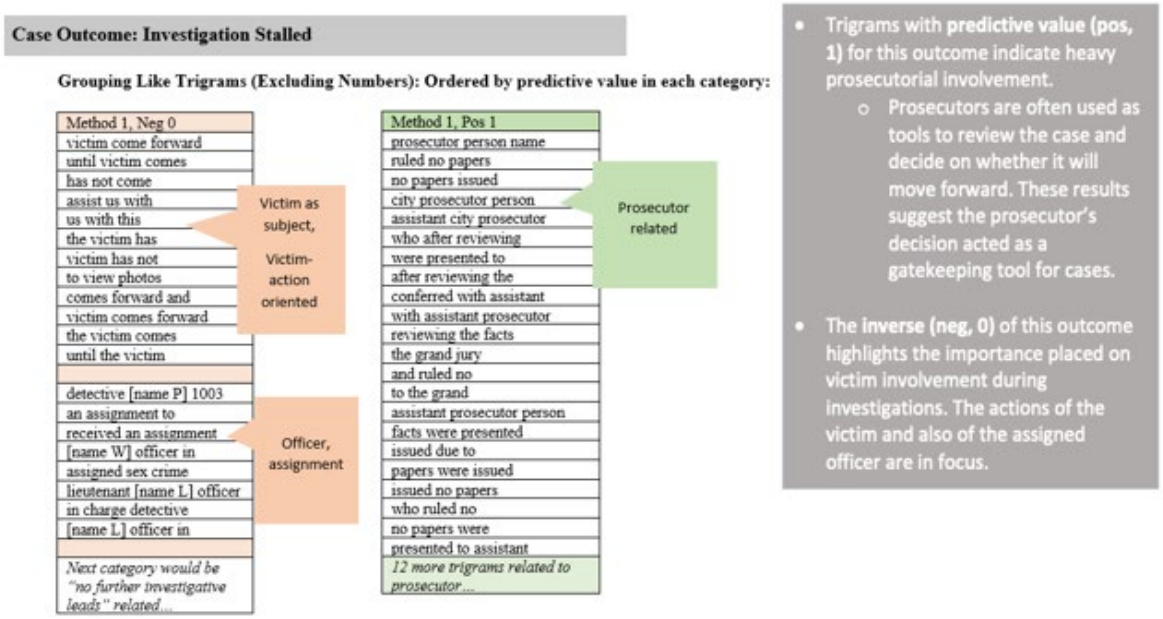
Method-1. case 00 victim, suspect wanted clean, detective [deidentified] 1003, victim come forward, until victim comes, the above described, has not come, an assignment to, person name 1im, received an assignment, 05 30 2004, assist us with, [deidentified] officer in, 1999 00 00, us with this, assigned sex crime, at this time, narrative case 01, lieutenant [deidentified] officer, in charge detective, of this date, [deidentified] officer in, time as the, the victim has, investigative leads at, 2000 00 00, as of this, with this investigation, victim has not, crime child abuse, sex crime child, narrative case 00, to view photos, leads at this, comes forward and, investigation we have, such time as, this investigation we, until such time, victim comes forward, the victim comes, until the victim, leads assigned sex, there are no, are no further, investigative leads assigned, we have no, have no further, no further investigative, further investigative leads

Positive, 1

Method-1. prosecutor person name, ruled no papers, no papers issued, city prosecutor person, assistant city prosecutor, who after reviewing, person name who, cleanup cleanup cleanup, 2003 00 00, the arrested male, 2002 00 00, clean up clean, up clean up, were presented to, after reviewing the, conferred with assistant, exceptional clean up, with assistant prosecutor, reviewing the facts, the grand jury, and ruled no, to the grand, assistant prosecutor person, facts were presented, issued due to, papers were issued, the named suspect, issued no papers, who ruled no, no papers were, presented to assistant, facts of this, name who reviewed, 2008 00 00, with assistant city, 2009 00 00, city of cleveland, consulted with assistant, his constitutional rights, name who ruled, name who after, same and ruled, 2006 00 00, conferred with prosecutor, the facts ruled, and no papers, 2007 00 00, reviewed by assistant, 2012 00 00, 1993 00 00

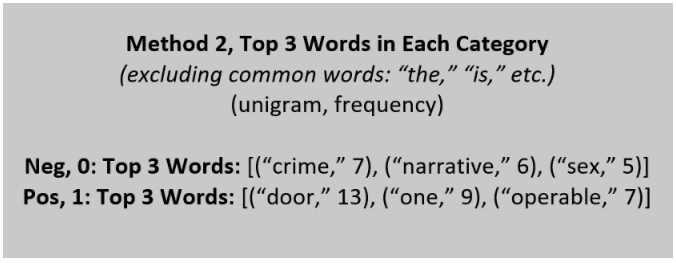
0	1
Method 1: Top 5 Predictive Trigrams	
case 00 victim, suspect wanted clean, detective [deidentified] 1003, victim come forward, until victim comes	prosecutor person name, ruled no papers, no papers issued, city prosecutor person, assistant city prosecutor

Figure 14: Investigation Stalled Trigram Categories



Text classification Method 2 (CNB) highlights the mention of the top three predictive words "door," "one" and "operable," with the number of times the word is mentioned in the predictive (positive, 1) provided in parentheses for *Investigation Stalled* cases. The top three words for the inverse (negative, 0) are "crime," "narrative" and "sex." (See Figure 15 for the top three most frequent unigrams resulting from Method 2.)

Figure 15: Investigation Stalled Text Classification Method 2



Investigation Forwarded for Review

In support of H_{2B}, cases with more investigative activity present different trigrams compared to those with less. For cases that had more investigative activity, *Investigation Forwarded for Review*, the first two trigram categories with predictive value (positive, 1)

indicate forward-moving procedural activities: sending a case to grand jury or arresting, charging and naming a suspect (See Figure 16 for raw results). Positive trigrams also show the existence of form 10, which is an attachment to police reports that has further investigative details. Interestingly, cases that moved forward also mentioned rape or unlawful sex specifically. This could suggest officers were writing more details (or perhaps just more words) in the report, so there were more mentions of the crime itself, or officers charged suspects more often in these reports, so the actual rape charge was mentioned more frequently. Thus, the results suggest officers are more inclined to predictively use the word rape (e.g., "unlawful" or "2907.02") in cases that progressed further in the criminal justice system.

The inverse (negative, 0) of this outcome also highlights prosecution-related language, but it is language used to stop a case from moving forward: the prosecutor issued or ruled no papers, or the victim signed a no prosecution form. As hypothesized, lack of victim action is also mentioned frequently ("victim did not"). These results are saturated with a variety of closing language (mostly negatively worded language), suggesting the cases would not move further (insufficient evidence, unfounded, no papers, no leads). (See Figure 17 for trigram categories).

Figure 16: Investigation Forwarded for Review Raw Results

Case Outcome: Investigation Forwarded [for] Review (Report Count, n = 2,307)

Raw Results: Analysis for Aim #2

Negative, 0

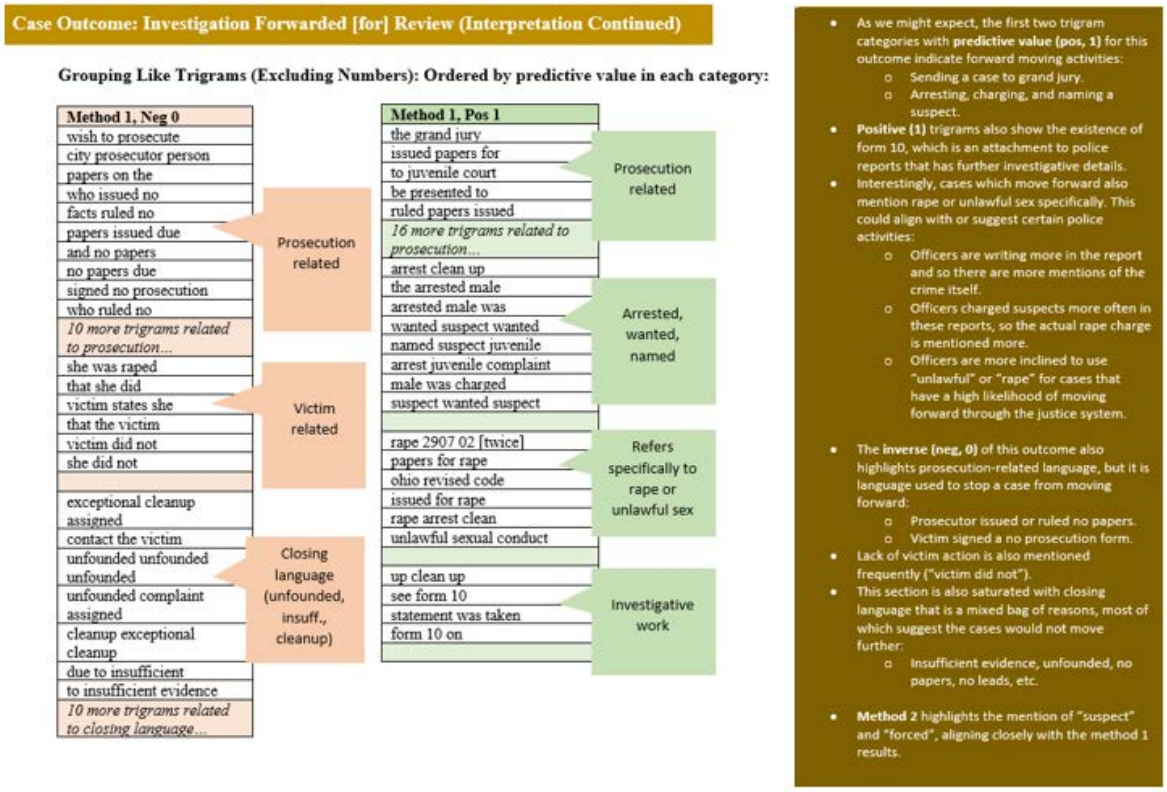
Method-1. exceptional cleanup assigned, wish to prosecute, she was raped, that she did, 2002 00 00, city prosecutor person, the basis of, 2011 00 00, to contact the, on the basis, papers on the, who issued no, facts ruled no, be held in, victim states she, that the victim, contact the victim, unfounded unfounded unfounded, did not wish, unfounded complaint assigned, victim did not, papers issued due, and no papers, no papers due, not wish to, she did not, signed no prosecution, who ruled no, cleanup exceptional cleanup, up exceptional clean, exceptional cleanup exceptional, no papers on, due to insufficient, to insufficient evidence, clean up exceptional, papers due to, no papers were, review ruled no, issued due to, unfounded complaint unfounded, complaint unfounded complaint, and ruled no, no prosecution form, issued no papers, held in abeyance, no further investigative, further investigative leads, no papers issued, ruled no papers, exceptional clean up

Positive, 1

method-1. the grand jury, to the grand, up clean up, clean up clean, cleanup cleanup cleanup, arrest clean up, issued papers for, rape 2907 02, to grand jury, the arrested male, cleanup cleanup assigned, grand jury package, to juvenile court, be presented to, for rape 2907, ruled papers issued, county grand jury, papers for rape, case to the, the cuyahoga county, directly to the, see form 10, case be presented, ohio revised code, crimes unit office, issued for rape, papers issued for, cuyahoga county grand, be referred to, rape arrest clean, cleanup assigned sex, presented directly to, arrested male was, wanted suspect wanted, named suspect juvenile, to the cuyahoga, suspect wanted suspect, suspect juvenile complaint, be presented directly, referred this case, forwarded to the, was taken from, arrest juvenile complaint, referred to the, person name 13, male was charged, statement was taken, unlawful sexual conduct, form 10 on, from person name

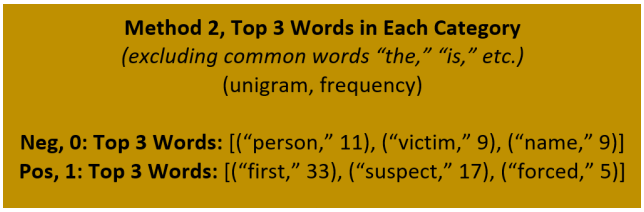
0	1
Method 1: Top 5 Predictive Trigrams	
exceptional cleanup assigned, **wish to prosecute,** **she was raped,** **that she did,** **2002 00 00**	**the grand jury,** **to the grand,** **up clean up,** **clean up clean,** **cleanup cleanup cleanup**

Figure 17: Investigation Forwarded for Review Trigram Categories



Text classification Method 2 (CNB) highlights the mention of "suspect" and "forced," aligning closely with Method 1's results. (See Figure 18 for the top three most frequent unigrams resulting from Method 2).

Figure 18: Investigation Forwarded for Review Text Classification Method 2



Aim 3

Aim 3 assesses: (a) whether sentiments in the responding officers' narratives are different in cases that *Proceeded to Prosecution* or not, and (b) how the phrases in the incident reports vary depending on whether the case *Proceeded to Prosecution* or not. *Proceeded to Prosecution* is defined as a binary variable indicating that a prosecutor "accepted" or charged the case. These

are the most successful cases in our study—those that made it the farthest in the criminal justice system.

Aim 3 hypotheses:

H_{3A}: Sentiment analysis measures predict whether a case was successfully prosecuted—more specifically, longer reports and those with more positive and less subjective sentiment *Proceeded to Prosecution.*

H_{3B}: Phrases in the reports vary depending on whether the case was successfully prosecuted—more specifically, reports that *Proceeded to Prosecution* have phrases that more positively describe the victim, thus potentially indicating less signaling.

Aim 3: Sentiment Analysis Findings

Table 9's differences of means tests show that word count, polarity and sentiment varied for cases that *Proceeded to Prosecution* versus those that did not, but subjectivity is non-significant.

Table 9: Difference of Means for Sentiment Analysis Measures on Proceeded to Prosecution Outcome

Sentiment Analysis Measures	Proceeded to prosecution (n = 1,473)		Did not proceed to prosecution (n = 4,066)		p value	Cohen's d
	M	SD	M	SD		
Word count	489.55	286.64	383.42	224.94	< **.001**	-.437
Subjectivity	.252	.055	.252	.056	.984	.001
Polarity	-.002	.039	-.016	.036	< **.001**	-.377
Sentiment	.004	.007	.002	.008	< **.001**	-.273

In support of Aim 3 hypotheses, Models 2 and 3 in Table 10 establish that polarity and subjectivity scores predict whether a case *Proceeded to Prosecution* with strong goodness of fit metrics (very strong goodness of fit for sentiment and subjectivity, moderate for polarity). Cases

that proceed to this phase have more positive words/tone. Reports with more words, younger victims and cases *with* fully named suspects more frequently *Proceeded to Prosecution*.

Table 10: Logistic Regression for Sentiment Scores on Proceeded to Prosecution Outcome

	Model 1: Sentiment (N = 4776)				Model 2: Polarity (N = 4776)				Model 3: Subjectivity (N = 4776)			
Covariates	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**
Scores for Incident Reports												
Sentiment Score	38453 6.439	**	4.690	12.860								
Polarity Score					15671. 534	***	1.005	9.660				
Subjectivity Score									5.613	**	.663	1.725
Control Variables												
Word Count	1.001	***	.000	.001	1.001	***	.000	.001	1.001	***	.000	.001
Victim Black[a]	.971		.078	-.029	1.001		.079	.001	.959		.078	-.042
Victim Hispanic	1.477		.224	.390	1.525		.226	.422	1.479		.224	.391
Victim Race Other	1.055		.629	.054	1.049		.628	.048	.982		.630	-.018
Victim Female	1.042		.163	.041	1.034		.164	.034	1.042		.162	.041
Victim Under 13 Years of Age[b]	3.081	***	.106	1.125	3.094	***	.107	1.129	3.035	***	.106	1.110
Victim 13-17 Years of Age	1.861	***	.085	.621	1.880	***	.086	.631	1.851	***	.085	.616
Suspect Fully Named in Report	10.035	***	.111	2.306	9.984	***	.110	2.301	10.774	***	.110	2.377
Suspect Criminal History Mentioned in Report	.952		.138	-.050	.972		.139	-.028	.976		.138	-.024
Victim Criminal History Mentioned in Report	.686		.644	-.377	.735		.661	-.308	.705		.649	-.349
Constant	.030	***	.204	-3.492	.030	***	.206	-3.506	.019	***	.272	-3.956
Chi-square	1109.304***				1197.963***				1108.560***			
Cox & Snell R-square	.207				.222				.207			
Hosmer & Lemeshow Test	.667				.178				.737			

Notes: ***p < .001; **p < .01; *p < .05. [a] White is reference category [b] Victim 18+ is reference group.

Aim 3: Text Classification Findings

The trigram categories with predictive value (positive, 1) for the *Proceeded to Prosecution* outcome indicate similar results to the *Investigation Forwarded [for] Review* outcome: (a) prosecutorial: presenting a case to the prosecutor, papers issued for rape, presenting a case to the grand jury, (b) suspect: arresting, charging and naming a suspect, (c) mentioning rape specifically and (d) investigative activity or additional forms. (See Figure 19 for raw results).

The inverse (negative, 0) trigrams of this outcome heavily emphasize actions that stall or stop a case from moving forward: (a) prosecutorial: no papers or no prosecution form, (b) investigative: no further leads, held in abeyance, unfounded complaint and (c) negatively worded victim references: not wish, did not. (See Figure 20 for trigram categories).

Figure 19: Proceeded to Prosecution Raw Results

Case Outcome: Proceeded [to] Prosecution (Report Count, n = 1,519)

Raw Results. Analysis for Aim #3

Negative, 0

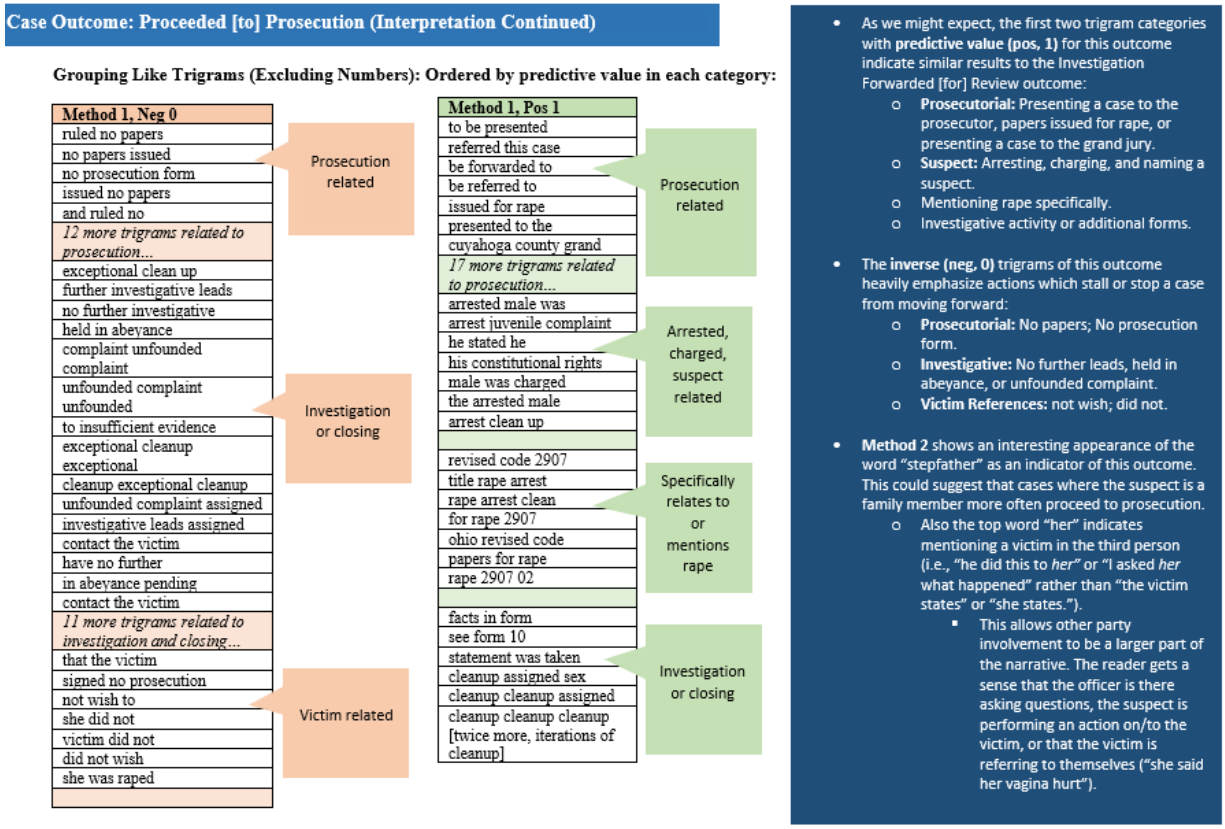
exceptional clean up, ruled no papers, further investigative leads, no further investigative, held in abeyance, no papers issued, no prosecution form, issued no papers, complaint unfounded complaint, unfounded complaint unfounded, and ruled no, exceptional cleanup exceptional, review ruled no, cleanup exceptional cleanup, due to insufficient, to insufficient evidence, issued due to, papers due to, no papers on, no papers were, that the victim, clean up exceptional, signed no prosecution, up exceptional clean, unfounded complaint assigned, not wish to, investigative leads assigned, she did not, victim did not, who ruled no, unfounded unfounded unfounded, did not wish, leads assigned sex, she was raped, contact the victim, no papers due, papers issued due, be held in, have no further, we have no, papers on the, at this time, exceptional cleanup assigned, and no papers, who issued no, on the basis, and issued no, leads no further, to contact the, in abeyance pending

Positive, 1

to be presented, arrested male was, revised code 2907, arrest juvenile complaint, title rape arrest, facts in form, he stated he, his constitutional rights, referred this case, be forwarded to, be referred to, issued for rape, presented to the, taken from the, male was charged, forwarded to the, person name 13, see form 10, was taken from, cuyahoga county grand, papers issued for, rape arrest clean, be presented directly, to the cuyahoga, for rape 2907, presented directly to, statement was taken, case to the, case be presented, ohio revised code, directly to the, ruled papers issued, the cuyahoga county, county grand jury, cleanup assigned sex, papers for rape, grand jury package, be presented to, rape 2907 02, to juvenile court, the arrested male, cleanup cleanup assigned, to grand jury, issued papers for, arrest clean up, cleanup cleanup cleanup, clean up clean, up clean up, to the grand, the grand jury

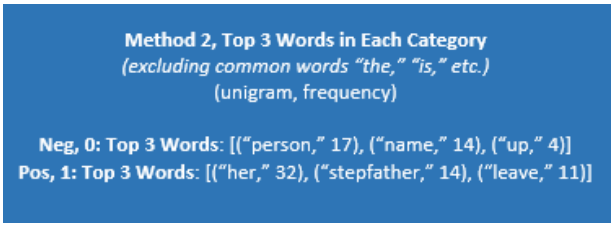
0	1
Top 5 Predictive Trigrams	
exceptional clean up, ruled no papers, further investigative leads, no further investigative, held in abeyance	**to be presented, arrested male was, revised code 2907, arrest juvenile complaint, title rape arrest**

Figure 20: Proceeded to Prosecution Trigram Categories



Text classification Method 2 (CNB) shows an interesting appearance of the word "stepfather" as a positive indicator of this outcome. This could suggest that cases where the suspect was a family member more often *Proceeded to Prosecution*. Also, the top word "her," indicates mentioning a victim in the third person (e.g., "he did this to her" or "I asked her what happened" rather than "the victim states" or "she states"). This allows other party involvement to be a larger part of the narrative. In other words, the victim is the subject, not the object of the sentence. The reader gets a sense that the officer is asking questions, the suspect is performing an action on/to the victim or the victim is referring to themselves ("she said her vagina hurt"). See Figure 21 for a list of the top three most frequent trigrams (excluding stop words) under Method 2 for both positive and negative results.

Figure 21: Proceeded to Prosecution Text Classification Method 2



Additional Case Outcomes and Summary of Findings

Sentiment Analysis for Additional Outcomes

To aid in determining whether the sentiment analysis measures could help detect negative statements about a victim's credibility, we also explored additional outcomes. These variables include cases that: stalled either at the investigation *or* prosecution phase (given the ambiguity of prosecutorial involvement), had explicit statements by responding officers disbelieving a victim's statement, closed because of a lack of victim engagement with the investigation, were unfounded (investigation determined a crime did not occur) and included runaway victims. These additional outcomes were chosen because the literature suggests that negative statements about a victim's credibility would most likely be present in these cases. In other words, if we find sentiment analysis measures predict these outcomes, then the existence and direction of these relationships provide insight into potentially signaling language.

Table 11 summarizes the existence and direction of the relationships between the sentiment analysis measures and the study's outcomes. The unsuccessful cases (*Did Not Proceeded to Prosecution*) and cases with the most negative opinions about the victim's credibility all demonstrate more negative words/tone (negative polarity) and less subjectivity (fewer personal opinions/tone). The most successful cases have more positive opinions and more subjective tone/text. Additionally, when examining the additional case outcomes, subjectivity is not as predictive in any of the case outcomes where the victim's [lack of] credibility should be

more prevalent. Lastly, Tables 12 through 15 present the findings for the covariate (word count), in each Model for each outcome. Less successful cases have fewer words in the incident report than more successful cases.

Table 11: Summary of the Directional Relationships in the Logistic Regressions by Case Outcome

	Directional Relationships in Logistic Regressions			
Case Outcomes	Model 1: Sentiment	Model 2: Polarity	Model 3: Subjectivity	Covariate: Word count[a]
Investigative activity				
Investigation stalled	+[b]	-	-	-
Investigation forwarded for review	-	-	n.s.	-
Successful outcome				
Proceeded to prosecution	+	+	+	+
Additional case outcomes				
Stalled at investigation or prosecution	-	-	n.s.	n.s.
Victim not believed	-	n.s.	n.s.	n.s.
Victim no engagement	-	-	n.s.	-
Unfounded	-	-	n.s.	-
Runaway	n.s.	n.s.	n.s.	n.s.

Table 12: Logistic Regression for Sentiment Scores on Victim Not Believed Outcome

	Model 1: Sentiment (n= 136)				Model 2: Polarity (n= 136)				Model 3: Subjectivity (n= 136)			
Covariates	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**
Scores for Incident Reports												
Sentiment Score	.000	***	11.581	-41.859								
Polarity Score					.074		2.446	-2.598				
Subjectivity Score									.188		1.638	-1.671
Control Variables												
Word Count	1.000		.000	.000	.999		.000	-.001	.999		.000	-.001
Victim Black[a]	.622	**	.181	-.475	.628	*	.180	-.465	.639	*	.180	-.448
Victim Hispanic	.190		1.016	-1.660	.188		1.015	-1.673	.188		1.015	-1.673
Victim Race Other	2.055		1.064	.720	2.337		1.059	.849	2.261		1.063	.816
Victim Female	1.792		.471	.583	1.791		.471	.583	1.783		.471	.578
Victim Under 13 Years of Age[b]	2.504	***	.262	.918	2.597	***	.261	.955	2.610	***	.261	.959
Victim 13-17 Years of Age	2.726	***	.195	1.003	2.745	***	.194	1.010	2.748	***	.194	1.011
Suspect Fully Named in Report	.992		.195	-.008	.836		.188	-.179	.803		.186	-.219
Suspect Criminal History Mentioned in Report	.906		.439	-.098	.869		.438	-.140	.851		.439	-.161
Victim Criminal History Mentioned in Report	7.603	**	.777	2.029	6.409	**	.773	1.858	6.504	*	.773	1.872
Constant	.018	***	.516	-3.994	.020	***	.515	-3.901	.032	***	.674	-3.435
Chi-square	<.001***				<.001***				<.001***			
Cox & Snell R-square	.012				.010				.010			
Hosmer & Lemeshow Test	.881				.267				.011			

Notes: ***p < .001; **p < .01; *p < .05. [a] White is reference category. [b] Victim 18+ is reference group.

Table 13: Logistic Regression for Sentiment Scores on Victim No Engagement Outcome

Covariates	Model 1: Sentiment (n=1903)				Model 2: Polarity (n=1903)				Model 3: Subjectivity (n=1903)			
	Odds Ratios	Sig.	Std. error	B	Odds Ratios	Sig.	Std. error	B	Odds Ratios	Sig.	Std. error	B
Scores for Incident Reports												
Sentiment Score	.000	**	4.115	-11.517								
Polarity Score					.161	*	.891	-1.829				
Subjectivity Score									1.033		.589	.033
Control Variables												
Word Count	.999	***	.000	-.001	.999	***	.000	-.001	.999	***	.000	-.001
Victim Black[a]	1.232	**	.069	.209	1.231	**	.069	.227	1.236	**	.069	.212
Victim Hispanic	.874		.221	-.135	.873		.221	-.136	.875		.221	-.133
Victim Race Other	.734		.566	-.309	.770		.565	-.262	.766		.566	-.266
Victim Female	1.207		.164	.188	1.198		.163	.180	1.204		.164	.185
Victim Under 13 Years of Age[b]	.116	***	.155	-2.157	.117	***	.155	-2.142	.117	***	.155	-2.143
Victim 13-17 Years of Age	.472	***	.077	-.750	.473	***	.077	-.734	.475	***	.077	-.745
Suspect Fully Named in Report	.436	***	.069	-.831	.421	***	.067	-.748	.414	***	.067	-.883
Suspect Criminal History Mentioned in Report	.749	*	.152	-.289	.748		.152	-.290	.752		.152	-.285
Victim Criminal History Mentioned in Report	.669		.519	-.402	.625		.520	-.470	.641		.519	-.445
Constant	1.744	**	.177	.556	1.758	**	.177	.564	1.751	*	.238	.560
Chi-square	<.001***				<.001***				<.001***			
Cox & Snell R-square	.140				.140				.139			
Hosmer & Lemeshow Test	.115				.117				.060			

Notes: ***p < .001; **p < .01; *p < .05. [a] White is reference category. [b] Victim 18+ is reference group.

Table 14: Logistic Regression for Sentiment Scores on Unfounded Outcome

Covariates	Model 1: Sentiment (n=374)				Model 2: Polarity (n=374)				Model 3: Subjectivity (n=374)			
	Odds Ratios	Sig.	Std. error	B	Odds Ratios	Sig.	Std. error	B	Odds Ratios	Sig.	Std. error	B
Scores for Incident Reports												
Sentiment Score	.000	***	8.094	-96.326								
Polarity Score					.001	***	1.558	-6.916				
Subjectivity Score									.216		1.048	-1.534
Control Variables												
Word Count	.999	*	.000	-.001	.999	**	.000	-.001	.999	**	.000	-.001
Victim Black[a]	.772	*	.121	-.259	.785	*	.115	-.242	.807		.119	-.215
Victim Hispanic	.465		.473	-.765	.512		.430	-.670	.449		.469	-.802
Victim Race Other	2.374		.679	.865	2.931		.660	1.075	2.888		.668	1.061
Victim Female	.787		.227	-.240	.803		.217	-.219	.806		.221	-.215
Victim Under 13 Years of Age[b]	2.070	***	.165	.727	2.320	***	.154	.841	2.199	***	.161	.788
Victim 13-17 Years of Age	1.228		.140	.206	1.348	*	.132	.299	1.271		.137	.240
Suspect Fully Named in Report	.983		.126	-.017	.776	*	.115	-.254	.615	***	.118	-.486
Suspect Criminal History Mentioned in Report	.527		.374	-.640	.480	*	.370	-.734	.484	*	.371	-.726
Victim Criminal History Mentioned in Report	4.912	**	.674	1.592	2.356		.635	.857	3.233		.653	1.173
Constant	.122	***	.264	-2.106	.129	***	.250	-2.044	.258	***	.380	-1.353
Chi-square	<.001***				<.001***				<.001***			
Cox & Snell R-square	.046				.015				.015			
Hosmer & Lemeshow Test	.053				.390				.063			

Notes: ***p < .001; **p < .01; *p < .05. [a] White is reference category. [b] Victim 18+ is reference group.

Table 15: Logistic Regression for Sentiment Scores on Runaway Victim Outcome

	Model 1: Sentiment (n=61)				Model 2: Polarity (n=61)				Model 3: Subjectivity (n=61)			
Covariates	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**	**Odds Ratios**	**Sig.**	**Std. error**	**B**
Scores for Incident Reports												
Sentiment Score	.000		18.08	-34.27								
Polarity Score					.000		4.022	-7.743				
Subjectivity Score									.481		2.572	-.732
Control Variables												
Word Count	1.001		.001	.001	1.001		.000	.001	1.000		.001	.000
Victim Black[a]	.791		.294	-.234	.807		.281	-.215	.819		.294	-.200
Victim Hispanic	.896		.764	-.110	.843		.760	-.171	.894		.763	-.112
Victim Race Other	.000		8729.1	-16.23	.000		8582.5	-15.69	.000		8684.5	-16.25
Victim Female	1.474		.740	.388	1.469		.739	.385	1.436		.739	.362
Victim Under 13 Years of Age[b]	34.04	**	1.103	3.528	35.95	***	1.103	3.582	34.59	**	1.103	3.543
Victim 13-17 Years of Age	150.6	***	1.011	5.015	168.5	***	1.010	5.127	150.8	***	1.011	5.016
Suspect Fully Named in Report	.597		.296	-.515	.595		.279	-.519	.514	*	.285	-.666
Suspect Criminal History Mentioned in Report	1.382		.633	.324	1.145		.627	.136	1.306		.630	.267
Victim Criminal History Mentioned in Report	.000		8504.4	-13.87	.000		7666.9	-13.69	.000		8584.8	-13.93
Constant	.000	***	1.273	-8.23	.000	***	1.269	-8.69	.000	***	1.437	-7.94
Chi-square	<.001***				<.001***				<.001***			
Cox & Snell R-square	.029				.029				.028			
Hosmer & Lemeshow Test	.018				.036				.120			

Notes: ***p < .001; **p < .01; *p < .05. [a] White is reference category [b] Victim 18+ is reference group.

Text Classification for Additional Outcomes

Unfounded

The predictive value (positive, 1) trigrams for *Unfounded cases* reflect one key aspect of the relationship between unfounded cases and police reports—officers' mention of the lack of evidence in the case.

The inverse (negative, 0) trigrams for these cases are saturated with procedural closing language, particularly exceptional cleanup or no further leads. Exceptional clean-up is frequently mentioned in these reports and can refer to several closing reasons. (See Figure 22 for raw results and Figure 23 for trigram categories).

Figure 22: Unfounded Raw Results

Case Outcome: Unfounded (Report Count, n = 386)

Raw Results. Analysis for Aim #3

Negative, 0

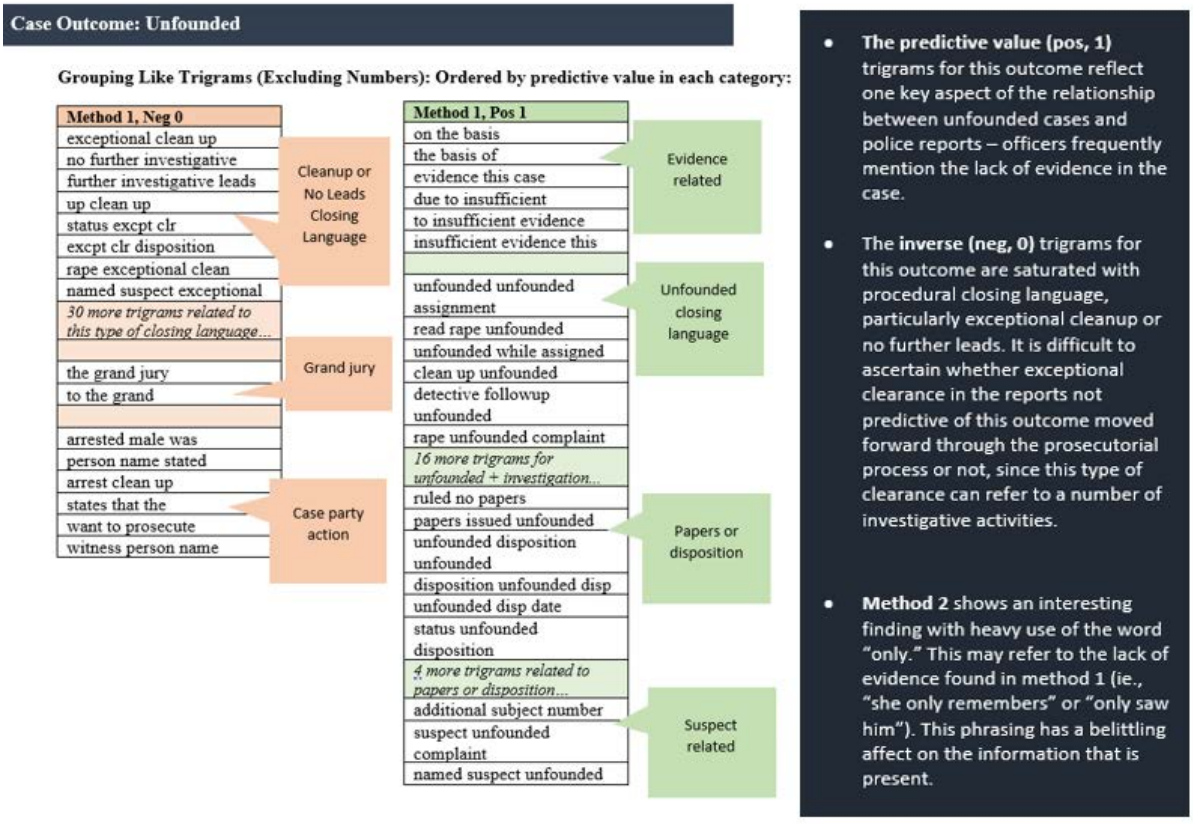
exceptional clean up, no further investigative, further investigative leads, up clean up, clean up clean, cleanup cleanup cleanup, cleanup assigned sex, clean up assigned, clean up exceptional, exceptional cleanup exceptional, cleanup exceptional cleanup, up exceptional clean, up sex crimes, clean up sex, status excpt clr, case status excpt, excpt clr disposition, cleanup cleanup assigned, the grand jury, arrested male was, to the grand, exception disp date, disposition exception disp, investigative leads assigned, rape exceptional clean, at this time, clr disposition exception, leads no further, investigative leads no, clean up on, leads assigned sex, clean up sir, disposition no further, up assigned detective, clean up assignment, up assignment sex, up disposition no, exceptional cleanup assigned, person name stated, named suspect exceptional, case will be, leads sex crimes, arrest clean up, by strickla nws, strickla nws conversion, investigative leads sex, up disposition exceptional, states that the, want to prosecute, witness person name

Positive, 1

07 19 2004, on the basis, the basis of, additional subject number, victim register reports, ruled no papers, unfounded unfounded assignment, 11 10 2004, read rape unfounded, 09 04 2004, unfounded while assigned, papers issued unfounded, suspect unfounded complaint, clean up unfounded, unf comp unf, comp unf comp, 11 19 2005, detective followup unfounded, complaint unfound complaint, unfound complaint unfound, in charge unfounded, unfounded complaint sir, rape unfounded complaint, unfounded disposition unfounded, evidence this case, disposition unfounded disp, unfounded disp date, insufficient evidence this, unfounded assignment sex, named suspect unfounded, title unfounded complaint, status unfounded disposition, case status unfounded, an unfounded complaint, new title unfounded, unfounded complaint on, complaint assigned detective, to insufficient evidence, due to insufficient, unfounded unfounded assigned, disposition unfounded complaint, up disposition unfounded, complaint sex crimes, unfounded complaint sex, complaint assigned sex, unfounded assigned sex, unfounded complaint assigned, unfounded unfounded unfounded, unfounded complaint unfounded, complaint unfounded complaint

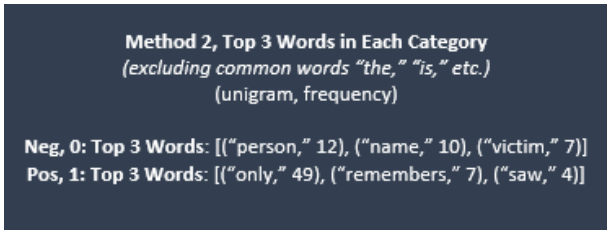
0	1
Top 5 Predictive Trigrams	
exceptional clean up, no further investigative, further investigative leads, up clean up, clean up clean	**07 19 2004, on the basis, the basis of, additional subject number, victim register reports**

Figure 23: Unfounded Trigram Categories



Text Classification Method 2 (Multinomial Naive Bayes) shows an interesting finding with the predictive use of the word "only." This may refer to the lack of evidence found in Method 1 (e.g., "she only remembers" or "only saw him"). This phrasing has a belittling or minimizing effect on the information present. (See Figure 24 for the top three most frequent word results from Method 2).

Figure 24: Unfounded Text Classification Method 2



Stalled

The predictive value (positive, 1) trigrams for the *Stalled [Investigation or Prosecution]* outcome suggest many moving parts within this outcome's report narratives. This could indicate that officers completed a variety of investigative work (asking the victim to view photos, interviewing the reporting person and/or sending a DNA sample to the Bureau of Criminal Investigation [BCI]), but the evidence was not sufficient, or the case was held in abeyance (stalled) until more evidence surfaced.

The inverse (negative, 0) trigrams for this outcome (i.e., cases not stalled) lean heavily on victim involvement or action (or lack thereof). The trigrams emphasize things the victim did not do: (a) has not come forward, (b) is uncooperative, (c) does not wish to [insert action] and/or (d) is unwilling to cooperate. For the inverse of a case stalling, the reports leave the reader with two options. There was either prosecutorial involvement (grand jury, juvenile court, issued papers or no prosecution [if the victim has signed the form]), or the case hinged on the victim (she is not

willing, not available, not cooperative, does not want to come forward). See Figure 25 for raw results and Figure 26 for trigram categories.

Figure 25: Stalled Raw Results

Case Outcome: Stalled (Report Count, n = 1,045)

Raw Results. Analysis for Aim #3

Negative, 0

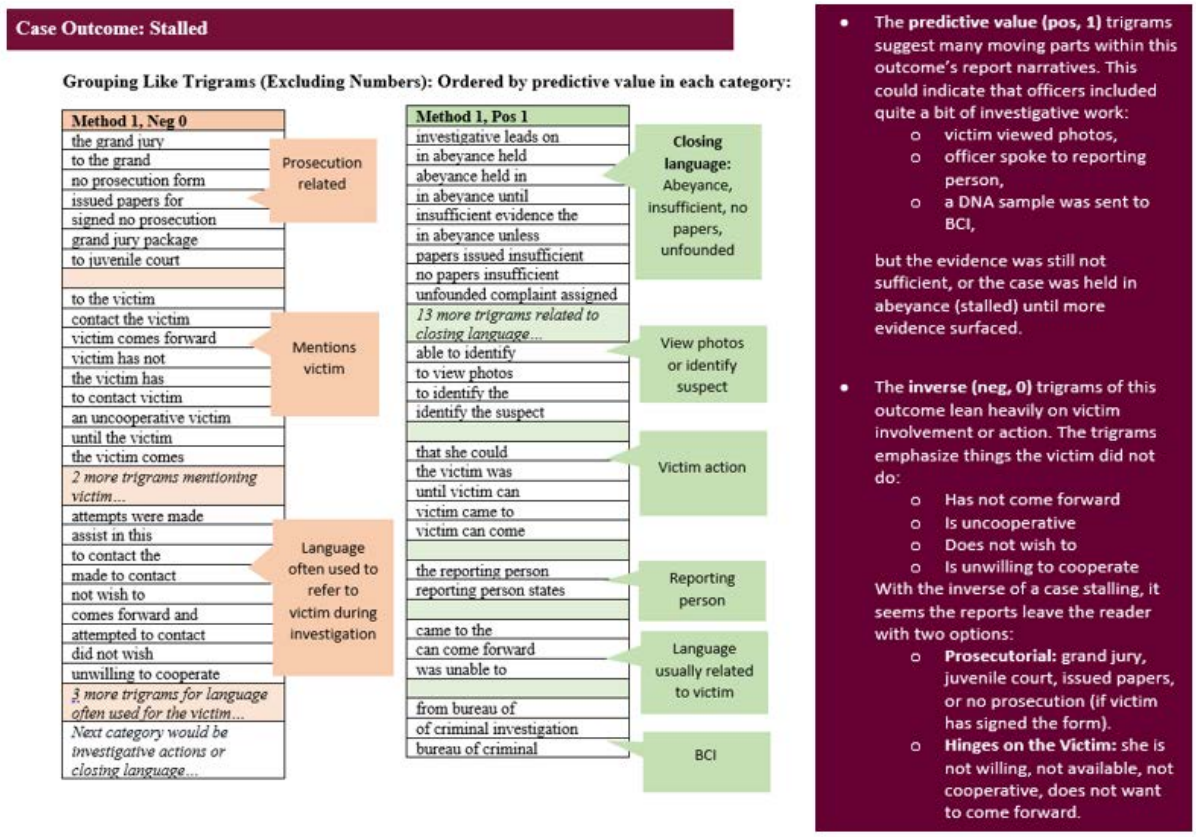
the grand jury, exceptional clean up, to the grand, no prosecution form, cleanup cleanup cleanup, to the victim, contact the victim, victim comes forward, attempts were made, assist in this, victim has not, clean up assigned, to contact the, made to contact, were made to, not wish to, in this investigation, comes forward and, attempted to contact, up clean up, did not wish, this investigation there, the victim has, clean up clean, to contact victim, up assigned detective, cleanup assigned sex, unwilling to cooperate, investigation there are, an uncooperative victim, until the victim, the arrested male, issued papers for, signed no prosecution, rape 2907 02, grand jury package, arrest clean up, the victim comes, to assist in, cleanup cleanup assigned, uncooperative victim this, letter was sent, until victim comes, did not want, to juvenile court, clean up on, several attempts were, not come forward, was conducted several, certified letter was

Positive, 1

investigative leads on, mt person name, suspect until victim, 11 10 2004, in abeyance held, abeyance held in, 01 22 2002, time we have, able to identify, to view photos, that she could, to identify the, identify the suspect, 05 30 2004, the victim was, in abeyance until, rape no further, insufficient evidence the, the reporting person, from bureau of, in abeyance unless, came to the, until victim can, evidence this case, reporting person states, complaint assigned detective, insufficient evidence this, papers issued insufficient, that there was, issued insufficient evidence, victim came to, can come forward, victim can come, was unable to, no papers insufficient, papers insufficient evidence, insufficient evidence to, unfounded complaint assigned, in abeyance pending, unfounded complaint unfounded, will be held, of criminal investigation, complaint unfounded complaint, bureau of criminal, be held in, no further investigative, further investigative leads, due to insufficient, to insufficient evidence, held in abeyance

0	1
Top 5 Predictive Trigrams	
the grand jury, exceptional clean up, to the grand, no prosecution form, cleanup cleanup cleanup	**investigative leads on, mt person name, suspect until victim, 11 10 2004, in abeyance held**

Figure 26: Stalled Trigram Categories



Victim No Engagement

The predictive value (positive, 1) trigrams for the *Victim No Engagement* outcome hinge heavily on victim action (or lack thereof). Even the investigative language mentioned actions the officer took to contact the victim ("attempts were made," "letter was sent"). The remaining language emphasized what the victim lacked ("victim did not," "not want to," "uncooperative," "unwilling," "desire to prosecute").

The inverse (negative, 0) trigrams of this outcome (i.e., cases with victim engagement) indicate a flurry of activity including: (a) prosecutorial involvement, (b) statements taken, (c) possible DNA sample (BCI involvement), (d) what the victim did do (came to the office, came forward) and (e) suspect arrest. See Figure 27 for raw results and Figure 28 for trigram categories.

Figure 27: Victim No Engagement Raw Results

Case Outcome: Victim No Engagement (Report Count, n = 2,296)

Raw Results. Analysis for Aim #3

Negative, 0

the grand jury, held in abeyance, to the grand, up clean up, clean up clean, to insufficient evidence, due to insufficient, victim came to, reporting person states, came to the, statement was taken, complaint unfounded complaint, taken from the, unfounded complaint unfounded, be held in, arrest clean up, cleanup cleanup cleanup, was taken from, gave written statement, bureau of criminal, written statement was, will be held, the victim came, of criminal investigation, crimes unit office, rape 2907 02, issued papers for, matter id 518, to grand jury, the crime scene, written statement from, and gave written, the arrested male, unit and gave, took written statement, appeared at the, victim can come, crimes unit and, 2004 00 00, can come forward, information was received, in abeyance pending, be presented to, for rape 2907, unfounded complaint assigned, at the sex, case will be, advised of his, worker person name, cleanup cleanup assigned

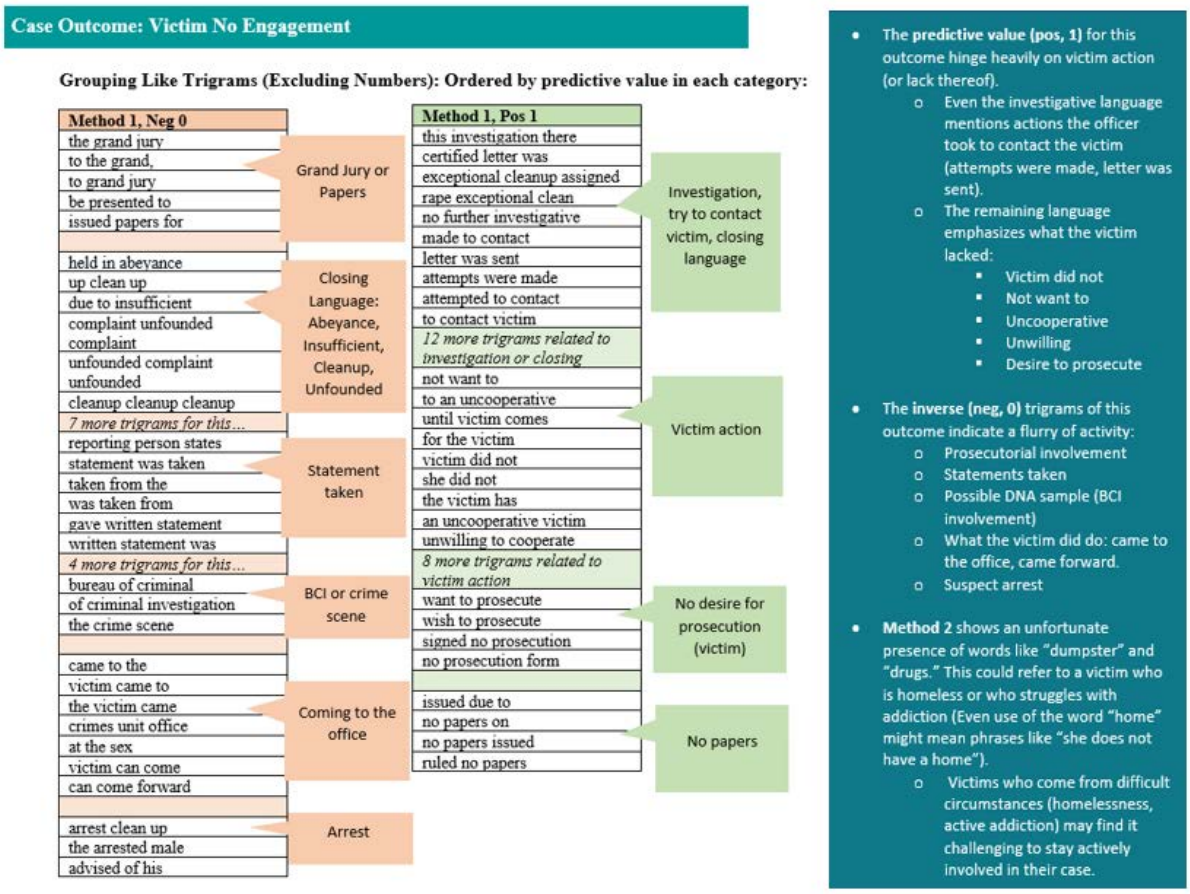
Positive, 1

this investigation there, not want to, issued due to, to an uncooperative, until victim comes, certified letter was, exceptional cleanup assigned, rape exceptional clean, no papers on, for the victim, want to prosecute, no further investigative, ex clean up, further investigative leads, victim did not, were made to, made to contact, letter was sent, up exceptional clean, she did not, wish to prosecute, have no further, the victim has, the victim comes, of this date, attempts were made, as of this, assist in this, an uncooperative victim, comes forward and, until the victim, unwilling to cooperate, in this investigation, attempted to contact, to contact victim, clean up exceptional, cleanup exceptional cleanup, victim has not, exceptional cleanup exceptional, to the victim, no papers issued, to contact the, contact the victim, signed no prosecution, did not wish, victim comes forward, not wish to, ruled no papers, no prosecution form, exceptional clean up

Interpretation

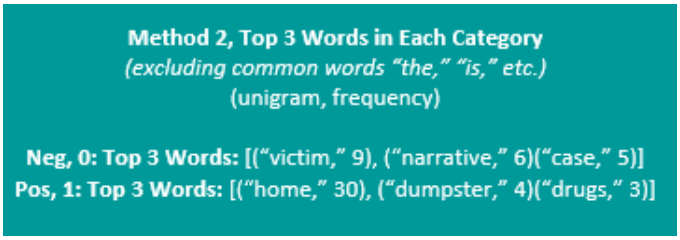
0	1
Top 5 Predictive Trigrams	
the grand jury, **held in abeyance,** **to the grand,** **up clean up,** **clean up clean**	**this investigation there,** **not want to,** **issued due to,** **to an uncooperative,** **until victim comes**

Figure 28: Victim No Engagement Trigram Categories



Text Classification Method 2 (CNB) shows an unfortunate presence of words like "dumpster" and "drugs." This could refer to a victim who is precariously housed, who struggles with addiction (even the use of the word "home" might mean phrases like "she does not have a home") or raped near or around a dumpster. The implications hint at the fact that victims who come from difficult circumstances (unhoused, active addiction) may find it challenging to stay actively involved in their case. See Figure 29 for a list of the top three most frequent trigrams under Method 2 for both positive and negative results.

Figure 29: Victim No Engagement Text Classification Method 2



Victim Not Believed/Victim Lied

The predictive value (positive, 1) trigrams for the *Victim Not Believed/Victim Lied* outcomes speak volumes by their lack of specificity. Aside from the officer declaring the case unfounded, we see a few things, (a) mention of a friend or specific person, (b) specific use of "lied" and "not raped" and (c) dates or zone car number. Considering the small number of reports in this category, the trigrams are remarkably similar to one another and are vague. Aside from saying the victim lied, all the other language was either dates/numbers or closing language. This could suggest short, undetailed reports with few investigative activities, a finding supported in the word count analyses.

The inverse (negative, 0) trigrams for this outcome show just the opposite—a variety of investigative and prosecutorial activities. This is also one of the few trigram results where a rape kit is frequently mentioned. The victim-oriented language is not in a negative form. Rather than "the victim did not," we see "the victim went" and "victim stated." See Figure 30 for raw results and Figure 31 for trigram categories.

Figure 30: Victim Not Believed/Victim Lied Raw Results

Case Outcome: Victim Not Believed/Victim Lied (Report Count, n = 158)

Raw Results. Analysis for Aim #3

Negative, 0

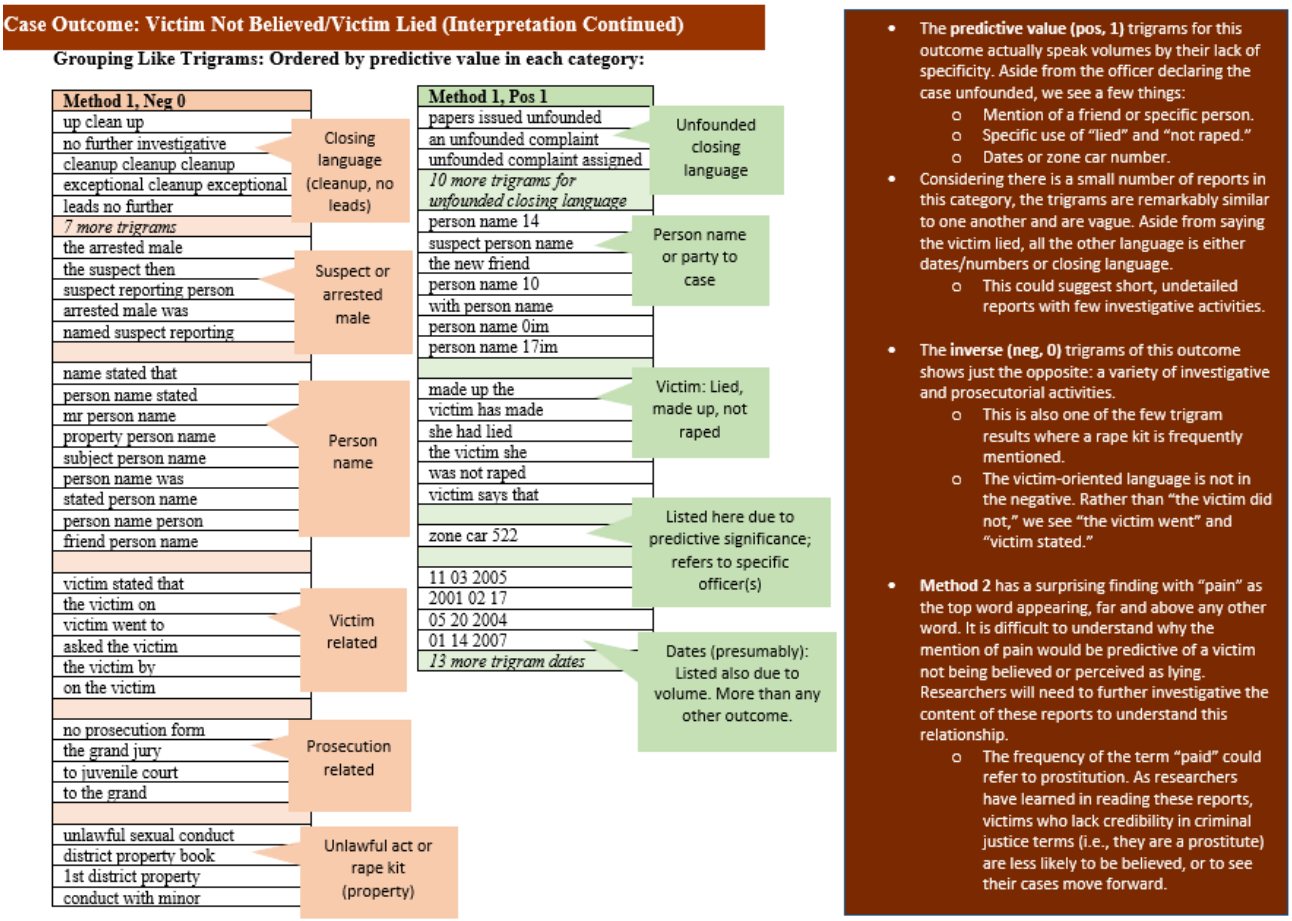
up clean up, clean up clean, further investigative leads, no further investigative, the arrested male, name stated that, person name stated, cleanup cleanup cleanup, victim stated that, no prosecution form, 2011 00 00, mr person name, the victim on, exceptional cleanup exceptional, property person name, in connection with, cleanup exceptional cleanup, unlawful sexual conduct, and entered into, subject person name, at this time, leads no further, investigative leads no, cleanup assigned sex, person name was, district property book, states that he, time she was, that when she, 2012 00 00, the grand jury, victim went to, case will be, cleanup cleanup assigned, the suspect then, suspect reporting person, asked the victim, 04 2010 00, arrested male was, of her and, stated person name, the victim by, on the victim, to juvenile court, named suspect reporting, 1st district property, conduct with minor, to the grand, person name person, friend person name

Positive, 1

person name 14, papers issued unfounded, zone car 522, made up the, victim has made, an unfounded complaint, 11 03 2005, 02 17 by, suspect person name, says that the, 2001 02 17, the new friend, she had lied, 05 20 2004, who stated that, 01 14 2007, person name 10, 09 09 2005, unfounded complaint assigned, the victim she, 01 08 2005, 12 28 2007, 01 19 2005, unfounded unfounded assigned, with person name, was not raped, unfounded complaint on, 05 01 2008, title unfounded complaint, 03 09 2008, 09 13 2006, complaint assigned sex, person name 0im, 12 11 2004, unfounded assigned sex, 08 07 2005, 08 01 2004, victim says that, 06 26 2008, new title unfounded, 08 12 2006, 11 19 2005, unf comp unf, comp unf comp, 12 17 2008, person name 17im, additional subject number, unfounded unfounded unfounded, unfounded complaint unfounded, complaint unfounded complaint

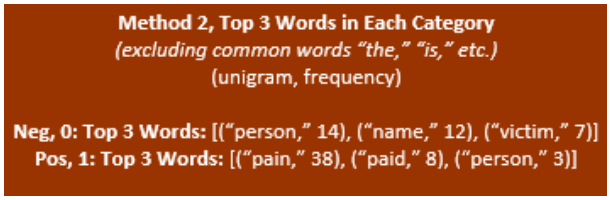
0	1
Top 5 Predictive Trigrams	
up clean up, **clean up clean,** **further investigative leads,** **no further investigative,** **the arrested male**	**person name 14,** **papers issued unfounded,** **zone car 522,** **made up the,** **victim has made**

Figure 31: Victim Not Believed/Victim Lied Trigram Categories



Text Classification Method 2 (CNB) has a surprising finding with "pain" as the top word appearing, far and above any other word. It is difficult to understand why the mention of pain would be predictive of a victim not being believed or perceived as lying. Researchers need to further investigate the content of these reports to understand this relationship. The frequency of the term "paid" could refer to prostitution. As researchers have learned in reading these reports, victims who lack credibility in criminal justice terms (e.g., "victim in known prostitute"—a direct quote, written as a factual statement in the reports) are less likely to be believed or to see their cases move forward. See Figure 32 for a list of the top three most frequent trigrams under Method 2 for both positive and negative results.

Figure 32: Victim Not Believed/Victim Lied Text Classification Method 2



Runaway Victim

The predictive value (positive, 1) trigrams for reports with a *Runaway Victim*: (a) use of the term "habitual," (b) juvenile victims and/or (c) the victim is a missing person. The trigrams "sex with him" and "interference with custody" are unique to this outcome. "Sex with him" could suggest that the rape is referred to as consensual sex, or the victim had consensual sex with the suspect at some point prior to the rape. "Interference with custody" could suggest the victim or suspect is a minor, or the report mentions custody related to an arrest. The presence of numerous trigrams might suggest short reports with relatively few details.

The inverse (negative, 0) trigrams for these cases (i.e., reports do not mention that the victim is a runaway) show heavy investigative activity: (a) officer and doctor involvement, (b) mention of a rape kit and BCI, (c) a named suspect and (d) victim action (active rather than passive). There are two trigrams that indicate urgency, "called the police" and "was approached by." The first may be obvious (the police were called), but the second may refer to instances where police were approached by the victim, who then reported the rape shortly after escaping the assault. It may also refer to the suspect approaching the victim. See Figure 33 for raw results and Figure 34 for trigram categories.

Figure 33: Runaway Victim Raw Results

Additional Case Characteristics: Runaway (Report Count, n = 64)

Raw Results. Additional Case Characteristics

Negative, 0

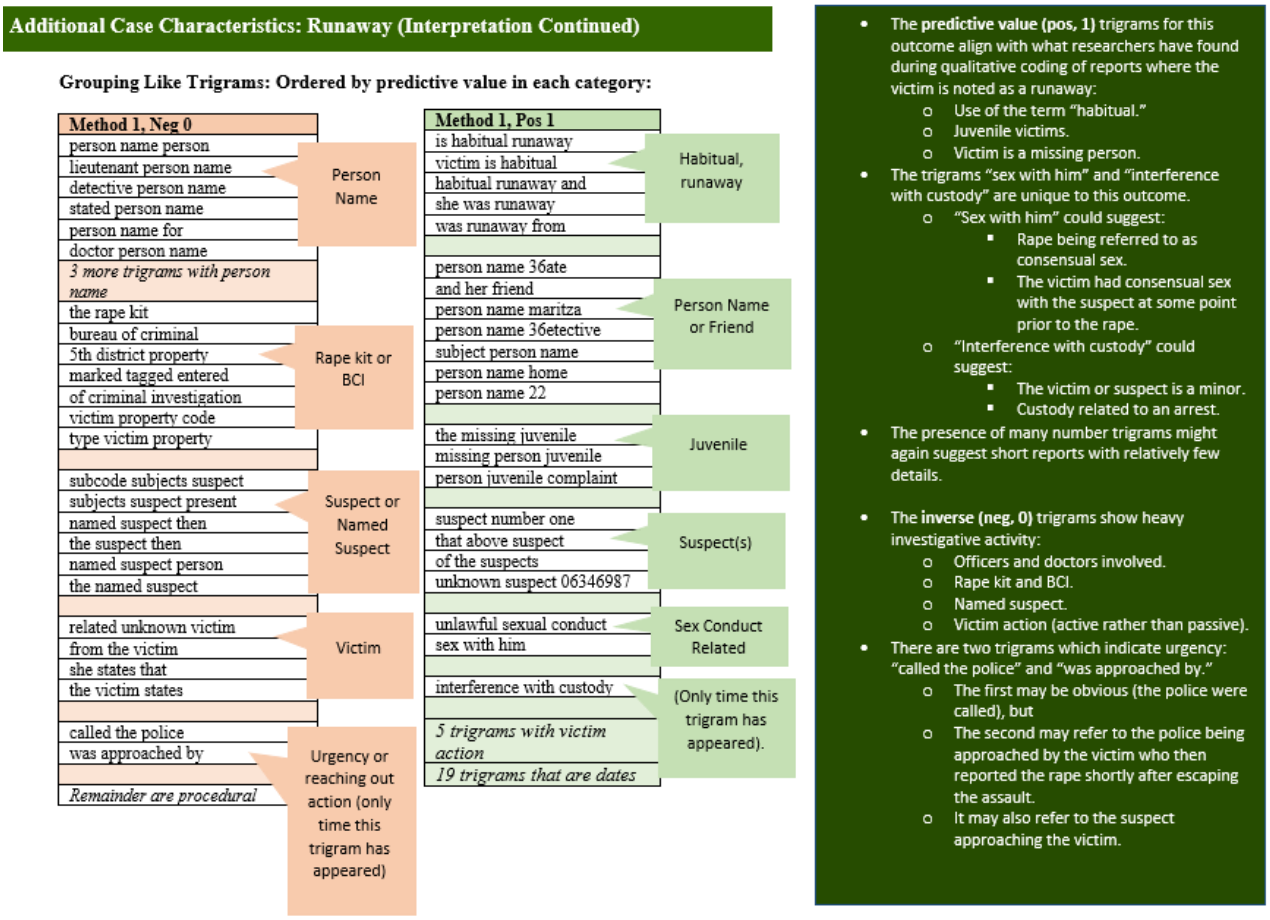
person name person, related unknown victim, to sex crimes, called the police, received the above, the rape kit, bureau of criminal, to follow up, 00 while assigned, 5th district property, lieutenant person name, subcode subjects suspect, subjects suspect present, named suspect then, are no further, assignment to further, the suspect then, this time the, marked tagged entered, detective person name, [deidentified] officer in, with patrol officer, was approached by, of criminal investigation, to further investigate, also stated that, victim property code, stated person name, type victim property, to zone car, from the victim, she states that, assigned to zone, 1999 00 00, 00 by person, at this time, sex crimes unit, the victim states, 00 00 by, person name for, doctor person name, 2009 00 00, 1997 00 00, person name to, person name then, 2004 00 00, named suspect person, that person name, the named suspect, exceptional clean up

Positive, 1

is habitual runaway, victim is habitual, 03 27 2005, 01 29 2005, habitual runaway and, person name 36ate, 30 2002 20, 09 30 2002, the missing juvenile, 10 06 2001, suspect number one, she was runaway, 04 16 2004, 08 23 2006, 11 07 2005, 03 09 2004, missing person juvenile, unlawful sexual conduct, that above suspect, and her friend, 12 13 2005, was runaway from, 03 22 2006, the victim was, the victim is, stated that above, she and her, 02 09 2006, 2004 at approx, interference with custody, 03 31 2005, 10 05 2001, 03 15 2007, person name [deidentified] , 08 21 2006, person name 36etective, unknown 99 109497, subject person name, the victim had, sex with him, 6753 state rd, person juvenile complaint, person name home, 09 16 2005, 2005 initial value, of the suspects, person name 22, unknown suspect 06346987, 03 17 2002, 11 13 2010

0	1
Top 5 Predictive Trigrams	
person name person, related unknown victim, to sex crimes, called the police, received the above	**is habitual runaway, victim is habitual, 03 27 2005, 01 29 2005, habitual runaway and**

Figure 34: Runaway Victim Trigram Categories



Aim 2 and 3: Human-Detected Sentiment Analysis

Below we present findings from hand coded, human-detected sentiment analysis of the reports, serving as qualitative validation of findings (Ignatow & Mihalcea, 2018), and providing a better understanding of the sentiment analyses. These reports were first categorized based on their high, median or low sentiment analysis ranked scores, and then selected at random.

Highest Sentiment Analysis Scored Reports

The highest sentiment analysis scored and human-coded summary table (Table 16) and word cloud (Figure 35) indicate that police reports written with more positive and subjective statements concerning details of the case and the victim often *Proceeded to Prosecution*.

These higher sentiment score cases most often involved male perpetrators who are well-known to the victim (e.g., dad, husband, boyfriend, bus driver). Word counts are near the average (~400 words), and additional (often seemingly unnecessary) details about the victim are not included (e.g., neurodiversity status "victim has ADHD and is off their medication").

Table 16: Hand-Detected Sentiment Analysis: Highest Sentiment Analysis Scored Reports

Score	Victim Characteristic	Perpetrator Characteristic	Year	Word Count	Coded Words
Highest Subjectivity *(more subjective)*					
.532	Black, Female, 30s, Mother	Victim's Boyfriend, Father to Victim's Kids	2009	371	Grand Jury, Violent, Death Threats, Domestic Violence, Forced, Named Suspect, Fear, Controlling, Vaginal Rape, Beaten, Harassment, Papers Filed, Suspect Charged
.499	Black, Female, Juvenile	Victim's Dad	2006	276	Caught in Act, Father Raped Daughter for Three Years, Named Suspect, Grand Jury
Highest Polarity *(more positivity)*					
.197	Black, Female, 20s, Mother	Victim's Friend	2004	312	Witnesses, Condom Evidence, Grand Jury, Drinking, Named Suspect
.175	Black, Female, Juvenile	Victim's Bus Driver	1993	198	Sixth Grade Student, Named Suspect, Grand Jury
Highest Overall Sentiment *(overall more positive tone)*					
.034	White, Female, 20s	Victim's Friend	2006	280	Republican National Convention, Drinking, Felt Sick, Unconscious, Named Suspect, Grand Jury, Indictment
.032	Black, Female, 50s	Victim's Friend	1994	60	Drinking, Forced, Asleep, Evidence, Papers Issued, Named Suspect, Suspect Charged

Below are two illustrative examples from the narratives of the high sentiment analysis scored reports and a word cloud of the qualitative coding:

"... the named suspect now began calling, threatening to burn the house down with her and the kids inside while they sleep tonight. Victim states that the named suspect has called at least 10 times today with these threats of killing her. Victim explains that she is scared to death of the named suspect, who has a key to the house and fears the worst from the extremely violent, possessive, controlling and unpredictable named suspect."

"Victim states allowing the suspect to stay overnight due to his drunkenness. During the night, at the above times, the suspect forced himself on top of the victim and had sexual intercourse without her permission."

Figure 35: Highest Sentiment Scores Word Cloud

Median Sentiment Analysis Scored Reports

The median sentiment analysis scored and human-coded summary table (Table 17) and word cloud (Figure 36) indicate that these police reports were written with a more neutral, factual tone in terms of opinion and objectivity. The word cloud for the six median sentiment-scored reports reveals that these "neutral" reports often involve Black, juvenile victims, who are described as being uncooperative, unruly and/or runaways. These reports most often involved perpetrators who are adjacent to the victim (e.g., a family friend, employer's boyfriend, school mates). While the scores indicate neutrality, many of these cases *Did not Proceed to Prosecution,* the named suspects were canceled and no papers were issued.

Table 17: Hand-Detected Sentiment Analysis: Median Sentiment Analysis Scored Reports

Score	Victim Characteristic	Perpetrator Characteristic	Year	Word Count	Coded Words
Median Subjectivity					
.248	Black, Female, Juvenile	Victim's Mother's Friend	1994	305	Death Threat, Named Suspect, Anal Rape, Vaginal Rape, Mentally Disabled, Drug Use, No Signs of Trauma, No Further Investigative Leads, Cancel Named Suspect
.248	Black, Female, Juvenile	Victim's Father	1993	207	Named Suspect, Victim Was A Toddler, Parental Visitation, Divorce, Evidence, No Arrests, Cancel Named Suspect
Median Polarity					
-.015	Black, Female, Juvenile	Boss's Boyfriend	1994	232	Named Suspect, Took Shower & Washed Clothes, Watched TV With Suspect After Assault, Unfounded, Cancel Named Suspect, No Papers
-.015	Black, Female, Juvenile	Victim's Friend	1995	453	Park/Playground, Smoking, Forced, Violent, Witnesses, Evidence of Assault, No Arrest, Uncooperative Victim, No Further Investigative Leads
Median Overall Sentiment					
.002	White, Female, 20s	Two Suspects Met at A Bar	1998	760	Started Consensual, Drinking, Suspects Fled, Uncooperative Victim, No Further Investigative Leads
.002	Black, Female, Juvenile	Gang Rape School Mates	1994	399	Outside, Parking Lot, Gang Rape, Vaginal Rape, Forced, Violent, Runaway, Liar, Unruly, Behavioral Problems, No Evidence

Below are some illustrative examples from the narratives of the median sentiment analysis scored reports and the word cloud of the coding:

"Victim's mother stated that the victim is not telling the truth, and that she does not know the named suspect . . . victim is mentally retarded and states that she had been raped by the (named suspect) in 1992. Does not want to live with her mother due to heavy cocaine use. Conferred with doctor, no signs of trauma."

"The named suspect then started to kiss the victim and removed the victim's pants and underwear. The named suspect then removed his pants and had sexual intercourse with the victim. Victim does not know if the named suspect used a condom or ejaculated inside the victim. The named suspect did penetrate the victim. After sexual intercourse, both the victim and named suspect watched television until victim's boss came home and paid the victim for babysitting."

"Victim states she was attracted to offender #1 and they began kissing each other. Offender #1 then walked victim to the men's room where he began pulling her top off and then began feeling her breasts. At this time offender #1 pulled off victim's top and began unbuttoning victim's pants. Victim states at this time she told offender #1 'no it is going too far' and that she wanted to go upstairs."

"Reporting person indicates 'this is the 4th or 5th rape that her daughter has reported.' Reporting person also states her daughter is constantly running away, making up stories and is "one messed up kid." Reporting person further states her daughter is involved with juvenile court and various counselors to try to get her behavioral problems straightened out."

Figure 36: Median Sentiment Analysis Scores Word Cloud

Lowest Sentiment Analysis Scored Reports

The lowest sentiment analysis scored and human-coded summary table (Table 18) and word cloud (Figure 37) indicate that these reports are more objective and more negative. These six reports frequently mention unruly juvenile victims and those with mental health issues, and tend to include sentences that discuss a lack of evidence (e.g., “no signs of physical trauma,” “no signs of assault”) and what the victim unable to do (e.g., “victim was unable,” “victim could not remember”), and actual psychological diagnoses of the victims. Additionally, these reports involve perpetrators who are more distantly connected to the victims (e.g., acquaintances or completely unknown), and the cases ended with no papers being issued or unfounded complaints.

Table 18: Hand-Detected Sentiment Analysis: Low Sentiment Analysis Scored Reports

Score	Victim Characteristic	Perpetrator Characteristic	Year	Word Count	Coded Words
Lowest Subjectivity *(more objective)*					
.111	White, Female, 20s	Victim's Friend	2005	146	Drinking, Drugs, Clubbing, Unconscious, Passed Out, Named Suspect, Suspect Fled, Cancel Named Suspect, Unfounded, No Papers
.116	Black, Female, Juvenile	Victim's Caregiver	2001	256	Raped for Misbehaving, Violent, Hit, Vaginal Rape, No Signs of Trauma or Assault
Lowest Polarity (more negativity)					
-.125	Black, Female, Juvenile	Two Unknown Suspects	2002	248	Consensual Sex for Drugs, Case Worker, Mental Health Issues, PTSD, Catatonic, Unable to Communicate, Back Alley, Psychotic Disorder, Uncooperative, No Papers, No Further Investigative Leads
-.118	Hispanic, Female, Juvenile	Family Friend	2002	562	Runaway, Unruly, Detention Center, Named Suspect, Drinking, Missing Juvenile
Lowest Overall Sentiment *(overall more negative tone)*					
-.023	Black, Female, Juvenile	Two Unknown Suspects	2002	749	Legal Guardian, RTA Bus, Parking Lot, Death Threat, Force, Violent, Abandon Building, Vaginal Rape, Evidence of Trauma, Court Mandated Counseling, Skipping School, No Papers, Insufficient Evidence
-.021	White, Female, 30s	Unknown Male	2005	383	Paranoid Schizophrenia, Delusional, Primary Degenerative Dementia, No Sign of Trauma, Made Same Claim Before, No Evidence of Trauma, Unfounded Complaint

Below are some illustrative examples from the narratives of the lowest sentiment analysis scored reports:

> ". . . the victim gave a written statement and she didn't know what the suspect did because she had drank alcohol and took valiums."
>
> "We conferred with the ER doctors who stated that there were no signs of trauma in victim's vagina. Also, no visible signs of an assault on victim's back."
>
> "Reporting person further stated that victim is known to have consensual sex for drugs in the past. Reporting person states that victim demeanor changed on Tuesday morning and asked her if she was raped, and she just shook her head "yes." Victim's clothes were washed, and she showered before going to the hospital. Witness states she saw two black males going in back alley with victim and she checked on victim about 10 minutes later and saw the two males have sex with victim, but witness states that victim was not struggling with males, and it seemed like consensual sex. Victim was unable to speak with us because she suffers from post-traumatic stress disorder and was in a semi-catatonic state. Victim was unable to answer any questions."
>
> "The reporting person stated that victim has made the same type of complaint in the past and that the victim suffers from paranoid schizophrenia, is delusional and has primary degenerative dementia among other things. We then talked to the victim who at first did not remember the incident ..."

Figure 37: Lowest Sentiment Analysis Scores Word Cloud

Discussion

By exploring the first step in the investigative process, the purpose of this study was to identify signaling in narratives of police officers' rape reports that affected case outcomes. Signaling, in this context, is defined as information conveyed by responding officers in the narratives of police reports, negatively referencing a victim's credibility. Signaling was examined with the use of machine learning technology—specifically natural language processes, namely sentiment analyses and text classification. To the best of our knowledge, no previous research has attempted to define, document and quantify signaling and its impact on investigative and prosecutorial outcomes using machine learning technology. This study contributes to our knowledge of case flow and attrition in reported rape cases while at the same time expanding the methodological tools available to researchers. Machine learning technology allows us to leverage the nuance of qualitative research on a scale previously seen only in quantitative assessments.

In this project, we explored whether sentiment—opinion and subjectivity—can be detected in incident reports that were theoretically supposed to contain pertinent facts. If detected, what was the nature of the phrases, sentiments and subjectivity contained in the reports? The results indicate that signaling could be detected in these rape reports with the use of machine learning technologies, but it was not quite what was expected.

We hypothesized and found that these reports do have a low but significant level of sentiment that tends to skew slightly negative (not surprising given that the subject matter is rape) with higher levels of subjectivity. The reports are remarkably stable over time in the degree of sentiment (with a slight uptick in the early 2000s) and word count (with an average of around 415 words in the incident report). We also hypothesized that if detected, *negative* sentiment and *positive* subjectivity in the reports would speak to the responding officers' signaling about a

victim's credibility. We further supposed that the reports connected to the most successful cases would be those with "the most pertinent facts"—in other words, neutral and/or non-significant sentiment. Lastly, we expected that the longer reports would be associated with more positive outcomes and associated with victims, who traditionally have less criminal justice credibility issues.

However, the predictive nature of the sentiment contained in these reports is a bit different than expected. Our findings indicate that the most successful cases have *positive* sentiment and *positive* subjectivity. In the cases where signaling was expected to be most prevalent (cases that were unfounded, with explicit statements about victims lying, runaway victims, etc.), we find negative sentiment and (mostly) non-significant subjectivity. A human review of the reports with low sentiment scores and more negative polarity indicates that the low/negative scores are likely an indicator of the "no's" ("victim did not know," "victim was unable to recall," "no signal of trauma"), but predictive phrases also entail the words that describe how "bad" the rapes were (e.g., "the named suspect now began calling, threatening to burn the house down with her and the kids inside while they sleep tonight").

Our word count findings are as hypothesized. We found that longer reports are highly predictive of more investigative activity and successful outcomes. Victims with traditionally fewer criminal justice credibility issues had longer incident reports. As mentioned in the literature review, victim credibility issues can be complicated and intersectional, but in this study include: race/ethnicity, being an adolescent, being a runaway, having an unfounded case and/or not believed, not remaining engaged or having one's criminal history mentioned in the report. In the analyses presented here, we are unable to determine if the shorter reports are directly tied to

these credibility issues, or more indirectly via an unmeasured mediating or moderating relationships. Future analyses could dissect the direct versus indirect nature of this finding.

The text classification analyses indicate the highly structural and procedural nature of rape reports and the difficulty in getting beyond all the procedural words to get at the "meatier" words that might indicate signaling. The most predictive trigrams for the cases that *Did Not Proceed to Prosecution* were connected to what the officers/prosecutors did, the procedural language around why/how the case was closed or what the victims did or did not do, say or know. Interestingly, the successful cases were those where officers were more inclined to use the term "rape," "unlawful" and the criminal state statute number for rape—a signal indicating a victim's credibility. The categories of phrases are similar for cases that were *Forwarded for Prosecutorial Review* (= 1) and *Proceeded to Prosecution* (= 1) (despite the signs for the sentiment analysis measures switching from negative to positive). These phrases do not sufficiently speak to signaling about a victim's credibility. However, given how structured the text was in the rape reports, the more informative data in trigrams comes from comparing the predictive (positive, 1) to the inverse (negative, 0) for each outcome to detect which trigrams were and were not in the reports. The more successful cases (*Proceeded to Prosecution*—a relatively low bar for success) include details of the procedures that were followed and activities that occurred. The victim references/preferences are not as predictive (and perhaps engagement is implied because the case proceeded). Using a different method (CNB) for text classification produced interesting unigrams that need further exploration, like "stepfather" and "her" for cases that *Proceeded to Prosecution* and "pain" and "paid" for *Victim Not Believed/Victim Lied* cases.

These findings have several important implications for best practice. First, best practice should include writing detailed, lengthy reports. The length of the report is likely one of the most

reliable indicators of signaling. *"Three-finger reports"* is how a retired police chief and advisory board member for this grant said particularly terse reports are referred to among some officers—or the length of three finger salute or pledge turned horizontal (for a visual, think a "scouts" salute or pledge, where the palm is facing out, the thumb is holding down the little finger, fingers pressed together, not spread apart, but instead of vertical, the hand is turned horizontally). Officers are signaling information about a victim's credibility not by providing strong, opinionated statements, but by stating very little (via sentiment analyses), vaguely and without much from the victim's perspective (via text classification).

Second, counter to what we expected, best practice should entail writing reports that do not include "just the facts." The negatively worded reports that described what the victim did not know, do or say ("victim does not know if the named suspect used a condom or ejaculated inside the victim"), and the neutrally worded, factually-dense reports ("victim is a habitual runaway" or "named suspect then removed his pants and had sexual intercourse with the victim") failed to capture or convey the extent of the trauma of rape. Negatively and/or neutrally worded reports also did not include the victim's perspective of the event—positive subjectivity—just that the victim stated that the event occurred.

Third, best practice should work to minimize the number of unqualified statements and observations, especially in reference to the victim. In the qualitative coding discussed here, we found many unqualified statements, often factually written. In returning to our examples discussed in the literature review of human-detected examples of signaling in the investigations:

> (a) "…observed no bruises, contusions on the female nor were her clothes disheveled. At times during the interview she smirked as if it was funny, but she did show signs that she was in pain or discomfort."

(b) “Juvenile has had sex in the past. Rape kit to be completed. Reporting person advised to obtain further information on [suspect]. Full intercourse per juvenile.”

(c) “Victim is a known prostitute and crack cocaine abuser.”

Those are mainly factually written, unqualified statements, by the officers. The report writer does not provide detail as to why there were no bruises and disheveled clothes, why a victim’s prior sexual history or being “known prostitute” are mentioned or relevant. It is possible that the victims mentioned this as being a key aspect of rape, that the sexual contact happened within the last 72 hours or that there was additional vaginal sexual contact with a consent partner in the last 72 hours (important information in rape kit cases) in the interview with officers, and this information did not get captured in the reports. However, without that important next statement qualifying why the factual statement is pertinent to the investigation, a human likely reads this as signaling—disbelieving the victim’s statements and/or blaming a victim for what happened to them. Our findings indicate that the computer does this too, but differently (e.g., neutral/negative, without detail, without the victim’s perspective), and with different implications, as discussed below.

Fourth, best practice necessitates the victims be strongly centered in the rape report, but not just what happened to them or what they did not do or remember (Archambault et al., 2020). Instead, what was the rape like (in as much detail as possible)? How did they feel? What do they remember thinking, hearing, smelling, tasting, etc.? For example (as referenced above), “victim explains that she is scared to death of the named suspect, who has a key to the house and fears the worst from the extremely violent, possessive, controlling and unpredictable named suspect.” Almost all incident reports were from the victim’s perspective. Information on, about and from the suspects are notably absent from the data and findings—indirectly and tangentially

mentioned ("arrested male was," "male was charged"). This, despite the events described in the reports, is a direct result of the suspect's actions. Thus, the detected subjectivity contained in the reports is less about the officers' and suspects' subjective statements, and more about the victim's subjective statements—their perspective and description of what happened to them. Thus, our finding that more successful reports include more subjective statements speaks to the extent to which the victim is centered or personalized in the reports. There is one important caveat to this practice. Research suggests that when victims are written as the subjects/actors in these statements, victims are more likely to be seen as being responsible for what happened to them via victim-blaming and rape myth acceptance increases (Niemi & Young, 2016). Therefore, victim-centered reports where the victims are described as subjects in the action/sentence (the actor) might be less preferable to reports where victims are recipients of the action (objects in the sentence, acted upon). For example (as referenced above), "the named suspect then started to kiss the victim and removed the victim's pants and underwear. The named suspect then removed his pants and had sexual intercourse with the victim."

Fifth, best practice requires providing better support to victims throughout the entire criminal justice process—even before the report is written. Our findings also speak to what prior research from a subset of these data has found: despite victim credibility issues, cases that fail to progress in the criminal justice process are those where the victim is not engaged in the process, and where there is an unknown suspect—termed the *bureaucratic burden* (Lovell, Overman, et al., 2020). These two factors were highly predictive in our analyses. These are highly bureaucratic processes necessary for most criminal cases to progress, as the investigative phase is where most rape cases fail to proceed (Lovell, Overman, et al., 2020; Morabito, Williams, et al., 2019)—even before taking a formal statement from the victim or suspect. The merits of the case

are often placed on a traumatized victim right after the rape. Victims are expected to recall and provide a strong and consistent account of events before additional investigative activities are undertaken. Before effort is expended on the investigation, victims need to demonstrate they will remain engaged (e.g., "she has to prove she wants this… then I'll take a look" [R. Campbell & Fehler-Cabral, 2018]) and can name their offender. These two factors will likely advance a case to prosecutorial review, even if the report has few words and/or negative statements about a victim. In other words, the wording in the report and the victim's credibility issues become more salient once engagement and suspect identification have been rectified.

Finally, best practice entails placing a greater priority on improving report writing. More detailed and accurate incident reports are vital for the entire criminal justice process, from investigations (Strom, Markey, Feeney, & Scott, 2022), to testing of forensic evidence (Lopez-Jauffret, 2022) and to prosecution (Long et al., 2022). More trauma-informed, victim-centered report writing has the potential to improve the entire criminal justice process—improving the interpersonal engagement officers have with victims (Campbell & Raja, 1999), which increases the likelihood of victim engagement in investigations and prosecutions, which increases the likelihood of successful prosecutions, which serves to make our communities safer (Luminais, et al., 2020). Additionally, research also supports that changing the way one writes influences the way one thinks (Hofmann, 1993). Ensuring the responding officers, often the most untrained in trauma-informed practices, write in more trauma-informed, victim-centered ways can not only produce better reports—a vital component in the investigation and prosecution of a crime—but also improve their perceptions and treatment of victims. Trauma-informed, victim-centered writing entails writing from the perspective of believing what a victim says about being raped,

until the information leads you to believe otherwise, instead of starting from the perspective of not believing or blaming a victim (McGuire et al., 2022).

In summary, we set out to assess whether we can teach a computer to detect "signaling" or *innuendo* about a victim's credibility in incident reports of rape. The findings indicate that, yes, we can teach a computer to do this, but what the computer is able to pick up using the techniques employed here often takes the form of effort on the part of the officer (length of the report), the actions and engagement of the victim (sentiment and polarity) and the personalization and centering of the victim (subjectivity). The text classification findings support the sentiment analyses by providing context to the findings and specific, predictive phases. Below, next steps are detailed as to how this information can be further applied and expanded.

Limitations and Future Directions

There are several factors that limit the generalizability of these findings. First, these data are derived from one large, urban, Midwestern police department in the United States, which might not reflect all jurisdictions. Second, our data are also limited to rapes that include sexual assault kits (SAKs). While there is limited research on how rapes with SAKs compare to those without, we know that over 50% of all rapes reported to CDP included a SAK from 1993 through 2009 (Lovell & Dissell, 2021), and are disproportionally connected to "stranger" rapes (Lovell, et al., 2022). These data may not be representative of most recent rapes (post-2012) with SAKs. Third, the data are from the official documentation of the crime as written by officers, which presents issues of variation in report writing from officer to officer, missing or inaccurate information contained in the reports and information not being provided directly by the victims. Fourth, our data are skewed toward capturing what is present rather than what is not present in the reports, although this is true for all research that relies on criminal justice administrative

documentation. Lastly, our findings are limited to the potential signaling of a responding officer to an investigator, with the acknowledgment that other actors within the criminal justice system also play an important role in attrition and criminal adjudication. The reports do not often denote information about any interactions or conversations between the other actors within the system, or additional information about the crime not contained in the reports, which also may contribute to the decision to proceed or not.

In terms of future directions, these research findings signify the need for a crime dictionary or lexicon, ideally one that is rape-specific, to provide information on signaling words and phrases. The open-source dictionary, applied and used broadly in sentiment analysis, is general-use lexicon. These dictionaries represent what is currently available for sentiment analyses but are not an ideal fit for criminal justice data. To that end, as a deliverable for this award, we have developed an open-source lexicon specific to these data. More research is needed to further refine potentially signaling words in rape reports, which can be added to the open-source lexicon. Additionally, the two methods for text classification produced vastly different results, despite Method 1 only producing marginally improved metrics. This suggests more research is needed to explore these methods in greater detail.

Turning the pdfs into text reports was the most time consuming and difficult aspect of this project, which is likely a major contributing factor as to why this type of research is rare in criminology research. The criminal justice field is an extremely text-heavy field (which is great for this type of research), and although most criminal justice entities now have electronic case management systems, digitized text lay stagnant as pdf “pictures” in electronic file folders. This format means that the text is not easily searchable and requires a person to examine documents one at a time for each potential inquiry. The discussed results demonstrate the need for criminal

justice practitioners to have case files that are "living," dynamic documents that can be searched and examined easily (Lovell, Williamson, et al. 2022). To be more engaged with the important information contained in police reports, criminal justice practitioners need technological tools to interact with their textual data. These tools include: a software program that helps automate the pdf-to-text conversion and cleaning, and another program that aids in the practitioner interfacing with the data (so that the text is not in one massive word processing document or spreadsheet). Future technological advances in law enforcement should include advancements in the accessibility and degree of interaction with criminal justice information.

Conclusion

Overall, regarding the presence and nature of sentiment in the incident reports, we found support for H_{1A} and H_{1B}. We detected sentiment in the reports, which tended to skew near neutral/slightly negative and more subjective. The detected sentiment was also predictive across several victim and suspect characteristics and case outcomes. However, overall, these incident reports of rape did not contain high levels of sentiment and had not changed much in their level of sentiment or length over the decades. When examining the characteristics of the victims, suspects and the cases that were most likely to include statements about a victim's credibility (unfounded, victim not engaged and victim not believed), we found that the reports with fewer words and whose words were more negative and subjective tended to be those associated with Black victims (compared to non-Black victims, which in this sample means almost all were White victims), and cases where the suspects were not fully named (thus, stranger or near-strangers to the victims). Reports where the suspects were not fully named have, on average, 100 fewer words. Unfounded cases and cases closed because of a lack of victim engagement had fewer words and were more negatively worded. Interestingly, this pattern did not hold in the

reports where officers explicitly stated that victims were not believed (likely written in a more factual tone), although these cases still had more negative sentiment than cases where there were no explicit statements doubting victims. In terms of the reports and the demographics of victims, younger victims' reports had more words. Age of victim, when expressed as a continuous measure, indicated no relationship with the sentiment analysis measures. When age was grouped, the only grouped mean differences were for victims who were under 13 years of age—their reports were more subjective and more positive than victims who were over 13 years of age.

We also found partial support for H_{2A}. We hypothesized that shorter reports with more negative and more subjective tone would be stalled earlier in the process. However, incident reports connected to *Investigation Stalled* were shorter by an average of 61 words (as predicted), with more negative (as predicted) and less subjective words (not as predicted). Incident reports connected to cases with more investigative activity, *Investigation Forwarded for Prosecutorial Review,* were 99 words shorter than those that progressed further (as predicted), with more negative (as predicted) and non-significant subjectivity (not as predicted).

As for H_{2B}, we hypothesized and found that the phrases would be different in reports where the cases stalled earlier in the process. The trigrams most predictive for *Investigation Stalled* (= 1) mentioned prosecutorial involvement, likely indicating the "slippery slope" of prosecutorial conferment of cases. By comparison, the phrases most predictive were the cases where the *Investigations Not Stalled* (= 0) more frequently mentioned the actions of the victims and the assigned detective, followed by phrases related to investigative leads, or lack thereof. The phrases most predictive for *Investigation Forwarded for Prosecutorial Review* (= 1) mentioned, as expected, prosecutorial involvement; arresting, charging or naming a suspect; phrases related to the rape and use of the term specifically; and additional investigative activity

or forms. By comparison, the phrases most predictive in the cases where *Investigations Not Forwarded for Prosecutorial Review* (= 0) mentioned the actions of the victims and the assigned detective, followed by trigrams related to investigative leads, or lack thereof.

We also found partial support for H_{3A}. We hypothesized that the most successful cases, which were also those cases with the most activity, were those that had more words and positive sentiment, and less subjectivity, i.e., a more neutral, factual tone. However, our findings indicated that the most successful cases had, on average, 106 more words than those that stalled earlier (as predicted), are more positive (as predicted) and more subjective (not as predicted). In further support of this finding, reports that logically should have had the most amount of signaling because they contained explicit statements doubting and/or unfounding a victim's account, or where victims did not engage with the investigation, had more negative and less subjective text.

As for H_{2B}, we hypothesized and found that the phrases were different in reports where the cases were the most successful. The phrases most predictive for *Proceeded to Prosecution* (= 1) mentioned prosecutorial involvement; arresting, charging or naming a suspect; trigrams related to the rape specifically and additional investigative activity or forms. These phrases were similar to those in *Investigation Forwarded for Prosecutorial Review*. The trigrams most predictive in the cases that *Did Not Proceed to Prosecution* (= 0) heavily emphasized actions that stall or stop a case from moving forward, such as prosecutorial decline, lack of investigative leads and negatively worded victim references/preferences. Using another text classification method (Method 2), the most predictive unigrams included the word "stepfather" and "her." This potentially indicates that cases in which the suspect was the victim's stepfather, and cases in which the victim was mentioned in the third person, or as the recipient of the rape/action, more

often lead to prosecution. The most predictive trigrams in the cases that should have had the most signaling language (e.g., unfounded, victim not believed) were almost all connected to procedural closing language, or lack of victim action/preference for not wanting to remain engaged. Of note, in cases where *Victim Not Believed/Lied*, reports lacked specificity and had trigrams with references to witnesses, friends or other specific persons such as mothers—not seen in the other outcomes. In other words, these reports were short, undetailed and contained little investigative activity. In the runaway cases, the trigrams were different from the other cases. They included the terms habitual, juvenile and missing persons. As with cases where victims were not believed, trigrams related to witnesses, friends or other involved persons were mentioned and were short, with relatively few details. The trigrams "sex with him" and "interference with custody" appeared for the first time with these cases. Lastly, to help provide a contextual understanding of the sentiment analysis scores, we qualitatively hand coded 18 reports—six with high sentiment scoring, six with median sentiment scoring and six with low sentiment scoring. The findings support our quantitative interpretation of the sentiment and text classification analyses. The reports with the highest sentiment scoring, *Proceeded to Prosecution*, involved perpetrators who were well-known to victims and were written with more positive statements that included subjective statements about and from the victims (e.g., what the victim did or said, what was done to the victim), and did not often include seemingly unnecessary details about the victim.

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References

Addington, L. A., & Rennison, C. M. (2008). Rape Co-occurrence: Do Additional Crimes Affect Victim Reporting and Police Clearance of Rape? *Journal of Quantitative Criminology, 24*(2), 205–226. https://doi.org/10.1007/s10940-008-9043-9

Alderden, M. A., & Ullman, S. E. (2012). Creating a more complete and current picture: Examining police and prosecutor decision-making when processing sexual assault cases. *Violence Against Women, 18*(5), 525–551. https://doi.org/10.1177/1077801212453867

Archambault, J., Lonsway, K. A., & Keenan, S. (2020). *Effective report writing: Using the language of non-consensual sex*. End Violence Against Women International (EVAWI). chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://evawintl.org/wp-content/uploads/Module-1_Report-Writing-11-9-2020-1.pdf

Argiento, R., Pemantle, R., Skyrms, B., & Volkov, S. (2009). Learning to signal: Analysis of a micro-level reinforcement mode. *Stochastic Processes and Their Applications, 119*(2), 373–390. https://doi.org/10.1016/J.SPA.2008.02.014

Ask, S. (2018). 'She had it coming?': An experimental study of text interpretation in a police classroom setting. *Nordic Journal of Linguistics, 41,* 133–153. https://doi.org/10.1017/S0332586518000094

Attenborough, F. (2014). Rape is rape (except when it's not): The media, recontextualisation and violence against women. *Journal of Language Aggression and Conflict, 2*(2), 183–203. https://doi.org/10.1075/jlac.2.2.01att

Baccianella, S., Esuli, A., & Sebastiani, F. (2010, May). SentiWordNet 3.0: An Enhanced Lexical Resource for Sentiment Analysis and Opinion Mining. *Proceedings of the Seventh International Conference on Language Resources and Evaluation (LREC'10).* LREC 2010, Valletta, Malta. http://www.lrec-conf.org/proceedings/lrec2010/pdf/769_Paper.pdf

Beichner, D., & Spohn, C. (2005). Prosecutorial charging decisions in sexual assault cases: Examining the impact of a specialized prosecution unit. *Criminal Justice Policy Review, 16*(4), 461–498. https://doi.org/10.1177/0887403405277195

Beichner, D., & Spohn, C. (2012). Modeling the effects of victim behavior and moral character on prosecutor's charging decisions in sexual assault cases. *Violence and Victims, 27*(1), 3–24. https://doi.org/10.1891/0886-6708.27.1.3

Benz, A. (2011). *Language, games, and evolution: Trends in current research on language and game theory: Vol. 6207.* Springer. https://doi.org/10.1007/978-3-642-18006-4

Bouffard, J. A. (2000). Predicting type of sexual assault case closure from victim, suspect, and case characteristics. *Journal of Criminal Justice, 28*(6), 527–542.

Brown, J. M., Hamilton, C., & O'Neill, D. (2007). Characteristics associated with rape attrition and the role played by scepticism or legal rationality by investigators and prosecutors. *Psychology, Crime & Law, 13*(4), 355–370. https://doi.org/10.1080/10683160601060507

Byrman, G. (2013). Police writing techniques in reported interviews. In M. De Guzman, A. M. Das, & D. K. Das (Eds.), *The evolution of policing: Worldwide innovations and insights* (pp. 247–262). CRC Press, Taylor & Francis Group.

Campbell, B. (2022). Advancements in trauma-informed training and interviewing for law enforcement and prosecutors. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 315–326). Routledge, Taylor & Francis Group.

Campbell, R. (1998). The community response to rape & victims & experiences with the legal, medical, and mental health system. *American Journal of Community Psychology*, *26*(3), 355–379.

Campbell, R. (2006). Rape survivors' experiences with the legal and medical systems: Do rape victim advocates make a difference? *Violence Against Women*, *12*(1), 30–45. https://doi.org/10.1177/1077801205277539

Campbell, R. (2017). Qualitative fieldwork within the criminal justice system: Emotions, advocacy, and the pursuit of social justice for untested sexual assault kits (SAKs). *Qualitative Psychology*, *4*(3), 315–325. https://doi.org/10.1037/QUP0000063

Campbell, R., Adams, A. E., & Patterson, D. (2008). Methodological challenges of collecting evaluation data from traumatized clients/consumers. *American Journal of Evaluation*, *29*(3), 369–381. https://doi.org/10.1177/1098214008320736

Campbell, R., & Fehler-Cabral, G. (2018). Why police "couldn't or wouldn't" submit sexual assault kits for forensic DNA testing: A focal concerns theory analysis of untested rape kits. *Law & Society Review*, *52*(1), 73–105. https://doi.org/10.1111/lasr.12310

Campbell, R., Greeson, M. R., Bybee, D., & Raja, S. (2008). The co-occurrence of childhood sexual abuse, adult sexual assault, intimate partner violence, and sexual harassment: A mediational model of posttraumatic stress disorder and physical health outcomes. *Journal of Consulting & Clinical Psychology*, *76*, 194–207. https://doi.org/10.1037/0022-006X.76.2.194

Carr, A. F., Schnelle, J. F., Kirchner, R. E., Larson, L. D., & Risley, T. R. (1980). Effective police field supervision—A report writing evaluation program. *Journal of Police Science and Administration*, *8*(2), 212–219.

Craig, E. (2016). The inhospitable court. *University of Toronto Law Journal*, *66*(2), 197–243. a9h. https://doi.org/10.3138/UTLJ.3398

DiMaggio, P., Nag, M., & Blei, D. (2013). Exploiting affinities between topic modeling and the sociological perspective on culture: Application to newspaper coverage of U.S. government arts funding. *Poetics*, *41*(6), 570–606. https://doi.org/10.1016/j.poetic.2013.08.004

Du Mont, J., & Myhr, T. L. (2000). So few convictions. *Violence Against Women*, *6*(10), 1109–1136. https://doi.org/10.1177/10778010022183541

Federal Bureau of Investigation (FBI). (2013). *Crime in the United States: 2013: Clearances*. FBI: UCR. https://ucr.fbi.gov/crime-in-the-u.s/2013/crime-in-the-u.s.-2013/offenses-known-to-law-enforcement/clearances/clearancetopic_final

Federal Bureau of Investigation (FBI). (2018). *Crime in the United States: 2018: Clearances*. FBI: UCR. https://ucr.fbi.gov/crime-in-the-u.s/2018/crime-in-the-u.s.-2018/topic-pages/clearances

Federal Bureau of Investigation (FBI). (2019). *Crime in the United States: 2019: Methodology*. FBI. https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/topic-pages/methodology

Frohmann, L. (1997). Convictability and discordant: Reproducing race, class, and gender ideologies in prosecutorial decisionmaking. *Law & Society Review*, *31*(3), 531–556. https://doi.org/10.2307/3054045

Gaines, D. C., & Wells, W. (2017). Investigators' and prosecutors' perceptions of collaborating with victim advocates on sexual assault casework. *Criminal Justice Policy Review*, 0887403415592176. https://doi.org/10.1177/0887403415592176

Gray-Eurom, K., Seaberg, D. C., & Wears, R. L. (2002). The prosecution of sexual assault cases: Correlation with forensic evidence. *Annals of Emergency Medicine*, *39*(1), 39–46. https://doi.org/10.1067/mem.2002.118013

Gregory, A. H., Compo, N. S., Vertefeuille, L., & Zambruski, G. (2011). A comparison of US police interviewers' notes with their subsequent reports: US police interviewers' notes. *Journal of Investigative Psychology and Offender Profiling*, *8*(2), 203–215. https://doi.org/10.1002/jip.139

Guerini, M., Gatti, L., & Turchi, M. (2013). *Sentiment analysis: How to derive prior polarities from SentiWordNet*. arXiv. https://doi.org/10.48550/arXiv.1309.5843

Güss, C. D., Tuason, Ma. T., & Devine, A. (2020). Problems with police reports as data Sources: A researchers' perspective. *Frontiers in Psychology*, *11*, 2708. https://doi.org/10.3389/fpsyg.2020.582428

Hofmann, T. (1993). *Realms of meaning: An introduction to semantics*. Taylor & Francis Group.

Hohl, K., & Stanko, E. A. (2015). Complaints of rape and the criminal justice system: Fresh evidence on the attrition problem in England and Wales. *European Journal of Criminology*, *12*(3), 324–341. https://doi.org/10.1177/1477370815571949

Ignatow, G., & Mihalcea, R. (2018). *An introduction to text mining: research design, data collection, and analysis*. SAGE Publications, Inc.

Johnson, D., Peterson, J., Sommers, I., & Baskin, D. (2012). Use of forensic science in investigating crimes of sexual violence: Contrasting its theoretical potential with empirical realities. *Violence Against Women*, *18*(2), 193–222. https://doi.org/10.1177/1077801212440157

Jordan, J. (2004). Beyond belief? Police, rape and women's credibility. *Criminology & Criminal Justice*, *4*(1), 29–59. https://doi.org/10.1177/1466802504042222

Kaffer, N. (2015, June 22). *How Detroit cop culture hindered rape investigations*. Detroit Free Press. https://www.freep.com/story/opinion/columnists/nancy-kaffer/2015/06/20/rape-kits/29013941/

Kaiser, K. A., O'Neal, E. N., & Spohn, C. (2017). "Victim refuses to cooperate": A Focal concerns analysis of victim cooperation in sexual assault cases. *Victims & Offenders*, *12*(2), 297–322. https://doi.org/10.1080/15564886.2015.1078864

Kanable, R. (2005). Getting it write right: Convictions require good report writing. *Law Enforcement Technology*, 160–168.

Karystianis, G., Adily, A., Schofield, P. W., Greenberg, D., Jorm, L., Nenadic, G., & Butler, T. (2019). Automated analysis of domestic violence rolice peports to explore abuse types and victim injuries: Text mining study. *Journal of Medical Internet Research*, *21*(3), e13067. https://doi.org/10.2196/13067

Kelley, K. D., & Campbell, R. (2013). Moving on or dropping out: Police processing of adult sexual assault cases. *Women & Criminal Justice*, *23*(1), 1–18. https://doi.org/10.1080/08974454.2013.743365

Kelly, L., Lovett, J., & Regan, L. (2005). *A gap or a chasm? Attrition in reported rape cases*. Home Office Research Study 293, https://www.ojp.gov/ncjrs/virtual-library/abstracts/gap-or-chasm-attrition-reported-rape-cases

Kerstetter, W. A., & Van Winkle, B. (1990). Who decides?: A study of the complainant's decision to prosecute in rape cases. *Criminal Justice and Behavior*, *17*(3), 268–283. https://doi.org/10.1177/0093854890017003003

Kingsnorth, R. F., & Macintosh, R. C. (2004). Domestic violence: Predictors of victim support for official action. *Justice Quarterly*, *21*(2), 301–328. i3h.

Kuang, D., Brantingham, P. J., & Bertozzi, A. L. (2017). Crime topic modeling. *Crime Science*, *6*(1), 12. https://doi.org/10.1186/s40163-017-0074-0

Langhinrichsen-Rohling, J., Jules, B., Lathan, E., Coates, A., & Crisler, R. (2022). Understanding sexual assault disclosure: Victim decision-making processes underlying the national sexual assault kit initiative. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 43–62). Routledge, Taylor & Francis Group.

Langhinrichsen-Rohling, J., Lathan, E. C., Stefurak, T., & Duncan, J. (2022). Transforming police response to sexual assault from the inside out: A case study of the Mobile, Alabama Sexual Assault Kit Promise Initiative. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 165–184). Routledge, Taylor & Francis Group.

Lievore, D. (2004). Victim credibility in adult sexual assault cases (ISBN 0 642 53860 3; ISSN 0817-8542; Trends & Issues in Crime and Criminal Justice, Vol. 288). *Australian Institute of Criminology*.

Long, J., Powers, P., Fuhrman, H., & Newman, J. (2022). Prosecutorial response to sexual violence. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 185–201). Routledge, Taylor & Francis Group.

Lopez-Jauffret, C. (2022). Behind the scenes of the forensic lab: Forensic decision making for sexual assault kit testing. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 267–282). Routledge, Taylor & Francis Group.

Lovell, R. (2022). Detailing the process of identifying and the outcomes of efforts to address lawfully "owed." *Journal of Forensic Sciences*, *67*(6), 2321–2333. https://doi.org/10.1111/1556-4029.15142

Lovell, R., Collins, C. C., McGuire, M. J., Overman, L. T., Luminais, M. N., & Flannery, D. J. (2019). Understanding intimate partner sexual assaults: Findings from sexual assault kits. *Journal of Aggression, Maltreatment & Trauma*, *28*(1), 8–24. https://doi.org/10.1080/10926771.2018.1494234

Lovell, R., & Dissell, R. (2021). Dissemination and impact amplified: How a researcher–reporter collaboration helped improve the criminal justice response to victims with untested sexual assault kits. *Journal of Contemporary Criminal Justice*, *37*(2), 257–275.

Lovell, R., Huang, W., Overman, L., Flannery, D., & Klingenstein, J. (2020). Offending histories and yypologies of suspected sexual offenders identified via untested sexual assault kits. *Criminal Justice and Behavior*, *47*(4), 470–486. https://doi.org/10.1177/0093854819896385

Lovell, R., Karakurt, G., Luminais, M., & McGuire, M. J. (2017). *Evaluation of victim assistance services at the Cleveland Rape Crisis Center: Key findings and Recommendations*. Begun Center for Violence Prevention Research & Education, Case Western Reserve University.

Lovell, R., & Langhinrichsen-Rohling, J. (Eds.). (2022). *Sexual assault kits and reforming the response to rape*. Routledge.

Lovell, R., Luminais, M., Flannery, D. J., Bell, R., & Kyker, B. (2018). Describing the process and quantifying the outcomes of the Cuyahoga County sexual assault kit initiative. *Journal of Criminal Justice, 57*, 106–115. https://doi.org/10.1016/j.jcrimjus.2018.05.012

Lovell, R., Overman, L., Huang, D., & Flannery, D. J. (2020). The Bureaucratic burden of identifying your rapist and remaining "cooperative": What the sexual assault kit initiative tells us about sexual assault case attrition and outcomes. *American Journal of Criminal Justice, 46*, 528–533. https://doi.org/10.1007/s12103-020-09573-x

Luminais, M., Lovell, R., & Flannery, D. (2017). *Perceptions of why the sexual assault kit backlog exists in Cuyahoga County, Ohio and recommendations for improving practice*. Begun Center for Violence Prevention Research and Education at the Jack, Joseph and Morton Mandel School of Applied Social Sciences at Case Western Reserve University. http://hdl.handle.net/2186/ksl:2006061457

Luminais, M., Lovell, R., McGuire, M., Klingenstein, J., Kavadas, A., & Overman, L. (2020). *Victim advocates and cold case investigations: Impact of integration on the Cuyahoga County Sexual Assault Kit Task Force*. The Begun Center for Violence Prevention Education and Research at the Jack, Joseph and Morton Mandel School of Applied Social Sciences at Case Western Reserve University. http://hdl.handle.net/2186/ksl:2006061588

Lovell, R., Williamson, A., Keel, T., Dover, T., & Weston, M. (2022). Advancing our understanding of sexual assault offenders. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 107–126). Routledge, Taylor & Francis Group.

McGill, K. A., Pusey, K., & Koon-Magnin, S. (2022). Where's my kit? An overview of attrition in sexual assault cases. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (pp. 24–42). Routledge.

McGuire, M. J., Sabo, D. B., & Klingenstein, J. (2022). Envisioning a better victim response: Survivor-centered advocacy, destigmatization, collaboration, and accountability. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 396–416). Routledge, Taylor & Francis Group.

McNaught, C., & Lam, P. (2010). Using Wordle as a supplementary research tool. *Qualitative Report*, *15*(3), 630–643.

Morabito, M. S., Pattavina, A., & Williams, L. M. (2017). Active representation and police response to sexual assault complaints. *Journal of Crime and Justice, 40*(1), 20–33. https://doi.org/10.1080/0735648X.2016.1216730

Morabito, M. S., Pattavina, A., & Williams, L. M. (2019). It all just piles up: Challenges to victim credibility accumulate to influence sexual assault case processing. *Journal of Interpersonal Violence, 34*(15), 3151–3170. https://doi.org/10.1177/0886260516669164

Morabito, M. S., Williams, L. M., & Pattavina, A. (2019). *Decision making in sexual assault cases: Replication research on sexual violence case attrition in the United States, 2006-2012*. Inter-university Consortium for Political and Social Research [distributor]. https://doi.org/10.3886/ICPSR37181.v1

Morgan, R. E., & Thompson, A. (2020). *Criminal victimization, 2020* (NCJ 301775). Bureau of Justice Statistics. https://bjs.ojp.gov/sites/g/files/xyckuh236/files/media/document/cv20.pdf

Mühlenbernd, R., & Quinley, J. (2013). Signaling and simulations in sociolinguistics. *University of Pennsylvania Working Papers in Linguistics, 19*(1). https://repository.upenn.edu/pwpl/vol19/iss1/16

Murphy, S. B., Edwards, K. M., Bennett, S., Bibeau, S. J., & Sichelstiel, J. (2014). Police reporting practices for sexual assault cases in which “the victim does not wish to pursue charges". *Journal of Interpersonal Violence, 29*(1), 144–156. https://doi.org/10.1177/0886260513504648

Niemi, L., & Young, L. (2016). When and why we see victims as responsible: The Impact of ideology on attitudes toward victims. *Personality and Social Psychology Bulletin*, *42*(9), 1227–1242. https://doi.org/10.1177/0146167216653933

O’Hara, S. (2012). Monsters, playboys, virgins and whores: Rape myths in the news media’s coverage of sexual violence. *Language and Literature, 21*(3), 247–259. https://doi.org/10.1177/0963947012444217

Ohio Prosecuting Attorneys Association. (2012). *The grand jury*. http://www.ohiopa.org/grandjury.html

Ohio Revised Code. (2021, April 12). *Section 2907.02—Ohio Revised Code: Ohio laws.* https://codes.ohio.gov/ohio-revised-code/section-2907.02

O’Neal, E. N., & Hayes, B. E. (2019). “A rape is a rape, regardless of what the victim was Doing at the time”: Detective views on how “problematic” victims affect sexual assault case processing. *Criminal Justice Review*, 0734016819842639. https://doi.org/10.1177/0734016819842639

O’Neal, E. N., & Hayes, B. E. (2020). Most [false reports] involve teens": Officer attitudes toward teenage sexual assault complainants-A qualitative analysis. *Violence Against Women, 26*(1), 24–45. https://doi.org/10.1177/1077801219828537

O’Neal, E. N., Tellis, K., & Spohn, C. (2014). When the bedroom is the crime scene: To what extent does Johnson’s typology account for intimate partner sexual assault? *Journal of Child Custody*, *11*(4), 278–303. https://doi.org/10.1080/15379418.2014.943450

O’Neal, E. N., Tellis, K., & Spohn, C. (2015). Prosecuting intimate partner sexual assault: Legal and extra-legal factors that influence charging decision. *Violence Against Women*, *21*(10), 1237–1258. https://doi.org/10.1177/1077801215591630

Pattavina, A., Morabito, M., & Williams, L. M. (2016). Examining connections between the police and prosecution in sexual assault case processing: Does the use of exceptional clearance facilitate a downstream orientation? *Victims & Offenders*, *11*(2), 315–334. https://doi.org/10.1080/15564886.2015.1046622

Quijano-Sánchez, L., Liberatore, F., Camacho-Collados, J., & Camacho-Collados, M. (2018). Applying automatic text-based detection of deceptive language to police reports: Extracting behavioral patterns from a multi-step classification model to understand how we lie to the police. *Knowledge-Based Systems, 149*, 155–168. https://doi.org/10.1016/j.knosys.2018.03.010

Quinlan, A. (2016). Suspect survivors: Police investigation practices in sexual assault cases in Ontario, Canada. *Women & Criminal Justice*, *26*(4), 301–318. https://doi.org/10.1080/08974454.2015.1124823

Renner, K. E. (2002). Reconceptualizing sexual assault from an intractable social problem to a manageable process of social change. In J. F. Hodgson & D. S. Kelley (Eds.), *Sexual violence: Policies, practices, and challenges in the United States and Canada*. Praeger.

Rennie, J. D., Shih, L., Teevan, J., & Karger, D. R. (2003). Tackling the poor assumptions of naive bayes text classifiers. *Twentieth International Conference on Machine Learning (ICML-2003)*, 616–623.

Reynolds, J. (2012). *Criminal justice report writing*. CreateSpace Independent Publishing Platform.
Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication*. University of Illinois Press.
Shaw, J., Campbell, R., & Cain, D. (2016). The view from inside the system: How police explain their response to sexual assault. *American Journal of Community Psychology, 58*(3–4), 446–462. https://doi.org/10.1002/ajcp.12096
Shaw, J., Campbell, R., Cain, D., & Feeney, H. (2017). Beyond surveys and scales: How rape myths manifest in sexual assault police records. *Psychology of Violence, 7*(4), 602–614. https://doi.org/10.1037/VIO0000072
Shinyama, Y. (2015). *pdfminer: PDF parser and analyzer* (Version 20191125) [Computer software]. http://github.com/euske/pdfminer
Sleath, E., & Bull, R. (2017). Police perceptions of rape victims and the impact on case decision making: A systematic review. *Aggression and Violent Behavior, 34,* 102–112. https://doi.org/10.1016/J.AVB.2017.02.003
Smith, R. (2007). *An overview of the Tesseract OCR engine.* 629–633. https://doi.org/10.1109/ICDAR.2007.4376991
Smith, C. P., & Freyd, J. J. (2014). Institutional betrayal. *American Psychologist, 69*(6), 575–587. https://doi.org/10.1037/a0037564
Smith, S. G., Zhang, X., Basile, K., Merrick, M., Jing Wang, M., & Kresnow, J. C. (2015). *National intimate partner and sexual violence survey: 2015 Data Brief.*
Soulliere, D. (2005). Pathways to attrition: A qualitative comparative analysis of justifications for police designations of sexual assault complaints. *The Qualitative Report, 10*(3), 416–438.
Spohn, C., & Holleran, D. (2001). Prosecuting sexual assault: A comparison of charging decisions in sexual assault cases involving strangers, acquaintances, and intimate partners. *Justice Quarterly, 18*(3), 651–688. https://doi.org/10.1080/07418820100095051
Spohn, C., & Tellis, K. (2011). Justice denied?: The exceptional clearance of rape cases in Los Angeles. *Albany Law Review, 74*(3), 1379–1421. a9h.
Spohn, C., & Tellis, K. (2012). The criminal justice system's response to sexual violence. *Violence Against Women, 18*(2), 169–192. https://doi.org/10.1177/1077801212440020
Spohn, C., & Tellis, K. (2014). *Policing and prosecuting sexual assault: Inside the criminal justice system*. Lynne Rienner Publishers.
Spohn, C., & Tellis, K. (2018). Sexual assault case outcomes: Disentangling the overlapping decisions of police and prosecutors. *Justice Quarterly*, 1–29. https://doi.org/10.1080/07418825.2018.1429645
Spohn, C., White, C., & Tellis, K. (2014). Unfounding sexual assault: Examining the decision to unfound and identifying false reports. *Law & Society Review, 48*(1), 161–192. https://doi.org/10.1111/lasr.12060
Stafford, T. (2022). Sexual assault of women of color: Establishing an equitable and culturally specific response. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and reforming the response to rape* (1st ed., pp. 63–75). Routledge, Taylor & Francis Group.
Strom, K., Markey, J., Feeney, H., & Scott, T. (2022). Envisioning an effective multidisciplinary sexual assault response: The importance of standards, partnerships, and measurable outcomes. In R. Lovell & J. Langhinrichsen-Rohling (Eds.), *Sexual assault kits and*

reforming the response to rape (1st ed., pp. 346–360). Routledge, Taylor & Francis Group.

Tasca, M., Rodriguez, N., Spohn, C., & Koss, M. P. (2013). Police decision making in sexual assault cases. *Journal of Interpersonal Violence, 28*(6), 1157–1177. https://doi.org/10.1177/0886260512468233

Tellis, K. M., & Spohn, C. C. (2008). The sexual stratification hypothesis revisited: Testing assumptions about simple versus aggravated rape. *Journal of Criminal Justice, 36*(3), 252–261. https://doi.org/10.1016/j.jcrimjus.2008.04.006

Walfield, S. M. (2016). When a cleared rape is not cleared: A multilevel study of arrest and exceptional clearance. *Journal of Interpersonal Violence, 31*(9), 1767–1792. https://doi.org/10.1177/0886260515569062

Westera, N. J., Kebbell, M. R., & Milne, R. (2011). Interviewing rape complainants: Police officers' perceptions of interview format and quality of evidence. *Applied Cognitive Psychology, 25*(6), 917–926. https://doi.org/10.1002/acp.1770

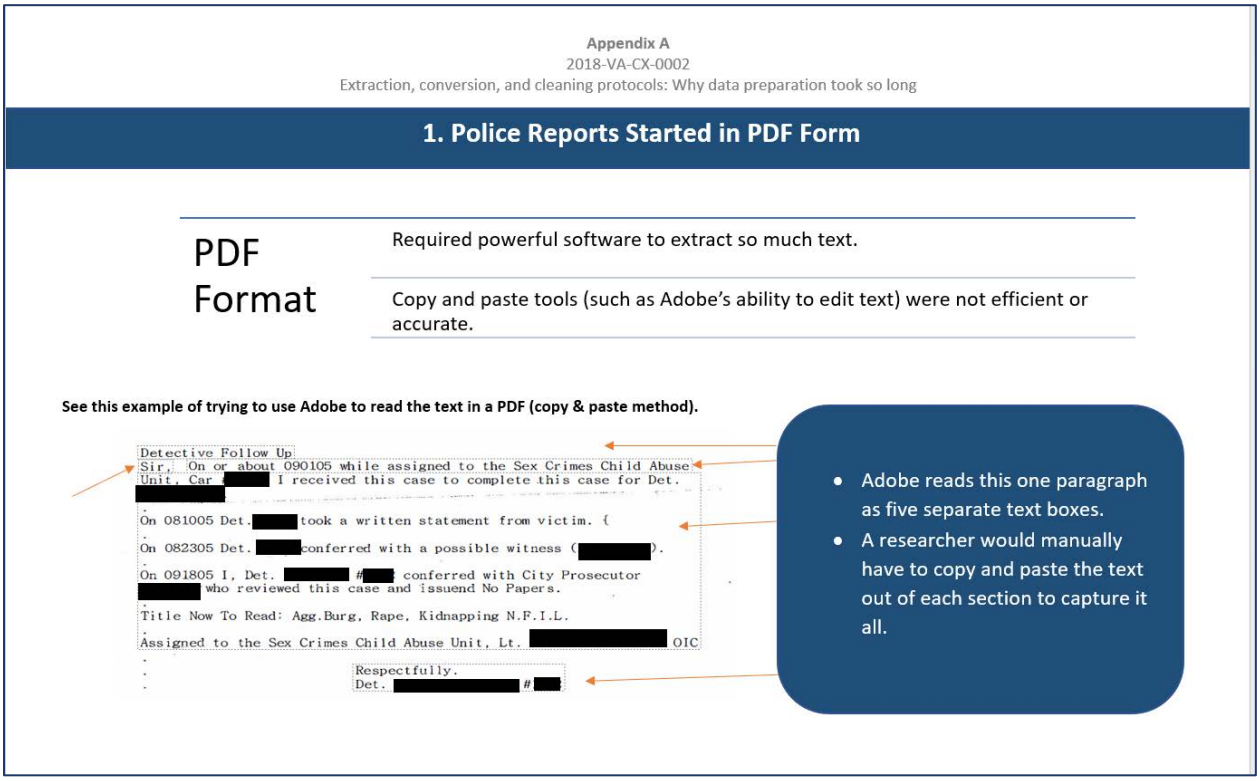
Yu, H., & Monas, N. (2020). Recreating the scene: An investigation of police report writing. *Journal of Technical Writing and Communication, 50*(1), 35–55. https://doi.org/10.1177/0047281618812441

Zhou, L., Burgoon, J. K., Nunamaker, J. F., & Twitchell, D. (2004). Automating linguistics-based cues for detecting deception in text-based aynchronous computer-mediated communications. *Group Decision and Negotiation, 13*(1), 81–106. https://doi.org/10.1023/B:GRUP.0000011944.62889.6f

Zollman, K. J. S. (2005). Talking to neighbors: The evolution of regional meaning. *Philosophy of Science, 72*(1), 69–85. https://doi.org/10.1086/428390

Appendix A

Extraction, Conversion and Cleaning protocols



2. Quality of and Formatting Within the Reports Presented Challenges

Quality & Formatting	After extracting the text via automation, there were many textual conversion errors that to need to be corrected by hand.
	A single report would travel from pdf, to automation, to txt file.

This example shows a small hiccup when automating from pdf to txt file.

Original PDF text:

victim with the rape kit. Victim further states that the suspect was
driving a white older Station Wagon with red seats and red carpet.
Victim states an air freshner was stuck on the dashboard. Vehicle also
has the wood grain looking doors.

Same section in a txt file, narrative extracted. A random character in the middle of the sentence shows up. Something the team looked for and deleted during cleaning process:

n into East Cleveland and took her to an area where there used to be apartment building and pulled the vehicle into a vacant lot and turned the vehicle off.

the rape kit. Victim further states that the suspect was • driving a white older Station Wagon with red seats and red carpet. Victim states an air freshner was stuck on the dashboard.

2. Quality of and Formatting Within the Reports Presented Challenges

Stemming from the type of program police reports are typed in, formatting within the reports showed up all over the text files after automation.

In this example, from the reporting officer (original narrative writer) to the detective follow-up, the text reads as a stream of consciousness.

Mater ID: [redacted]

ORIGINAL NARRATIVE (CASE)
KIDNAPPING/RAPE
On 06-10-2005 00:00:00, at approximately 2327 hours, members of zone car 521 ([redacted] # [redacted] received a radio broadcast to respond to the location of [redacted]
Members of zone car 521 arrived at 2331 hours. Members of zone car 521 found the victim lying on the ground with her head facing west and feet facing east. The victi[redacted]
Members of zone car 521 attempted to ask the victim some questions. The victim kept screaming and did not verbally respond to officers.
After further investigation, the victim appeared to be signing to officers. Victim appears to be deaf. Victim took her right hand and made a small circle, then took [redacted]
Members of zone car 521 contacted a supervisor and EMERGENCY MEDICAL SERVICES to have them respond to our location. Location is an alley between Central and Hawthorn[redacted]
EMERGENCY MEDICAL SERVICES #9 responded, along with [redacted]. [redacted]541A, [redacted] got information from [redacted] black male, [redacted]
The information that was obtained on scene was the victim's name and date of birth and address. Victim wrote this information down in the EMERGENCY MEDICAL SERVICES [redacted]
Members of zone car 521 wrote down some questions and tried to have the victim describe to officers what the suspect looked like.
Victim described to officers what the suspect looked like.
Victim described the suspect as a black male (pointed at Officer [redacted] skin), bald head (pointed to Officer [redacted] head). Victim went around her upper lip and [redacted]
Victim is being seen by Dr. [redacted]. A rape kit was performed on the victim.
Further investigation reveals: Victim pointed to a large container in a field and then pointed to the area where she was found. This seemed to indicate that she was [redacted]
Members of zone car 521 looked at a Cuyahoga County Census Tract Map and the alley that is between [redacted] has a name on the map of [redacted]
Victim was unable to give an approximate time.
Victim seen by Dr. [redacted]
Request Sex Crimes to follow up.
rept. typed as faxed, [redacted] 06-14-2005 00:00:00
ADDITIONAL INFORMATION
KIDNAPPING/RAPE (SUPPLEMENTAL)
Received an assignment to respond to the Cleveland Clinic to pick up a rape.
On 06-11-2005 00:00:00, at 1031 hours, received rape kit from Clinic Hospital Staff member.
Property marked, tagged and entered into property book.
rept. typed as faxed, [redacted] 06-14-2005 00:00:00
DETECTIVE FOLLOWUP (CASE)
New Title Now To Read : Rape/ No Further Investigative Leads
While assigned to the Sex Crimes/ Child Abuse Unit, I received the followig complaint to investigsate. The results are the following of this investigation. Unable to
registered letter was sent and no response to date.
NO FURTHER INVESTIGATIVE LEADS/////////NO FURTHER INVESTIGATIVE LEADS
Assigned: Sex Crimes/ Child Abuse Unit Lieutenant [redacted] Officer in Charge (also written O.I.C.)
Car 8174 Detective [redacted] # [redacted]
DETECTIVE FOLLOWUP (CASE)
New Title Now To Read: Rape/ Kidnapping/ Unfounded
While Assigned to the Sex Crimes/Child Abuse Unit, I received the following complaint to investigate. The results of the invest are as follows. After confering with [redacted]
transport to the interview. .
uNFouNDED//////////////uNFouNDED//////////////uNFouNDED/////////////// . Assigned: Sex Crimes/Child Abuse Unit Lieutenant [redacted], O.I.C. [redacted]
DETECTIVE FOLLOWUP (CASE)
appointment. This case along with another were matches in the CODIS System coming back to the name suspect. Attemptes were made to contact the victim with no success.
EXCEPTIONAL -CLEANUP//////////////////////EXCEPTIONAL -CLEANUP////////
Assigned: Sex Crimes/Child Abuse Unit Lieutenant [redacted] Officer in Charge (also written O.I.C.)
Car 8176 Detective [redacted] # [redacted]

There are multiple narrative entries here which need to be separated out from each other and the original narrative in order to make sense of them.

2. Quality of and Formatting Within the Reports Presented Challenges

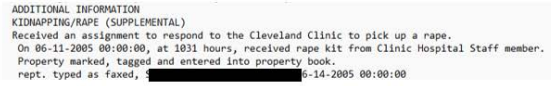
The research team had to teach the computer to distinguish between paragraphs corresponding to different parts of the investigation (e.g., incident report, investigation, etc.) by how the paragraphs were labeled.

- We made a list of all the ways narratives could be titled to help with this process.

Narratives can be titled in a number of ways:

- **First Narrative**
  Original narrative
- **Second Narrative (not always there)**
  Additional Narrative
  Additional Information
- **Last Narrative (Sex Crimes Unit)**
  Detective Narrative
  Detective Follow Up (may also be written "followup")
  SCU Narrative
  Supplement Narrative
  Supplemental Narrative

- **We still had to manually remove any narratives that were not about the rape itself:**
  - Rape kit pickup and drop-off.
  - Cleaning up the crime scene.


ADDITIONAL INFORMATION
KIDNAPPING/RAPE (SUPPLEMENTAL)
Received an assignment to respond to the Cleveland Clinic to pick up a rape.
On 06-11-2005 00:00:00, at 1031 hours, received rape kit from Clinic Hospital Staff member.
Property marked, tagged and entered into property book.
rept. typed as faxed, [redacted]6-14-2005 00:00:00

2. Quality of and Formatting Within the Reports Presented Challenges

Dates

Even something as simple as the way a date was written interrupted the computer's ability to analyze the text. Dates and portions of dates were appearing frequently in the preliminary topic modeling anlyses.

There was little consistency across reports (or within the same report) with how dates were formatted.

Example 1:

Change Of Title
Old Title: Rape/Kidnapping
New Title: Rape/Kidnapping/Exceptional Clean Up
On September 20, 2005 while assigned to the Cleveland Division of Police, Sex Crimes and Child Abuse U
On September 20, 2005 I drove to the victim's house to speak with her. Upon my arrival the victim was ve
On 9-23-05 the victim didn't show up or call to reschedule her interview. When I called the victim back to
On 9-27-05 the victim again didn't call or show up for her
interview. At that time a certified letter was mailed out to the victim with negative results.
On October 4, 2005 I conferred with the City of Cleveland
Prosecutor, A[redacted]who did not issue papers due to the victim being unwilling to cooperate.
Date of this report: October 4, 2005

Example 2:

4-24-2012 thru 5-9-2012 I conferred with interviews: Frank King and Jeffery Keith trying to speak with the victim, Sa
May 29-30,2012 Spoke with the two witnesses, Ashley Walker and Antoine Johnson and got both their statements.
June 6, 2012 I went to the location of occurrence and took photos. I then went to an address to show the victim a ph
biological mother. They live at 1[redacted]
Cleveland OH 44104. Her mother, [redacted] can be called from 216-894-1951 or 216-346-7087.
6-7-2012 I took the statement of [redacted] and mailed the Medical Release Form to the Hospital.
6-12-2012 Letter sent to named suspect J[redacted]
6-14-2012 I completed DNA Submission form for victim
6-20-2012 Sent out 'Victims of Crime' Information to victim at her address on Shaker Blvd.
6-26-2012 We went to 2[redacted]eet and spoke to the suspect [redacted] (2003 hrs). We got a phone nun
lives there with his 8 year old son and 2 yr old daughter and his pregnant fiance (due Oct or Nov 2012). He did admit
I received information for [redacted] (the other interview who was in the apt during the incident) He lives[redacted]
7--9-2012 Called Mr Harvey and left a message to come down for a
statement. Also called [redacted]r a statement and left
a message

2. Quality of and Formatting Within the Reports Presented Challenges

Abbreviations

The use of P.O. could mean "Patrol Officer" or "Probation Officer" depending on the context.

The use of Lt. could mean "Lieutenant" or "Light" (as in "he had lt. skin"), depending on the context.

Research team developed a list of abbreviations and their possible meanings. During automation process, placed the options in lieu of the abbreviation. During cleaning process, the team manually chose which one was needed, based on context.

ETA	ESTIMATED TIME OF ARRIVAL
Fel.	Felony or Felonious
FIR	FURTHER INVESTIGATION REVEALS
GOA	GONE ON ARRIVAL
GSI	GROSS SEXUAL IMPOSITION
ID'D	IDENTIFIED
INT	INTERVIEW OR INTERVIEWEE
INTOX	INTOXICATION/INTOXICATED
INTOX	INTOXICATED
INVEST	investigation
jc	juvenile complaint
LIEUT	Lieutenant
Lt.	Lieutenant OR LIGHT
m/t/E	Marked/Tagged/entered
M/T/E/S	MARKED/TAGGED/ENTERED/S
MO	Modus Operandi
MTE	MARKED, TAGGED, ENTERED
N.S.	NAMED SUSPECT
N/S	NORTHSIDE or Named Suspect
NARC. POSS	NARCOTIC POSSESSION
NFI	NO FURTHER INFORMATION
NFIL	No Further Investigative leads
NMD	NAMED
OFF.	OFFENDER
OIC	Officer in Charge (also written O.I.C.)
ORC	OHIO REVISED CODE

Original

FIR-Lt. [redacted] advised P.O. [redacted] that he was able to interview victim at Metro hospital with parent.

Lt. asked V what did [redacted] do, she stated, "he did nasty things". Lt. asked did he stick anything in you?" V stated, "yes he stuck something in my butt!". Lt. asked anything in front, V stated, "yes, I don't know what it was". Lt. asked did it hurt, V stated, "yes". Lt. asked did he ever do this before, V stated, "No".

V T&R by Dr. [redacted]

After abbreviation automation

Respectfully request Sex Crimes Unit to follow-up.
FURTHER INVESTIGATION REVEALS-Lieutenant OR LIGHT [redacted] advised PROBATION OR PAROLE OFFICER [redacted] that he was
Lieutenant OR LIGHT askedVICTIMwhat did [redacted] do, she stated, "he did nasty things". Lieutenant OR LIGHT asked did he stick anything in
don't know what it was". Lieutenant OR LIGHT asked did it hurt, V stated, "yes". Lieutenant OR LIGHT asked did he ever do this before, V
V T&R by Dr. [redacted]

2. Quality of and Formatting Within the Reports Presented Challenges

Report Quality

Report quality was an issue (particularly for older reports). These were set aside and manually typed by researchers.

FIELD REPORT
NARRATIVE

RMS NUMBER [redacted]

Victim [illegible]nally was Able to leave the house AT daylight
because she [illegible]lt SAFER. Victim called CPD From her Friend's house.
Z/C 313 Responded, SIU [redacted] Responded for photos and pictures
Victim conveyed To ST Vincent Charity hospital for examination
Victim will be staying AT brother inlaw house in Cleve Hts ?
[redacted]
Property Entered into 3rd District property book And locker
Request Sex Crimes To Follow up.

DETECTIVE FOLLOWUP (CASE)

On 04/03/2001, while assigned to the Sex Crimes and Child Abuse Unit, car 8176, I received this complaint to further investigate. The following information are the results.

04/09/2001, home number of r/p and victim - no response.

04/17/2001, received Forensic Lab results #[redacted] - pos. for human blood, negative for all other trace evidence.

04/19/2001, [redacted] assigned from the Department of Children and Family Services. Interview completed - no additional info.

[redacted]
goes down [illegible] steps Below ground.
the suspect [redacted] victim down the stairs
AND when they got down [illegible] sight the suspect [illegible]
Began kissing the victim on the mouth. He then unfastened
the victims pants pulled her down on to the stairs
unfastened his own pants AND Forced sexual [illegible]
intercourse on the victim. The suspect did not take his
Suspect did not use a condom AND After ejaculating
[illegible]tim he got up AND [illegible] the victim" As if he was
[illegible] something" RAN off in An unknown direction
[illegible]ted. the whole encounter [illegible]

cers that [redacted] (offender #1) was still at the location where the above incident happened. subject #2 then showed these officers the address of [redacted] still inside [redacted]n company with cmha unit #217. members of zone car 145 knocked on front door of 17917 parkmount avenue. subject #7, [redacted], answered the door. when asked if we could talk to her. subject #7 stated "come in". these officers asked if "justin" was present and subject #7 stated, "yes". that's him (pointing to offender). the male (offender #1) was arrested, advised of his constitutional rights which he stated he understood and placed in rear of zone car 145 at 0045 hours.

3. Multiple Report Types Meant Multiple Cleaning & Coding Methods

Form Types — There were four report form types in our sample

Form A

CLEVELAND POLICE DEPARTMENT
OFFENSE/INCIDENT REPORT
Date: 10/23/2013
Page: 1

Case Description: Rape
Case Number: [redacted]

Primary Victim: NONE

Date/Time Reported: [redacted]
Date/Time Occurred:
Date/Time Between :
Location Occurred :
Dispatch Incident Type: All Other
Area: District 3 Section: Zone 321 Grid:

Case Status: Open Disposition: Disp. Date:

Offense Number: 1
Crime Code: 07020 RAPE
Statute . : 2907.02 Attempted/Committed : Completed
Stat Desc : RAPE
Location Type . : Apartment Criminal Activity . :
Statute ORI/Group . : S Agg Aslt/Homc Crcmst:
Counts . . . . : 001 Larceny/Theft Offnse:
NCIC Code . . . . . . : Sex asslt Scene/Location Type2:
Offense Date . . . : Victim Drug Related :
Abandoned Structure : NO Property Damage . .

SUBJECTS:

Complainant: Present Information
[redacted]
Phone:

Race : Black Sex: FEMALE D.O.B: [redacted] Age: 49
Dr Lic #: St:

Reporting. : Present Information
[redacted]
Phone:

Race : Unknown Sex: UNKNOWN D.O.B: Age:
Dr Lic #: St:

Form B

SERVICE NO: [redacted]
ENTERED: 08/ 1032 HRS
CLEVELAND POLICE DEPARTMENT
OFFENSE/INCIDENT REPORT
DEPARTMENTAL COPY
VERSION 1 OF 01
TERM: [redacted]

TITLE: RAPE/NAMED SUSPECT/JUVENILE COMPLAIN
REPORT DATE: 08/14/97 CLASS: 02541 STATUS: O/O

LOCATION OF OCCURRENCE: [redacted]
PREMISE NAME:
DATE OCCURRED:
REPORTING OFFICERS:
INVESTIGATING UNIT NOTIFIED:

COMPLAINANT: [redacted]

TAKEN TO: UNIVERSITY HOSPITAL BY: SELF CONDITION:

INJURY: [redacted] SEX CRIME KIT COMPLETED

WITNESS #001: [redacted]
HOME ADDRESS:
BUSINESS ADDRESS:

REMARKS: INTERVIEWEE

EVIDENCE FOUND: RAPE KIT
DISPOSITION: M, T AND ENTERED
EVIDENCE MARKED BY: PTL KAROHL 1196

SEX ASSAULT M.O. USED: COMPLAINANT WAS AT RESIDENCE
VICTIM PECULIARITY: JUVENILE

SUSPECT #001: [redacted]
CCN:
CALES:
BLK HAIR BRO EYES
HAIR STYLE - SHORT
COMPLEXION - DARK
TATTOOS - ARM
BODY
TATTOO ON ARM AND STOMACH

3. Multiple Report Types Meant Multiple Coding Methods

Form C

Cleveland Division of Police
Detail

Print Date/Time: [redacted]
Login ID:
Case Number:
ORI Number: Cleveland Division of Police OHCLP0000

Case Details:

Case Number: [redacted]
Location:
Incident Type: Rape
Occured From:
Occured Thru:
Reported Date:

Reporting Officer ID: [redacted]
Status: Inactive
Disposition: Pending
Exc Clear: Investigation Pending
Status Date: 07/09/2009
Disposition Date: 07/09/2009
Exc Clear Date: 07/09/2009
Assigned Bureau: Sex Crimes & Child Abuse Unit

Case Assignments:

Assigned Officer	Assignment Date/Time	Assignment Type	Assigned By Officer	Due Date/Time
[redacted]	02/25/2002 14:32	Primary Investigating Officer	[redacted]	

Associated Cases	Status	Assisting ORIs	Role

Modus Operandi | Solvability Factors | Weight | Total:

Offenses

No.	Group/ORI	Crime Code	Statute	Description	Counts
1	State	11A	2907.02	Rape	1

Form D

NOV-19-2000 THU 10:02 AM Read 11-16-00 FAX NO. 5529 P. 01/04
12/0/13 [redacted]

CLEVELAND DIVISION OF POLICE
FIELD REPORT

RMS NUMBER [redacted]

TITLE Gross Sexual Imp / Arrest

Sexual Imposition 2907.06 C N

VICTIM INFORMATION

Suspected Rape

ADDT'L SUBJECT

4. Discrete Fields Presented a Significant Hurtle

Discrete Fields

Each police report has a section at the top of the report where **officers enter data into discrete fields or use drop down response options.**

These types of fields are **difficult for the computer to extract due to significant variations** in the spacing of this information in the pdf and the quality of the pdf.

However, this information **is extremely useful in our data analysis**. For example, in comparing report language for female juvenile victims and female nonjuvenile victims.

First, we developed a general coding scheme for variables that existed across reports:

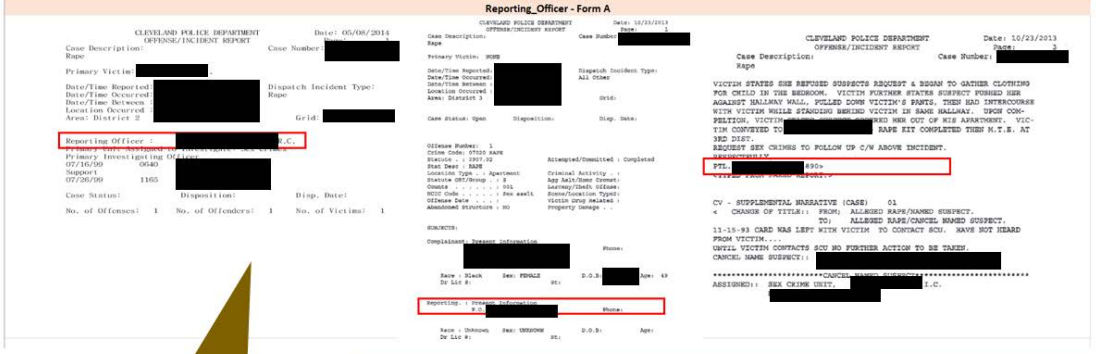
Variable	Description	Instructions	Value999	Value998
file_name_original	*file name from Texas A&M*	*Don't change*		
MatterID_master_merge_sentiment	*MatterID*	*Don't change*		
Standardized_RMS_corr_merge	*Case incident number*	*Don't change*		
Coder	Who entered the data?	Choose option		
Date_Entered	Date of coding	Enter date		
Coded_previous_waves	Parts of RMS coded previously - do not change	*Don't change*		
Form_Type	Which police report form is it?	Choose option		
DateofReport	Date of report to the police - corrected	Enter date		
DateofCrime	Date the crime occurred	Enter date		
TimeofOffense	Time of the offense?	Enter time		
Number_Offenders	How many offenders are part of this offense?	Enter #		
Number_Victims	How many victims are part of this offense?	Enter #		
Location_Assault_Report	Location of the Offense (top of RMS report). Up to city block.	Enter Address		
Area_or_District	Should be a district number	Enter #		
Reporting_Officer	Name of reporting officer	Enter First and Last Name		
Investigating_Officer	Investigating officer	Enter First and Last Name		
SCU_Detective	Detective name	Enter First and Last Name		
SCU_Detective_Flag	Helps indicate whether we need to investigate more later on	Choose option		
Victim1_Name	Victim 1 Name (Can also be labeled complainant)	Enter First and Last Name		
Victim1_DOB	Victim 1 DOB	Enter date		
Victim1_Sex	Victim 1 sex	Choose option	Missing *(Field is there, but no info)*	Not a field
Victim1_Race	Victim 1 Race	Choose option	Missing	Not a field
Victim1_Hispanic	Victim 1 Hispanic	Choose option	Missing	Not a field *(No field there)*
Victim1_Address	Victim 1 Address to city block	Enter Address		
Victim1_age	Victim 1 age	computed from dob and date of crime		
Victim1_Juvenile	Victim 1 Under the age of 18.	Choose option	Missing	
Victim2_Name	Victim 2 Name	Enter First and Last Name		

4. Discrete Fields Presented a Significant Hurtle

Then, we studied each report type to identify the different locations where certain key variables could be found.

Form A Officer Coding

Reporting_Officer - Form A



Example 1:

A reporting officer's name could be found mainly in three different locations on Form A.

Form C - Arrest Info

Option 1: The first way as shown below is not where under the arrest section – on this report there is no mention of arrest is the suspect info section.

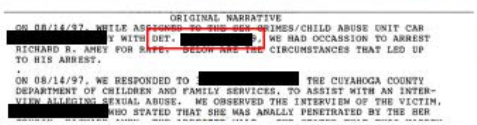
Option 2: There are times when the arrest section is blank but in the suspect section there is an indication the suspect was arrested - see "Suspect type"

Example 2:

There are multiple ways to indicate a suspect arrest on Form C.

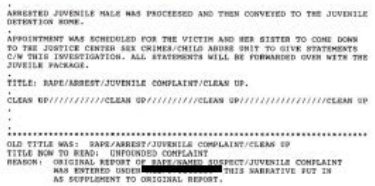
4. Discrete Fields Presented a Significant Hurtle

If you are getting the SCU Detective name from the Sex Crimes narrative, choose an option from the SCU_Detective_Flag (similar to Form A)



1 = Listed as second detective

2 = Listed in narrative as first detective



3 = SCU narrative there, no detective name

Example 3:

Sometimes, variables could only be found at the tops of narratives, across forms.

5. Sometimes Information Was Just Not Accurate or Logical

Revisiting this example:
Form C has a space for arrest information. But, the report indicates an arrest without that section filled out. If we coded strictly based on the completed fields, we would have missed crucial details.

Form C - Arrest Info

Option 1: The first way as shown below is not where under the arrest section – on this report there is no mention of arrest is the suspect info section.

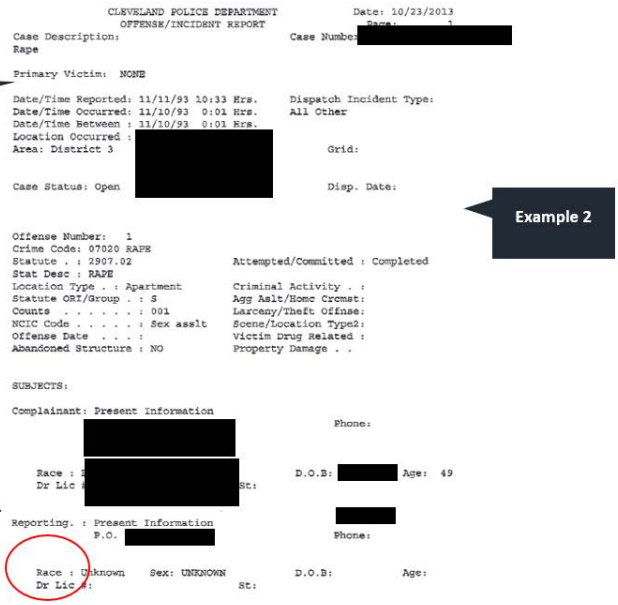
Example 1

Option 2: There are times when the arrest section is blank but in the suspect section there is an indication the suspect was arrested - see "Suspect type"

5. Sometimes Information Was Just Not Accurate or Logical

Typically, the reporting section on Form A is where the reporting person information goes.

However, on this form, the reporting officer's information is in that spot. If the victim was also the reporting person, we would expect to see her information there as well.



CLEVELAND POLICE DEPARTMENT Date: 10/23/2013
OFFENSE/INCIDENT REPORT
Case Description: Case Number: [redacted]
Rape

Primary Victim: NONE

Date/Time Reported: 11/11/93 10:33 Hrs. Dispatch Incident Type:
Date/Time Occurred: 11/10/93 0:01 Hrs. All Other
Date/Time Between : 11/10/93 0:01 Hrs.
Location Occurred : [redacted]
Area: District 3 Grid:

Case Status: Open Disp. Date:

Example 2

Offense Number: 1
Crime Code: 07020 RAPE
Statute . : 2907.02 Attempted/Committed : Completed
Stat Desc : RAPE
Location Type . : Apartment Criminal Activity . :
Statute ORI/Group . : S Agg Aslt/Homc Crcmst:
Counts . . . . . : 001 Larceny/Theft Offnse:
NCIC Code . . . . . : Sex asslt Scene/Location Type2:
Offense Date . . . : Victim Drug Related :
Abandoned Structure : NO Property Damage . .

SUBJECTS:

Complainant: Present Information
[redacted] Phone:
Race : [redacted] D.O.B: [redacted] Age: 49
Dr Lic [redacted] St:

Reporting. : Present Information
P.O. [redacted] Phone:

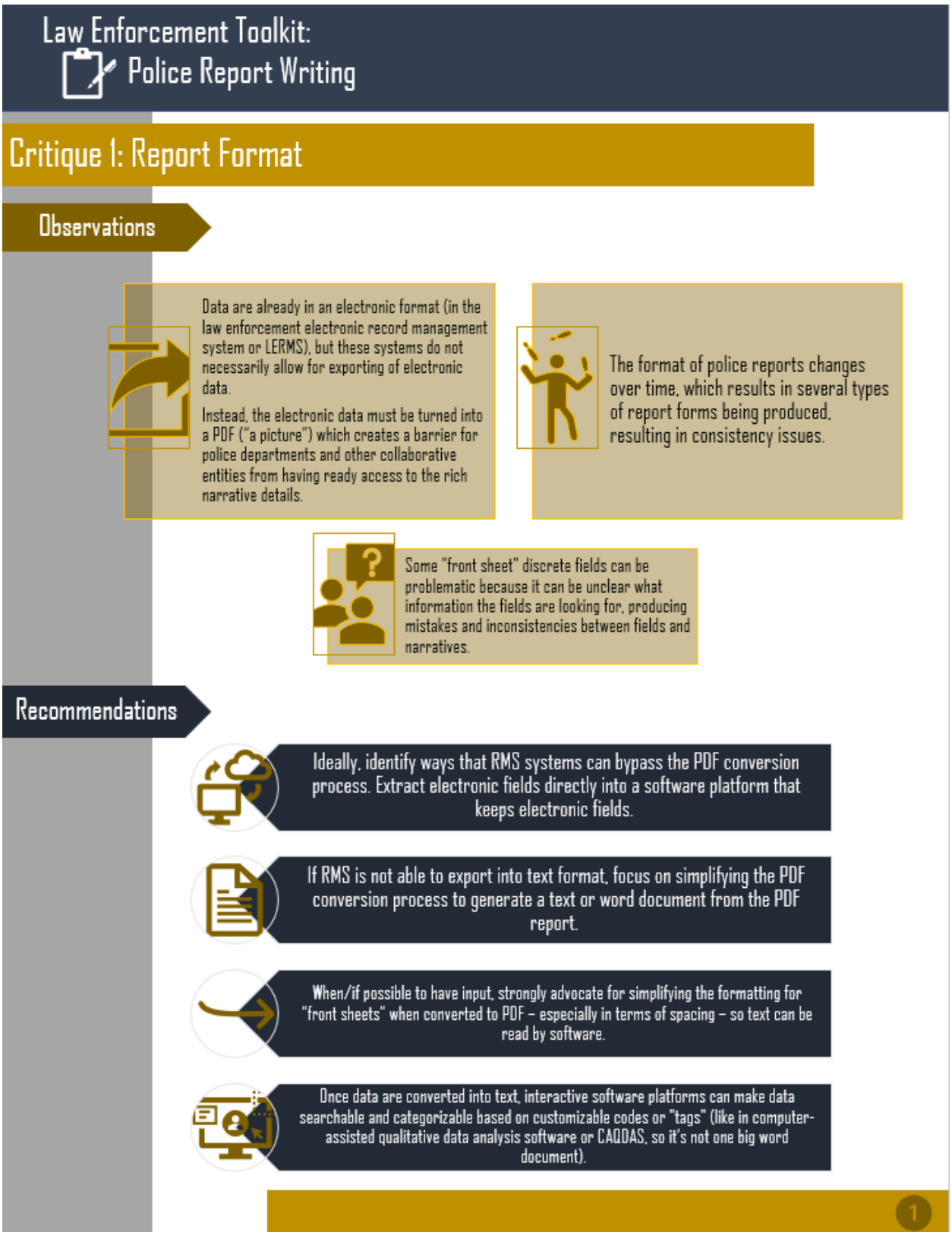
Race : Unknown Sex: UNKNOWN D.O.B: Age:
Dr Lic #: St:

Appendix B

Open-Source Lexicon for NLP with Rape Reports

Website: https://sites.google.com/view/nlp-for-rape-reports/

Appendix C



Law Enforcement Toolkit:
Police Report Writing

Critique 2: Report Narrative Structure

Observations

The current police report narrative structure is literally a blank page – completely open-ended without any writing prompts.

Blank fields do not facilitate consistency, clarity or completeness. They do not aid in minimizing bias and error. They also do not help customize reports by general crime categories, ensuring statutory elements of the crime are included in the narratives.

Recommendations

Create general prompts for crime categories to help guide the inclusion of evidentiary elements of the crime.

Create a general template for sex crimes narrative writing.

Example 1

Reporting Officer Narrative:

i. The first paragraph should include…
ii. The second paragraph should include…
iii. The third paragraph should include…

And so on, to provide guidance.

Example 2

Reporting Officer Narrative:

i. Part I should include: Location of parties to the case and persons available for interviewing.
ii. Part II should include: Victim Interview and assault details.
iii. Part III should include: Suspect Interview.
iv. Part IV should include: Other party interviews.
v. Part V should include: Investigative activities and next steps.

Signature Line for all involved officers.

See Fischer (2019) for detailed information regarding specific topics to include in police reports.

Create reminders about what should be included in the narrative (or build this into the RMS system, if possible).

Some examples include:

- Evidence summary (Archambault et al., 2020).
- Specific details about claims of force, penetration, etc.
- Write from the victim's perspective (Archambault et al., 2020).

These still allow officers the ability to document observations but helps encourage consistency and thoroughness.

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Law Enforcement Toolkit: Police Report Writing

Critique 3: Report Content

Observations

Front sheet discrete fields often lack accuracy, consistency, and/or detail.

Narrative content often lacks consistency, clarity, and context.

Recommendations

Write the report with the end game in mind: Prosecution.

Assume that you, an officer, would have to read this report in court—in front of the victim and/or victim's family, the defendant, the judge, and the jury. ***Is it accurate? Clear? Fair?***

Consider drop-down choices to help with accuracy for front sheet discrete fields.

If appropriate and relevant to include information about a victim's credibility, below are examples of elements that would benefit from drop-down options:

- Do you perceive the victim to be credible?
  - Yes/No. **Why** or why not?
- To further explain closing a case because of lack of victim engagement:
  - Dates and times of when you attempted to contact the victim.
  - Did victim provide a specific reason(s) why they did not want to pursue the case (e.g., they know the perpetrator, are fiscally depending on them, are afraid, etc.)?

Software updates can help.

- **If your RMS does not have the ability to see version history, if possible, strongly advocate for this option.**
  - Sometimes, if there was no named suspect at the time of the initial report, but one becomes available later, the front sheet discrete fields and narrative information may not match.
- **Consider building writing prompts and structure into the narrative portion of the reports, if possible, to help avoid "unqualified statements."**
  - ***Example:*** The report writer does not provide detail as to why bruises, disheveled clothes, sex in the past, or "known prostitute" are mentioned or relevant.

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Critique 3: Report Content *(continued)*

Recommendations

Tips for improving narrative clarity.

- **Establish guidelines, trainings, and expectations for how an officer should refer to the crime and to parties of the case.**
  - ***Example:*** The victim is referred to as the victim. Not, the juvenile, the runaway, etc. Even if the victim is also these things.
  - ***Example:*** The crime is described as a sexual assault or rape. Not sex, intercourse, etc.
- **Use quotation marks when quoting directly from someone interviewed.**
  - ***Example with Quotes***: The victim stated, "he pushed me down and had sex with me."
  - ***Example without Quotes***: He pushed her down and had sex with her.
  - The victim is recounting the assault and may say something like "had sex with me." She is making a rape police report, so she is not talking about consensual sex. The victim might use language like this, but the officer should refer to the act as rape or sexual assault. By using quotes, the officer establishes that they did not call the crime "sex" but are quoting what the victim described.
- **Statements of observation should be prefaced or followed by context and/or reasoning.**
  - ***Example 1:*** "The victim's clothes were not torn."
    - Why was this included?
    - Did you expect her clothes to be torn?
    - Did the environment of the assault or information gathered lead you to believe her clothes would be torn?
  - ***Consider instead:*** "Since the victim told me the suspect ripped her shirt off, I expected her blouse to be torn. I noticed it was (or was not)".
  - ***Example 2:*** "The victim was not crying."
    - Be mindful of including statements like this that might be construed by others as disbelieving the victim, whether intentionally or not.
    - Consider leaving this type of observation out of the report unless it is particularly pertinent to the case. And if so, provide a follow-up statement that details why it is relevant.
  - ***Consider instead:*** "Some victims I have interviewed cry when talking about the assault. I noticed this victim did not."

Law Enforcement Toolkit:
Police Report Writing

Critique 4: Writing About a Sex Crime

Observations & Recommendations

To Minimize Victim Blaming

Emphasize the victim's perspective and actions during the assault.

"The suspect forced the victim on the ground. She yelled, 'don't!' but could not stop him. She was terrified. She noticed he smelled like trash and had a deep voice."

(See Archambault et al., 2020 for more examples)

Do *not* include the victim's criminal history in the report.

This is not an indicator of the victim's ability to be a victim of a crime.

Use active vs. passive language.

Passive: "The victim was forced down."

Active: "The suspect forced the victim down."

(See Lonsway & Archambault, 2022 for more examples)

Writing About the Sex Crime

Avoid consensual terms for sex.

("foreplay," "had sex")

(Lonsway & Archambault, 2022, p. 4)

Use anatomical language for body parts.

Use terms that will assist the criminal case.

Strangled vs. Choked*

Penetrated Vagina vs. Forced Intercourse

**(Lonsway & Archambault, 2022, p. 7)*

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Law Enforcement Toolkit:
Police Report Writing

References

Archambault, J., Lonsway, K. A., & Keenan, S. (2020). *Effective Report Writing: Using the Language of Non-Consensual Sex.* End Violence Against Women International (EVAWI).

Fischer, B. (2019). *Investigating sexual assault: A guide for law enforcement officers.* Montana Department of Justice.

Lonsway, K.A., Archambault, J., (2022). *Suggested Guidelines on Language for Sexual Assault.* End Violence Against Women International (EVAWI).

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Institutions & Authorship

Cleveland State University
Criminology Research Center

Case Western Reserve University
Begun Center for Violence Prevention Research & Education

Texas A&M University

Research Leadership Team:

Rachel Lovell, PhD
Principal Investigator
Director, Criminology Research Center
Cleveland State University

Daniel J. Flannery, PhD
Co-Principal Investigator
Director, Begun Center for Violence Prevention Research & Education
Case Western Reserve University

Xinyue Ye, PhD
Lead Methodologist
Director, Urban Data Science Lab
Texas A&M University

Research Team Members: *Joanna Klingenstein, Laura Overman, Dani Sabo, PhD, Jiaxin Du*

Appendix D

Artifacts

Dissemination Activities

In the dissemination plan, we proposed a four prong-approach including:

(1) **Planned Scholarly Products**

a. **Peer-Review Publications**

i. We have not yet disseminated any findings from this funded project in the scholarly literature; however, we have outlines for several papers based on this final report.

b. **Presentations**

i. Lovell, R. E. How DNA testing and machine learning technology is informing and improving policy practices. *2020 American Association for the Advancement of Science Annual Conference*, Seattle, WA, February 14, 2020. (Funded by the National Institute of Justice AAAS Fellow's program.)

ii. Lovell, R. E. Using machine learning technology to detect "signaling" language regarding victim's credibility in sexual assault police reports. *CSU T.E.C.H. Hub Brown Bag.* Cleveland State University, Cleveland, Ohio. November 9, 2021.

iii. Lovell, R. E. Assessing Sentiment in rape reporting using natural language processing. *2022 American Society of Criminology Annual Conference*, Atlanta, GA. November 17, 2022.

(2) **Research Briefs**

Given the need to enter in the front sheet data towards the end of the project, we were unable to disseminate any research briefs during the grant period, but Appendix A and Appendix D will be reformatted into a public brief, and posted on the project's website (Appendix C), aimed at a broad audience.

(3) **Practitioners' Conferences**

a. Derrick, A. & Flannery, D.J. The case of Albert Ayala and why every sexual assault kit must be tested. *2022 Annual Crimes Against Women Conference*, Dallas, TX. May 23, 2022.

b. Lovell, R.E. & Klingenstein, J. What's hiding in the text? Analyzing sexual assault police report narrative for signaling. *Annual End Violence Against Women International Conference*, Chicago, IL. April 13, 2023. (Proposal accepted, no grant funds used for this presentation.).

(4) **Protocols**

a. Appendix A through D serve as open-source toolkits.

b. The website provided in Appendix C and the archived datasets in the National Archive of Criminal Justice Data (NACJD) from this project allow for the replication and adaptation of the methodology and findings.

Archived data

The text of the reports, along with the variables included in Table 1 and 2 and the corresponding codebook have been submitted to NACJD.