The Importance of Forensic Evidence on Decisions of Criminal Guilt

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Abstract

Recent studies have found that the general public perceives forensic evidence to be relatively inaccurate and to involve high levels of human judgement. This study examines how important the general public finds forensic evidence by comparing decisions on guilt and punishment in criminal cases that involve forensic versus eyewitness testimony evidence and examining whether a *CSI* effect exists. Specifically, this experimental survey study utilized a 2 (crime type: murder or rape) x 4 (evidence type: DNA, fingerprint, victim eyewitness testimony, or bystander eyewitness testimony) - 1 (no victim testimony for murder scenario) design, yielding seven vignettes scenarios to which participants were randomly assigned. Results indicate that forensic evidence was associated with more guilty verdicts and higher confidence in a guilty verdict. Forensic evidence did not change the expected sentence length and did not generally affect the ideal sentence length. However, for rape, respondents believed that the offender should receive a longer sentence when forensic evidence was presented but forensic evidence did not alter likely sentence that respondents expected the offender to receive. The results of this study did not support a *CSI* effect. Overall, this study suggests that forensic evidence – particularly DNA – has a stronger influence during the verdict stage than the sentencing stage.

Keywords: forensic science, forensic evidence, CSI effect, eyewitness testimony

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Highlights

- Forensic evidence is associated with more guilty verdicts.

- Forensic evidence is associated with higher confidence in guilty verdict.

- Forensic evidence does not affect expected or ideal sentence length for murder.

- Forensic evidence affects ideal sentence but not expected sentence length for rape.

- Belief in the accuracy of forensic TV shows does not moderate the relationship between forensic science and decisions of guilt.

Novelty Statement

Forensic science and eyewitness testimony have been considered convincing types of evidence. This experimental study examines how forensic evidence, compared to eyewitness testimony, influences decisions of guilt and punishment. Results suggest that forensic evidence affects decisions of guilt, as forensic evidence is associated with more guilty verdicts and higher confidence in guilty verdicts. The impact of forensic evidence on sentencing is more varied, with no notable difference in expected or ideal sentences for murder or expected sentence for rape, but an increase in the ideal sentence for rape. In general, forensic evidence – and DNA in particular – seems to have a stronger impact during the verdict stage than the sentencing stage for the violent crimes of murder and rape. There is no moderation effect of belief in the accuracy of forensic TV shows on the relationship between forensic science and decisions of guilt. Implications of these findings are discussed.

1 Introduction

Forensic evidence has been thought to be some of the strongest evidence admitted and judged in the courtroom (Freeman and Punzo, 2001; O'Neill Shermer et al., 2011; Maeder et al., 2017; Pearson et al., 2018; Schweitzer and Nuñez, 2018). DNA evidence in particular has been considered the gold standard for forensic techniques for jurors (Clancy and Bull, 2015; Hans et al., 2011; Lieberman et al., 2008). In fact, DNA has been found to have a greater effect on guilty verdicts than other types of non-DNA forensic evidence, demonstrating people's confidence in DNA and their preconceived expectations that DNA evidence is more precise and discerning than non-DNA forensic evidence, and thus, less likely to risk a coincidental match (Thompson and Newman, 2015). Research has indicated that jurors believe that DNA evidence is more reliable than it may be and do not understand its potential fallibility (Findlay and Grix, 2003; Lieberman et al., 2008). However, there have also been recent studies that have found that the lay public perceives forensic evidence in general to be relatively inaccurate and to involve high levels of human judgement (Ribeiro et al., 2019; Kaplan et al., 2020). Overall, inaccurate perceptions or beliefs of forensic evidence can have devastating effects, especially when faulty forensic analyses result in miscarriages of justice (Project, 2019). As such, there has been increasing interest in understanding how various actors of the criminal justice system – such as potential jury members, judges, defense attorneys and prosecutors – view forensic evidence and whether they recognize the limits of such evidence.

One concern that arises out of the use of forensic evidence in jury trials is what has been dubbed the "*CSI* effect." In essence, the *CSI* effect suggests that television shows that show forensic evidence may affect the general public's perceptions, beliefs, attitudes, or expectations of forensic science evidence such that forensic evidence may be incorrectly perceived as being as accurate or as quick to be analyzed as shown on TV (Cole and Dioso-Villa, 2006; Podlas, 2006; Smith and Bull, 2012; Kaplan et al., 2020; Ribeiro et al., 2019). This in turn could result in jurors placing an inordinate amount of importance on forensic evidence and lead them to incorrectly penalizing defendants when any form of forensic evidence is presented or incorrectly penalizing prosecutors when there is no forensic evidence (Eatley et al., 2016; Podlas, 2006). Examining whether criminal justice actors understand the limits of forensic evidence may be particularly important when there are other forms of evidence present that could contradict the available

forensic evidence or when forensic evidence is unavailable or unfeasible to obtain.

1.1 Forensic Evidence vs. Eyewitness Testimony

Prior work has indicated that certain types of forensic evidence are perceived as more accurate and objective than others (Ribeiro et al., 2019; Kaplan et al., 2020). Empirical studies evaluating the *CSI* effect commonly examine DNA and fingerprint evidence. Interestingly, a study by Kaplan et al. (2020) noted that DNA and fingerprinting was perceived as the two most accurate forensic techniques out of the 10 techniques evaluated, and these two types of evidence were also deemed foundationally valid in the President's Council of Advisors on Science and Technology (PCAST) report (The President's Council of Advisors on Science and Technology, 2016). However, in addition to forensic evidence, there are other types of evidence that could be presented during a case. Of particular interest is how forensic evidence is perceived compared to eyewitness testimony. Numerous studies have demonstrated that jurors perceive both eyewitness testimony and forensic analysis to be strong forms of evidence for trial decision-making (Berman et al., 1995; Brewer and Burke, 2002; Lieberman et al., 2008; Lindsay et al., 1981). Eyewitness testimony is considered one of the most convincing evidence presented to jurors and has historically been considered the gold standard (Beil, 2011; Brewer and Wells, 2011). Moreover, eyewitnesses who were more proximate, and therefore more familiar, with the defendant during the commission of the offense, such as the victim of an offense, may be perceived as more accurate in their descriptions of a defendant than bystander eyewitnesses; indeed, this type of witness familiarity with the defendant has been shown to significantly increase the likelihood for and confidence in guilty verdicts, as compared to when a stranger was a bystander eyewitness (Sheahan et al., 2018). However, jurors often believe eyewitness identifications to be more reliable than they actually are in reality (Brigham and Bothwell, 1983; Loftus and Schneider, 1987; Wells and Olson, 2003). In fact, eyewitness error is one of the leading causes of wrongful convictions, with an estimated one in three eyewitnesses making an erroneous identification (Wells et al., 1998; Wise et al., 2014)

Studies have examined the relative strength of forensic evidence compared to other types of evidence. Eyewitness testimony in particular has been a comparison of interest because eyewitness testimony has been considered one of the most convincing types of evidence (Brewer and Wells, 2011). Eyewitness testimony and forensic evidence both have significant effects on the level of

confidence in guilt, with forensic evidence eliciting higher levels of confidence (Pearson et al., 2018). Moreover, these effects were even larger for more serious crimes, suggesting that the presence of DNA evidence may lead to higher juror certainty in guilty verdicts if presented in trials involving more severe or harmful offenses (Pearson et al., 2018). Thus, forensic evidence (especially DNA evidence) tends to be perceived as more accurate and given more weight than eyewitness testimony for mock jurors when determining their verdicts and in the confidence in their verdicts (Freeman and Punzo, 2001; Lieberman et al., 2008; Pozzulo and Dempsey, 2009; Schweitzer and Nuñez, 2018; Skolnick and Shaw, 2001).

1.2 Current Study

In order for existing literature to better contemplate the needs of those who wish to apply it in the courtroom, Schweitzer and Nuñez (2018) have argued that researchers should focus on examining the importance of different types of evidence, commonly presented in criminal trials, to jurors and their verdicts. Specifically, testing how different characteristics of such evidence may lead to varying outcomes and confidence in juror verdicts may not only help to better understand juror behavior, but can also aid legal actors, such as judges and lawyers, make more informed decisions if they know what types of evidence, and for what particular cases, affect jurors' verdicts (Schweitzer and Nuñez, 2018). This is not only true for verdicts involving guilt determination, but also for juror sentencing. Indeed, juror sentencing is still a practice for felony offenses for over 4,000 cases each year, and therefore, their sentencing verdicts dictate the punishment outcomes for thousands of defendants every year (King and Noble, 2005).

Further, as evidence presented at any given trial is case-type specific, it is also important to examine the effects of evidence in cases involving offenses that already vary in the likelihood or probability of conviction. For example, tracking felonies in the 75 largest counties in the U.S. in 2009, the Bureau of Justice Statistics found that the basic probability a defendant would eventually be convicted of a felony charge at trial was highest for those charged with murder (60 percent) and drunk driving, while the lowest probability was for those charged with rape (35 percent) and assault (Reaves, 2013). As such, Schweitzer and Nuñez (2018) argue that it is especially important to examine the importance, weight, and effect of different types of evidence in trials that already vary in their probability of conviction. Such work will have both empirical

and practical applications for researchers and practitioners.

The current study, to offer guidance on these issues, seeks to extend current literature, regarding the importance of different types of evidence to mock jurors and the effects of such evidence on their verdict confidence, by comparing two forensic techniques (DNA and fingerprint) with two types of eyewitness testimonies (bystander and victim) for two different case-types (murder and rape). Based on prior work, these forms of evidence have been argued to be most important to jurors. There are five hypotheses tested in the current study.

1. Participants will be more likely to say that a defendant is guilty if there is forensic evidence rather than eyewitness testimony.

2. Participants will be more confident that a defendant is guilty if there is forensic evidence rather than eyewitness testimony.

3. Participants will expect a harsher sentence if there is forensic evidence rather than eyewitness testimony.

4. Participants will want a harsher sentence if there is forensic evidence rather than eyewitness testimony.

5. Participants who believe fictional TV shows depicting forensic evidence are accurate are more likely to say a defendant is guilty in cases with forensic evidence.

2 Method

To evaluate how different forms of forensic evidence affect decisions on criminal guilt, participants were randomly assigned to read one of seven vignettes depicting a crime and were then asked to answer the same set of questions regardless of the vignette. We used vignettes for two crimes where forensic evidence is frequently collected during an investigation - murder and rape (McEwen, 2011) - and varied which form of evidence was used during the hypothetical trial. We utilized two forms of forensic evidence - DNA and fingerprints - and compare them against two non-forensic types of evidence - testimony from an eyewitness and testimony from the victim (for the rape vignette only).

We chose DNA and fingerprint evidence because they are among the most common types of evidence collected in cases of rape or murder and thus are likely to be used in criminal cases

where jurors' perceptions of their importance will affect whether the defendant is convicted or not (McEwen, 2011). Past studies of how accurate the general public perceives forensic evidence to be has found that DNA and fingerprints are considered the most accurate (Kaplan et al., 2020) or among the most accurate (Ribeiro et al., 2019) forensic techniques.

Each vignette is a short story explaining the facts of the case. Following these facts is the text "During the trial, the prosecution's only evidence in the case was ..." with the type of forensic evidence used replacing the ellipses. While real-world criminal trials may have a number of forms of evidence tying the defendant to the crime, we used only a single form of evidence to isolate the impact of that evidence on our participants' decisions of guilt and sentencing.

The murder vignette used in the current study was a modified version of Porter et al. (2010)'s vignette. In this modified vignette, a man enters a convenience store which has a single store employee and a single customer inside, murders the employee, and flees the store. The possible types of evidence in this vignette are "the customer's eyewitness identification and testimony," "DNA found on the murder weapon that was matched to the defendant," and "a fingerprint found on the murder weapon that was matched to the defendant." The complete text of the vignette is in Appendix A.

The rape vignette used in the current study was adopted from Krahé et al. (2007) and depicts a stranger rape in a parking lot that is interrupted by a person driving into the lot and illumining the scene with their vehicle headlights. The language was slightly modified to better fit the vignette scenario such that the DNA evidence came from a rape kit of the victim; fingerprints were taken from a car in the parking lot near where the rape occurred; and the eyewitness was the driver of the vehicle that interrupted the rape. Similar to the murder vignettes, the possible evidence types for the scenario included DNA evidence, fingerprint evidence, and bystander witness evidence. In addition, the victim's "eyewitness identification and testimony" was a fourth possible form of evidence for the rape vignette. The complete text of the vignette used in this study is in Appendix B.

2.1 Decisions on Guilt

To measure how different types of evidence affect decisions on guilt, we used two questions from Krahé et al. (2007). First, we asked the participants "If you were a member of the jury, would you

vote to find the defendant guilty (that they committed the crime) or not guilty?". Their choices were "Guilty" or "Not Guilty."[1] We use logistic regression to estimate how the odds of a guilty decision are affected by the type of evidence provided. To more precisely measure opinions on defendant guilt, respondents were then asked how certain they were that the defendant was guilty on a numeric scale from 0% certain to 100% certain.[2,3] To estimate how each form of forensic evidence affects the respondent certainty, we use ordinary least squares (OLS) regression.

2.2 Decisions on Punishment

In addition to questions on whether the defendant was guilty, we evaluated decisions on punishment. As participants may factor in the cost of a mistake - that is, sentencing an innocent person to prison - they are expected to request a harsher sentence toward those whom they are more certain is guilty. As with the questions regarding decisions on guilt, we utilized questions from Krahé et al. (2007) to evaluate these decisions on punishment. Participants were asked "If the defendant is convicted, he will be sent to prison. What sentence do you think he is likely to receive in this case? (in years)" and "If the defendant is convicted, he will be sent to prison. What sentence do you think he should receive in this case? (in years)". We use OLS regression to estimate the effect of forensic evidence on recommended prison sentence.

2.3 *CSI* Effect

While most studies examine correlations between how many hours respondents watch forensic science TV shows and their opinions on the accuracy of forensic evidence (Cole and Dioso-Villa, 2006; Ribeiro et al., 2019), we utilized Kaplan et al. (2020)'s method of directly asking participants how accurate they believe these shows to be. To address whether this *CSI* effect is real, we asked participants how accurate they "think the [most accurate/average] fictional TV show is in depicting forensic science?" with a 4-point Likert scale from *Not accurate at all (1)* to *Very accurate (4)* with

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[1]These answers are displayed in a random order to avoid anchoring due to one answer always being shown first.

[2]To avoid the possibility of participants answer being biased by the default start value, that default value for the starting position of the anchor was randomly assigned to be 0, 50, or 100. A one-way ANOVA was conducted to determine whether the starting position of the anchor influenced respondents' self-reported confidence level in their verdict decision. There were no differences between the three anchor groups [$F(2,380) = .327$, $p = .721$].

[3]Krahé et al. (2007) used a 7-point Likert scale to answer this question. We preferred a 100-point numeric scale to more precisely measure the degree of certainty.

the option of *Not sure*. Using two moderation analyses, we examine whether belief in the accuracy of forensic science TV shows affects the relationship between forensic evidence and judging the defendant to be guilty. The PROCESS macro (version 3.5) was used to conduct the moderation analyses. The parameters were set to: Model = 1, confidence intervals = 95, number of bootstrap samples = 50,000. Verdict was the dependent variable (0 = not guilty, 1 = guilty), presence of forensic evidence was the independent variable (0 = no forensic evidence presented, 1 = DNA or fingerprint evidence presented), and one of the two measures of belief in the accuracy of forensic TV shows was used as the moderator (a moderation analysis was done for each measure).

2.4   Participants

We used Amazon's Mechanic Turk platform to find participants for the survey.[4] Mechanic Turk is a website that allows members of the general public to perform simple tasks, such as complete a survey, for small amounts of money. Participants view a description of the task on the Mechanical Turk website and then decide whether to proceed with the task or not. When a participant decided to participate in the current study, a link in the description of the task directed them to the Qualtrics survey website where they completed the survey. Participants were limited to adults residing in the United States and they received up to $1 in compensation for completing the survey. The study procedures were approved by the University of Pennsylvania's institutional review board and Rutgers University's institutional review board.

Three hundred ninety people completed the survey and submitted responses.[5] All respondents answered the survey on April 9th, 2020. We used two attention check questions to ensure that participants were reading the questions before answering. The first question of the survey after the introductory page that explained the purpose of the survey asked what that purpose was. Any selection other than "Decisions on guilt" was considered to have failed the attention check.[6] Participants were then randomly assigned to one of the seven vignette conditions. The second attention check question asks which crime the defendant was charged with; any answer other than the crime described in the participant's vignette was deemed an attention check failure.[7]

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[4]https://www.mturk.com/

[5]Participants were required to answer every question, resulting in no missing responses.

[6]The other choices were: "Mass incarceration", "Mental health", "Drunk driving", and "Juvenile crime".

[7]In case participants were unfamiliar with the legal definition of rape or murder, each vignette explicitly stated

Four participants failed the first attention check and an additional three participants failed the second attention check. After removing these seven participants, there were 383 participants whose responses were used in this study.

The sample consisted of slightly more people identifying as male (54%) than as female (46%). Respondents were generally in their late 30s (M = 37 years old, SD = 12) with the oldest respondent aged 79 and the youngest aged 20. They were, on average, well-educated; every respondent had at least a high school diploma and 59% having a four-year degree or higher. Nearly three-quarters (72%) of respondents identified as non-Hispanic White, 7% identified as non-Hispanic Black, 10% identified as non-Hispanic Asian or Pacific Islander, and about half of one percent identified as non-Hispanic American Indian or Alaska Native. Seven percent of respondents identified as Hispanic, and the remaining 3.5% identified as mixed-race. Nearly all (92.4%) of the sample were registered to vote in the United States and 17% had served on a jury in the past.[8]

3   Results

Respondents were randomly assigned to 1 of 7 vignette scenarios: murder with DNA evidence (n = 53), murder with fingerprint evidence (n = 52), murder with a bystander eyewitness testimony (n = 56), rape with DNA evidence (n = 53), rape with fingerprint evidence (n = 59), rape with a bystander eyewitness testimony (n = 57), or rape with a victim eyewitness testimony (n = 53). There was a significant association between crime type and verdict such that respondents for the murder vignettes were more likely to vote guilty while respondents for the rape vignettes were more likely to vote not guilty (2(1) = 5.425, p = .02). A one-way ANOVA was conducted to compare demographics between vignette groups. There were no differences in age [F(6, 376) = .302, p = .936], sex [F(6, 376) = .606, p = .726], education level [F(6,376) = .236, p = .965], income level [F(6,376) = .994, p = .429], voter status [F(6, 376) = 1.224, p = .293], or jury service [F(6, 376) = 1.519, p = .170) between respondents in any vignette group. For each hypothesis, the primary analysis compared forensic and non-forensic evidence categories. Secondary analyses compared each specific type of evidence with the other types, and we used the Benjamini-Hochberg

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which crime the defendant in the vignette was charged with.

[8]In the United States, people are often selected for jury duty based on voter-registration lists so this is a proxy for jury-eligibility.

procedure for controlling the false discovery rate (FDR) in order to correct for multiple comparisons (with $q = .05$) for these analyses (Benjamini and Hochberg, 1995).

3.1 Decisions on Guilt

There was a significant relationship between verdict and the presentation of forensic evidence (OR = 2.32, 95% CI [1.416, 3.802], p = .001), with the results suggesting that the odds of a guilty verdict doubled if forensic evidence was presented. This result held for murder (OR = 2.58, 95% CI [1.101, 6.061], p = .029) and rape (OR = 1.99, 95% CI [1.078, 3.674], p = .028). Table 1 shows the results of a logistic regression that evaluates how each form of evidence affects the odds of a conviction. Column 1 shows the reference group for each analysis while column 2 shows the evidence type analyzed. Columns 3 and 4 show the odds ratio (OR) and 95% confidence interval for the effect in a murder case while columns 5 and 6 do the same for a rape case.

For murder, the odds of a guilty verdict were 3 times greater when DNA evidence was presented relative to when bystander eyewitness testimony was provided, and this result was statistically significant (OR = 3.20, 95% CI [1.063, 9.632], p = .039). However, this significant result disappeared after FDR correction. While the odds of a guilty verdict were 2 times greater when fingerprint evidence was presented compared to when bystander eyewitness testimony was provided, this was not statistically significant. Additionally, the odds of a guilty verdict were 1.5 times greater when DNA evidence was presented compared to when fingerprint evidence was presented, but this result was not statistically significant.

For rape, the odds of a guilty verdict were 20 times greater when DNA evidence was presented (OR = 19.92, 95% CI [4.416, 89.872], p < .001) and 3 times greater when victim eyewitness testimony was presented (OR = 2.98, 95% CI [1.281, 6.946], p = .011) relative to when bystander eyewitness testimony was provided, and these result were statistically significant even after FDR correction. The odds of a guilty verdict were 1.5 times greater when fingerprint evidence was presented compared to when bystander eyewitness testimony was provided, but this was not statistically significant. The odds of a guilty verdict were almost 7 times greater when DNA evidence was presented (OR = 6.68, 95% CI [1.402, 31.814], p = .017) compared to when victim eyewitness testimony was presented, and this significant result survived FDR correction. The odds of a guilty verdict were 50% lower when fingerprint evidence was presented compared to victim

eyewitness testimony, but this result was not statistically significant. Finally, the odds of a guilty verdict were 13 times greater when DNA evidence was presented relative to when fingerprint evidence was presented (OR = 13.08, 95% CI [2.883, 59.324], p = .001), and this significant result survived FDR correction.

3.1.1 Confidence of Verdict

Respondents were instructed to rate the confidence of a guilty verdict decision on a sliding scale from 0% - 100%. The overall mean confidence level for the entire sample was 70.83 (SD = 27.61). An OLS regression was conducted to examine whether participants who received a vignette with forensic evidence (DNA or fingerprint) reported higher confidence in a guilty verdict decision than those who received a vignette with eyewitness testimony evidence (bystander or victim). The results showed that respondents had significantly higher levels of confidence ($\hat{\beta}$ = 13.58, 95% CI [8.140, 19.024], p < 0.001) in a guilty verdict decision when they received forensic evidence than eyewitness testimony evidence. This result held for murder ($\hat{\beta}$ = 13.25, 95% CI [5.517, 20.983], p = 0.001) and rape ($\hat{\beta}$ = 12.71, 95% CI [5.067, 20.354], p = .001) cases. Table 2 shows the results of an OLS regression that examines whether there were differences in confidence level based on the type of evidence and crime committed.

For murder, the presence of DNA ($\hat{\beta}$ = 12.99, 95% CI [4.002, 21.986], p = .005) or fingerprint evidence ($\hat{\beta}$ = 13.51, 95% CI [3.717, 23.305], p = .007) were associated with higher confidence in the respondent's verdict decision compared to bystander eyewitness testimony, and both of these results survived FDR correction. There were no differences in confidence when DNA evidence was presented compared to when fingerprint evidence was presented.

For rape, DNA ($\hat{\beta}$ = 35.08, 95% CI [25.989, 44.162], p < .001) and victim eyewitness testimony ($\hat{\beta}$ = 13.96, 95% CI [3.205, 24.719], p = .011) were associated with higher levels of confidence in verdict decision compared to bystander eyewitness testimony, and these results survived FDR correction. There was no difference in confidence level when comparing fingerprint evidence with bystander eyewitness evidence. DNA evidence was associated with higher levels of confidence in verdict decision compared to victim eyewitness testimony ($\hat{\beta}$ = 21.11, 95% CI [12.832, 29.395], p < .001), which survived FDR correction. There was no difference in confidence level when comparing fingerprint evidence with victim eyewitness evidence. DNA evidence was associated with higher

levels of confidence in verdict decision compared to fingerprint evidence ($\hat{\beta} = 29.69$, 95% CI [20.475, 38.896], p < .001), and this result survived FDR correction.

3.2 Decisions on Punishment

3.2.1 Likely Sentence

An OLS regression was run to examines whether the presentation of forensic evidence would be associated with a longer likely sentence compared to the presentation of eyewitness testimony. Results indicated no significant difference between the presentation of forensic evidence and witness evidence on the likely sentence length in general, or for murder or rape cases separately. Table 3 shows the results of the comparison between the specific types of evidence. DNA evidence was associated with a longer likely sentence for rape, but this significant result did not survive FDR correction. All other comparisons were null for rape cases. These findings suggest that respondents do not believe that the sentence defendants are likely to receive are dependent on the type of evidence presented in the case.

3.2.2 Ideal Sentence

An OLS regression was conducted to examine whether the presentation of forensic evidence (DNA or fingerprints) would be associated with a longer ideal sentence compared to the presentation of eyewitness testimony (victim and bystander eyewitness testimony). Respondents recommended an ideal sentence of nearly nine years longer when presented with forensic evidence relative to those presented with non-forensic evidence ($\hat{\beta} = 8.60$, 95% CI [3.238, 13.962], p = .002). This result was driven by the results for rape, with respondents recommending an ideal sentence of almost 10 years ($\hat{\beta} = 9.91$, 95% CI [4.910, 14.910], p < .001) when forensic evidence was present. For murder, there was no difference in the ideal sentence when forensic evidence was presented or not. Table 4 shows an OLS analysis examining the effect of each form of evidence on the ideal sentence length for murder and rape separately.

Results indicated no significant difference between the presentation of forensic evidence and witness evidence on the ideal sentence length for murder cases. For rape, when DNA evidence was present, there was an increase of 13 years for the ideal sentence that respondents reported a

defendant should receive compared to bystander eyewitness testimony evidence ($\hat{\beta} = 12.76$, 95% CI [5.173, 20.339], p = .001), and this result survived FDR correction. Compared to bystander eyewitness testimony, there were no differences in ideal sentence length when fingerprint or victim eyewitness testimony was presented. DNA evidence was associated with an increase of 14 years for the ideal sentence ($\hat{\beta} = 13.76$, 95% CI [6.341, 21.169], p < .001) compared to victim eyewitness testimony, which survived FDR correction. Although fingerprint evidence was associated with an increase of 7 years ($\hat{\beta} = 7.44$, 95% CI [0.843, 14.035], p < .027), this result did not survive FDR correction. There was no difference in ideal sentence when DNA evidence was presented compared to fingerprint evidence.

3.3 *CSI* Effect

Moderation analyses were conducted to determine whether participants who believe fictional TV shows depicting forensic evidence is accurate are more likely to say a defendant is guilty in cases with forensic evidence. For murder, belief in the accuracy of forensic TV shows does not moderate the relationship between the presence of forensic evidence and verdict. This null result was found regardless of whether the "average" and "most accurate" forensic TV show variable was used as a moderator. Similarly, there was no interaction effect between belief in the accuracy of forensic TV shows and presence of forensic evidence for rape. These results provide evidence against the presence of a "*CSI* effect" in people's opinions on the accuracy and importance of forensic evidence.

4 Discussion

The findings of the current study reveal that forensic evidence increases the likelihood that a defendant receives a guilty verdict (Hypothesis 1) and increases the level of confidence in a guilty verdict (Hypothesis 2). Additionally, the presentation of forensic evidence did not change the likely sentence that participants expected defendants to receive (Hypothesis 3); however, it did increase the length of sentence that respondents thought defendants should receive, though only for rape (Hypothesis 4). Lastly, there was no evidence of a *CSI* effect, as there were no differences in verdict decision between respondents who believed fictional forensic science TV shows were accurate and those who did not (Hypothesis 5).

Upon further examination, there were no significant differences between evidence types on verdict decision for murder. However, for rape, DNA evidence was consistently associated with a higher likelihood of a guilty verdict than all other types of evidence. DNA evidence was also consistently associated with higher levels of confidence in the verdict decision for rape, and was consistently associated with a higher likelihood of a guilty verdict than non-forensic evidence for murder. Additionally, victim eyewitness testimony was associated with a higher level of confidence in verdict decision for rape. Overall, the results suggest that forensic evidence (and specifically, DNA) has a strong role in the verdict phase. In contrast, forensic science does not seem to play as strong of a role in the sentencing phase. Neither type of forensic science evidence was associated with any significant change in the likely sentence length reported by participants for murder or rape. However, forensic does seem to increase the sentence length at people think an offender should receive, but with some caveats. Specifically, DNA evidence was consistently found to increase the sentence length that respondents thought an offender should get, but this effect was only found for rape and only when compared to non-forensic evidence, while fingerprinting was found to increase the sentence length that respondents thought an offender should get, but only for rape and only when compared to victim eyewitness testimony.

The results on decisions of guilt are consistent with those reported in previous studies (Freeman and Punzo, 2001; Lieberman et al., 2008; Pozzulo and Dempsey, 2009; Schweitzer and Nuñez, 2018; Skolnick and Shaw, 2001). The results of this study indicate that the presence of forensic evidence, particularly DNA evidence, is viewed as a strong form of evidence, as DNA evidence was found to increase the odds that the defendant will be found guilty (for rape cases) and individuals are more confident in their verdict decision when DNA is available (for rape and murder cases). Additionally, victim eyewitness testimony for our rape case increased the odds of a guilty verdict and the confidence in a guilty verdict compared to bystander eyewitness testimony. Given that the rape scenario occurred at night, this could indicate that respondents believed the eyewitness (a person driving their car into the parking lot where the rape occurred) could not see the offender as well as the victim could. However, as there was no significant effect of fingerprints in the rape case, this does indicate that respondents believe that victim eyewitness testimony is a superior form of evidence than fingerprints, lending support that the finding is not due to the scenario being at night. Future research should examine other scenarios to see if and how these findings hold.

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In general, the results suggest that forensic evidence does not seem to practically affect respondents' sentencing decisions. While respondents believed that the offender should have received a longer sentence when forensic evidence was presented in a rape case compared to when non-forensic evidence was presented, this did not match the likely sentence that respondents expected the offender to receive. Given that there were no differences in the likely sentence that respondents believed the defendant would receive even when forensic evidence was presented, forensic evidence may play a more crucial role during the verdict stage for rape cases. It is unclear why respondents' preference for a longer sentence did not translate into a longer likely sentence when forensic evidence was provided. This finding may reflect respondents' view that sentencing outcomes for rape cases tend to be relatively lenient – indeed, recent high-profile rape cases may have contributed to the development or exacerbation such perceptions (Reyes, 2001; Tierney, 2018; Miller, 2020). Nevertheless, these findings may provide some insight into what stage of the trial process forensic evidence would be most impactful and for what types of crimes. The results of this study suggest that forensic evidence would be most impactful during the verdict stage and may play a more important role for rape than murder cases.

Results from the current study do not support the *CSI* effect, as there were no differences in the strength of the relationship between the presence of forensic evidence and the verdict decision based on how accurately people thought forensic TV shows were. This finding is in line with prior work utilizing this method of examining the *CSI* effect (Kaplan et al., 2020). However, the current results do indicate that forensic evidence does seem to influence decisions on guilt and punishment, indicating that respondents do place importance on forensic evidence. It could therefore be useful to provide a general overview about the accuracy and drawbacks of forensic evidence that is presented during a trial to minimize the risk of having jurors incorrectly penalize defendants when forensic evidence is presented or incorrectly penalize prosecutors when no forensic evidence is available (Eatley et al., 2016; Podlas, 2006).

This work has practical implications for those wanting to apply it to the courtroom, and also helps to augment researchers' knowledge on the importance of different types of evidence to jurors and their verdicts, involving both guilt determination and sentencing (Schweitzer and Nuñez, 2018). Such results provide guidance to practitioners that forensic evidence helps to increase the probability of and certainty in juror guilty verdicts across different types of offenses. Yet, as the

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probability a person who commits rape will be eventually be convicted of rape has been found to be one of the lowest of any felonies (Reaves, 2013), this work may help to suggest ways in which different types of evidence can be used to strengthen the likelihood of conviction in rape cases.[9]

For example, DNA evidence was found to increase the odds of a jurors' guilty verdict by a factor of 20, as compared to when bystander evidence was presented. This immensely persuasive effect of DNA evidence in rape cases, even compared to murder cases, may be especially important to consider given the backlog of rape kits in the United States (Fucci, 2015). Indeed, this study suggests that introducing DNA evidence may significantly strengthen a prosecutor's argument and likelihood for conviction in rape cases, which may encourage prosecutors to spend more time and energy to ensure that rape kits are processed in a timely manner so that DNA evidence is available at trial if it has been collected. This study also has implications for law enforcement practices at the scene of the crime. As DNA evidence significantly increases the likelihood of a guilty verdict relative to eyewitness testimony for rape, but that fingerprints had no significant difference, law enforcement should prioritize collecting DNA evidence over fingerprints whenever possible - and particularly when limited by resource constraints that prevent collecting both - during rape cases. While DNA can also be collected from fingerprints in some cases, certain fingerprinting techniques prevent the collection of DNA from that print (Kasper, 2015). Recent technological advances have also increased the ease, speed, and cost of collecting DNA evidence, further increasing the benefit of prioritizing DNA collection over fingerprints when investigators cannot collect both (Jackman, 2018; Murphy, 2019a).[10]

Similarly, victim eyewitness testimony in the rape case increased the odds of a guilty verdict and jurors' confidence in their verdicts, as compared to bystander evidence. Findings such as these may lead prosecutors to encourage rape victims to provide victim testimony evidence during rape trials, as such testimony may increase the likelihood of conviction. However, it is also crucial for prosecutors to weigh the benefits of presenting victim testimony against the potential negative consequences, such as increased psychological damage for the victim from reliving a potentially

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[9]This is considering convictions relative to crimes occurred, which are far more common than both rapes reported to police and arrests made. When considering convictions per arrest, rape is within the normal range of violent felony convictions.

[10]This technology, however, is most efficient when analyzing DNA from individuals who are swabbed by the police, with more limited functionality for DNA collected at a crime scene which may be in lower quantities or have been degraded.

traumatic event, as well as potential victim-blaming behavior by others, particularly when there are demographic differences (e.g., socioeconomic status) between the accused and the accuser (Ferguson et al., 1987; Ford et al., 1998; Jones and Aronson, 1973; Yamawaki et al., 2007).

Ultimately, as this study has its limitations, this research suggests that future work should examine the current issues in several different areas. The current study focused on two specific crimes (murder and rape), as these crimes are more likely to involve forensic evidence. The scenarios utilized were crafted in order to make the crime reports more believable; yet, we do acknowledge that the use of these two separate crimes, which inherently differ in their details and scenarios, may introduce confounds for which our design and results cannot completely account for (i.e. some potential aspect that differed between the two crime scenarios that unintentionally affected results). Although our experimental design and random assignment of evidence should help to reduce the effects of such confounds, we suggest replicating this study with other vignette scenarios involved other case descriptions of both murder and rape in order to see if these results hold for other crime scenarios.

This study, as with any survey study, is also limited in its respondents and how representative they are of the target audience. This study's sample had more White and Asian or Pacific Islander respondents and fewer Black, American Indian or Alaska Native, and Hispanic respondents than are in the general public. The sample was also more educated than the general public with all respondents having a high school diploma, relative to approximately 87% of the general public, and 59% of the sample having a four-year degree or higher, relative to 32% of the public. Given these differences, this study's findings may not be perfectly representative of the opinions of the United States public as a whole. Future studies should examine nationally-representative - or as close as possible - samples to evaluate the opinions of the United States public as a whole. Future research should endeavor to examine demographic subsets - and other groups such as members of law enforcement, prosecutors, and defense attorneys - to see whether opinions differ among these groups.

Further, it may be useful to compare forensic and eyewitness testimony evidence for other types of violent crimes. Given the increasing use of forensic evidence - in particular, DNA - used in property crime cases, future research should also examine perceptions of types of evidence for property crimes (Roman et al., 2009; Murphy, 2019b). As the current study suggests, forensic

evidence may impact various crimes in dissimilar ways in different stages of the criminal justice process. Thus, it could be valuable for future studies to investigate what types of evidence would be instrumental in a trial for various crimes so that resources could be allocated more effectively.

The current study also involved a limited number of evidence types. These were chosen because they have been considered the "gold standard" either historically or by contemporary standards. However, there are many other forms of evidence that could be presented during a trial that were not evaluated in this study but should be considered in future work. This study used only a single form of evidence per vignette - to isolate the effect of that particular form of evidence on respondent opinions - however, actual cases may have multiple forms of evidence presented. Future studies should include combinations of evidence to examine how the interaction between multiple forms of evidence affect people's opinions.

Although similar length to studies using vignettes presenting evidence in criminal trials in other disciplines (Berryessa, 2017, 2018, 2020), this study's vignettes were short and thus were only able to provide limited evidence and information to participants. Indeed, experimental studies using vignettes are often critiqued in the legal community for their potential problems regarding their ecological validity and generalizability to real legal cases and situations due their limited breadth and lack of contextual application (Scurich, 2018). Therefore, we suggest that the issues in this study be replicated with more ecological research designs that may be more generalizable to real legal situations. Other studies have suggested using filmed expert testimony, jury deliberations, rather than decisions of individual juror behavior, or taped cross examinations on presented evidence to mimic real courtroom scenarios, which may elicit more holistic understandings of presented evidence and its relevance and application to specific legal questions at hand (Scurich, 2018; Berryessa, 2020).

Finally, given recent large-scale protests against police brutality specifically, and a perceived unjust criminal justice system generally, similar studies should be conducted periodically to examine if and how opinions on forms of evidence change over time (Buchanan et al., 2020). Opinions on forensic evidence, especially relative to civilian or police eyewitness testimony, may serve as a barometer of the public's belief in the legitimacy of the criminal justice system.

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Table 1: Logistic regression results for decisions on guilt based on evidence type

Evidence Type		Murder		Rape	
Reference	Comparison	Exp($\hat{\beta}$)	95% CI	Exp($\hat{\beta}$)	95% CI
Bystander					
	DNA	**3.20**	$\big[\textbf{1.063, 9.632}\big]$	**19.92***	$\big[\textbf{4.416, 89.872}\big]$
	Fingerprint	2.14	$\big[0.788, 5.825\big]$	1.52	$\big[0.719, 3.229\big]$
	Victim	—	—	**2.98***	$\big[\textbf{1.281, 6.946}\big]$
Victim					
	DNA	—	—	**6.68***	$\big[\textbf{1.402, 31.814}\big]$
	Fingerprint	—	—	0.51	$\big[0.217, 1.021\big]$
Fingerprint					
	DNA	1.49	$\big[0.442, 5.046\big]$	**13.08***	$\big[\textbf{2.883, 59.324}\big]$

Bolded results were significant before multiple-correction. Asterisked results survived false discovery rate (FDR) correction (Benjamini and Hochberg, 1995).

Table 2: OLS regression results for confidence of verdict based on evidence type, with bystander eyewitness testimony evidence as reference group

Evidence Type		Murder		Rape	
Reference	Comparison	$\hat{\beta}$ (Se($\hat{\beta}$))	95% CI	$\hat{\beta}$ (Se($\hat{\beta}$))	95% CI
Bystander					
	DNA	**12.99 (4.54)***	**[4.002, 21.986]**	**35.08 (4.58)***	**[25.989, 44.162]**
	Fingerprint	**13.51 (4.94)***	**[3.717, 23.305]**	5.39 (5.65)	[-5.809, 16.588]
	Victim	—	—	**13.96 (5.43)***	**[3.205, 24.719]**
Victim					
	DNA	—	—	**21.11 (4.18)***	**[12.832, 29.395]**
	Fingerprint	—	—	-8.57 (5.45)	[-19.381, 2.236]
Fingerprint					
	DNA	-0.52 (4.23)	[-8.905, 7.870]	**29.69 (4.65)***	**[20.475, 38.896]**

Bolded results were significant before multiple-correction. Asterisked results survived false discovery rate (FDR) correction (Benjamini and Hochberg, 1995).

Table 3: OLS regression results for the likely sentence that the defendant would receive based on evidence type

Evidence Type		Murder		Rape	
Reference	Comparison	$\hat{\beta}$ (Se($\hat{\beta}$))	95% CI	$\hat{\beta}$ (Se($\hat{\beta}$))	95% CI
Bystander					
	DNA	-3.83 (4.22)	$[-12.185, 4.534]$	2.60 (2.37)	$[-2.109, 7.301]$
	Fingerprint	3.33 (4.76)	$[-6.107, 12.774]$	-0.05 (2.15)	$[-4.310, 4.215]$
	Victim	—	—	-1.46 (2.36)	$[-6.134, 3.212]$
Victim					
	DNA	—	—	**4.06 (1.99)**	$\mathbf{[0.120, 7.993]}$
	Fingerprint	—	—	1.41 (1.75)	$[-2.063, 4.890]$
Fingerprint					
	DNA	-7.16 (4.53)	$[-16.142, 1.824]$	2.64 (1.78)	$[-0.875, 6.161]$

Bolded results were significant before multiple-correction. Asterisked results survived false discovery rate (FDR) correction (Benjamini and Hochberg, 1995).

Table 4: OLS regression results for ideal sentence that the defendant would receive based on evidence type

Evidence Type		Murder		Rape	
Reference	Comparison	$\hat{\beta}$ (Se($\hat{\beta}$))	95% CI	$\hat{\beta}$ (Se($\hat{\beta}$))	95% CI
Bystander					
	DNA	-5.90 (5.73)	[-17.267, 5.459]	**12.76 (3.83)***	**[5.173, 20.339]**
	Fingerprint	4.162 (5.98)	[-7.694, 16.018]	6.44 (3.43)	[-0.357, 13.237]
	Victim	—	—	-1.00 (2.40)	[-5.756, 3.759]
Victim					
	DNA	—	—	**13.76 (3.74)***	**[6.341, 21.169]**
	Fingerprint	—	—	**7.44 (3.33)**	**[0.843, 14.035]**
Fingerprint					
	DNA	-10.07 (5.82)	[-21.598, 1.465]	6.32 (4.43)	[-2.468, 15.100]

Bolded results were significant before multiple-correction. Asterisked results survived false discovery rate (FDR) correction (Benjamini and Hochberg, 1995).

Appendix A - Murder Vignette

In August 2018, a convenience store was robbed in a Philadelphia suburb. At the time, the only people in the store were the clerk behind the counter, and one customer who was shopping in the back of the store, who hid when the suspect entered the store. The store had video surveillance, but the footage was extremely grainy, and it was unable to provide investigators with any identifying information. The suspect approached the store clerk and threatened him with what appeared to be a large kitchen knife. After the store clerk handed over $140 from the cash register along with several cartons of cigarettes, the suspect demanded more money. When the clerk failed to provide the additional money, the suspect stabbed the clerk once in the chest, and then ran out of the store. Unfortunately, emergency medical teams were unable to save the store clerk. The police later recovered the murder weapon from a nearby dumpster. The accused was arrested that same night, and was charged with murder.

Appendix B - Rape Vignette

Alice was on her way home on a cold night in January. She had attended a meeting with colleagues and afterwards they had all gone out for a meal to a small Italian restaurant. Because she had to drive home, she didn't drink any alcohol. The road where she lives was closed because of road works, so she left her car in the parking lot around the corner. One of her colleagues offered to walk her back to her house but she told him this was not necessary. It was a frosty night, and she felt cold. As she started crossing the unlit parking lot to her house, she stopped to admire the beautiful night sky. Suddenly, a man stepped out from behind a parked car and blocked her way. At first, Alice thought the man was drunk and attempted to walk past him quickly. However, he grabbed her with a firm grip and pushed her against the car. When she tried to scream, he held his hand over her mouth. He told her to be quiet because otherwise he would have to harm her. She tried to escape from his grip, but he was stronger than her and hit her in the face. Suddenly, he pushed her to the ground, kneeled over her so that she could not resist, and had sexual intercourse with her. A man drove into the parking lot at this time with his headlights on, clearly illuminating Alice and her attacker. The attacker then fled the scene and Alice made an emergency call to the police. The police arrived within minutes and searched the area. Not far from the scene, they arrested a suspect, Rob, who had acted suspiciously by trying to dump his coat in a trash can. Rob was charged with the rape of Alice.